NATIONAL LOGISTICS SYSTEMS

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Foreword

This volume reports on the results of logistics research initiated and coordinated by the International Institute for Applied Systems Analysis (IIASA) within the former New Logistics Technologies (NLT) Activity of the Computer Integrated Manufacturing (CIM) Project. The focus of the research is on long-term changes in the logistics structures, performance, and strategies on the macro-economic level and their cross-country comparative assessment.

This collaborative book entitled "National Logistics Systems" is a result of the joint and coordinated effort of research teams and scientists from 12 countries (both West and East) and IIASA. It contains an introduction to the former IIASA "New Logistics Technologies (NLT) Activity" and National Reports on Logistics Structures and Strategies prepared on the basis of a predescribed format (Synopsis for National Reports on Logistics Structures and Strategies). The focus of the reports is on representative data, illustrating the major logistics trends, their socio-economic impacts, as well as the implications for management and policy making.

The data for this book were collected from 1987–1989. The individual reports should not be considered to be exhaustive treatments. The papers compiled in this volume are essentially as delivered by the authors, with some editing. However, the contributions were discussed at two NLT workshops (the Workshop on "New Logistics Technologies" in Buck, Hungary, December 1987, and the Workshop on "Cross-national Comparisons of Logistics Structures and Strategies" in Nozvay, Hungary, April 1989), and several times revised according to recommendations of the participants of these workshops as well as editorial recommendations.

The reports from the Eastern countries reflect the situation at the eve of the dramatic changes in these countries which started in late 1989. Accordingly, some of the conclusions and recommendations in these reports may be biased. However, they contain unique data and analyses which together with the reports from the Western countries and the background material (case studies, statistical data, extended versions of the reports, etc.) serve as a good base for more in-depth studies at least in three directions:

- cross-national comparisons of logistics structures and strategies;
- restructuring of the logistics systems of the Eastern countries in the transition toward market economies;
- unintended impacts of the developments in the logistics field.

The basic part of the work on this book has been carried out under the guidance of Dr. Pavel Dimitrov. However, the special contributions of several other persons deserve very much to be acknowledged: Professor Sten Wandel for the initial design and guidance of IIASA's New Logistics Technologies (NLT) Project; Professor Robert U. Ayres and Professor Jukka Ranta, leaders of IIASA's CIM Project, for their helpful advice, criticism, and encouragement. In particular, we are grateful to Dr. Bill Haywood for editing Chapter

I, the Dutch, the Czechoslovak, and the Polish reports; Mrs. Helene Pankl deserves thanks for the technical support in preparing the manuscript.

The book may serve a wide audience: International organizations, policy makers (ministers of transport, industry, trade, regional planners), business circles (multinational companies, joint venture companies, managers involved in or dependent on logistics), and the research community.

Prof. F. Schmidt-Bleek
Leader
Technology, Economy & Society Program

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CHAPTER I

LOGISTICS IN NATIONAL ECONOMIES: STRUCTURES, STRATEGIES AND INTERNATIONAL TRENDS

Logistics in National Economies: Structures, Strategies and International Trends

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Logistics in National Economies: Structures, Strategies and International Trends

Pavel Dimitrov

1 The Growing Role of Logistics in the Economy

Logistics[1] integrates activities that are located in different functions of the business (procurement, materials management and physical distribution) and different sectors of the economy (production sectors, transport, trade and communication). The individual activities that comprise logistics have always been an essential feature of each type of economic activity. The emergence of the logistics concept, however, is associated with the need to integrate the various activities that facilitate the flow of goods from the point of origin through to the point of consumption.

There are many signs that management consciousness of the importance of logistics has been growing rapidly during the last few decades. This can be identified by the growing number of publications, conferences, managerial and university courses, professional organizations, research projects etc. Logistics has become one of the "buzz" words in today's business life. A number of factors have contributed to growing importance and interest in logistics. Some of these are related to the "demand" for logistics services, others to the "cost" of the logistics activity, and a third group to the "supply" of logistics technologies.

On the demand side, the following are among the most important factors:

- saturation of the markets, leading to growth in the demand for high quality customized products and raised standards for customer service;
- growing product complexity and diversification resulting in increased complexity of intra-company economic links and increased vertical integration;
- shortening of the products life cycles;
- globalization of production, market and competition.

[1]Logistics is used here in a very general sense to denote all systematic actions aimed at bringing materials from primary sources through all intermediate stages to the end-user. It includes the planning, implementation and monitoring of transport, handling and storage activities as well as the information flow necessary for these operations.

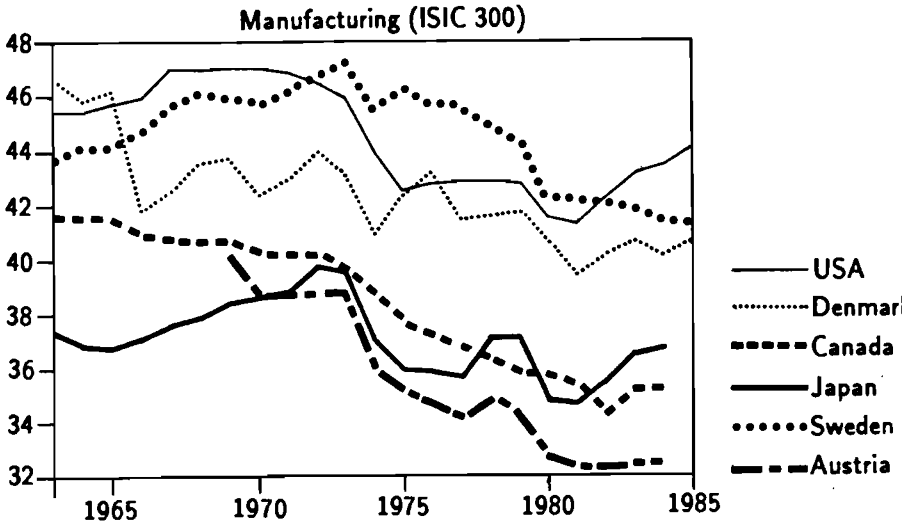

Figure 1: Value Added/Output (%)

The literature and the statistical sources are providing numerous examples and supporting data on the listed factors (see for example [Yamashina and Masumoto, 1989] and [Mortimer, 1988]). Ayres [Ayres, 1990] has presented convincing evidence of the growing complexity of products, measured in terms of the required parts and components. These along with the growing product diversification contribute to the increased complexity of intra-company economic links and the growing trend of vertical integrations. One illustration (based on author's estimates), regarding the growing rate of vertical integration (measured by the value added/output ratio (in %) in the manufacturing industries of six countries (USA, Japan, Denmark, Canada, Sweden and Austria) for the 1963–1985 period) is presented in Figure 1. However, these trends are not uniform among all countries and industries.

To compete successfully in today's market place requires service enhancement in a cost-efficient way (not only in the West but also in the East). The idea of "customer service" encompasses all the points of contacts between the supplier and the customer in terms of physical fulfillment of orders. Figure 2 shows the relation between service level and the outputs of the logistics system [Corstjens and Gautchi, 1983]. In the classical case high customer service can be achieved in two alternative ways:

- creating high inventories along the logistics chain;
- increasing the flexibility of production, supply, distribution, etc and thus shortening the response time to demand fluctuations in volume, product assortment and delivery time.

The current situation in most of the markets, characterized by short product life-cycle, increased complexity of economic links (due to product complexity and product diversification), severe competition and fast changing demand, requires short lead-times (production, delivery, including the time for designing new products). Ultimately, therefore, the means of achieving success in such markets is not to create high inventories but to accelerate movement through the logistics chain and make the entire manufactur-

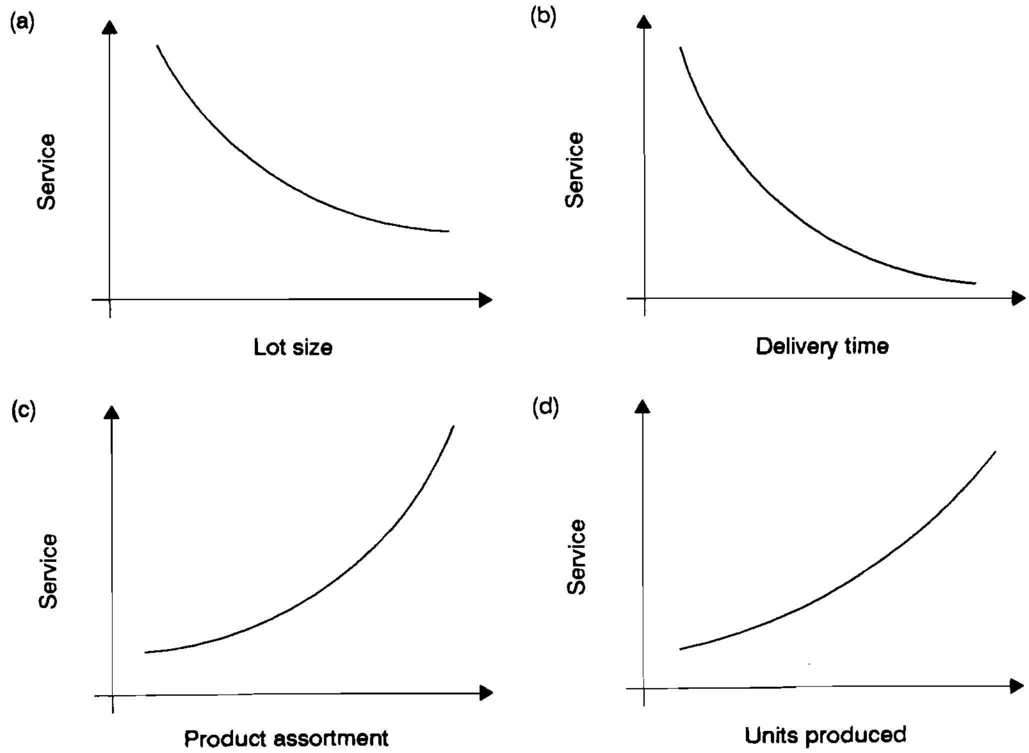

Figure 2: Relations between service level and logistics outputs

ing logistics system far more flexible and thus responsive to these fast changing markets [Dimitrov, 1989; Christopher, 1988; Ranta and Wandel, 1988].

The second group of factors of growing importance to logistics are related to the "costs" of the logistics activities and their great potential for improving efficiency of production and competitiveness of individual firms, and entire nations.

Different studies reveal a similar magnitude of logistics activity in the various countries. Thus in terms of costs, logistics activities amount to 20–30% of the total national expenditure. In relation to the Gross Domestic Product (GDP) it was estimated that logistics costs account to 21.2% in the USA [A.T.Kearney Ltd., 1984], 20.3% in Sweden [Agren, 1983], 19.5% in France [Les Couts Logistiques en France, 1981], 22.0% in United Kingdom [McKinnon, 1989], 26.1% in Bulgaria.

A study carried out by A.T.Kearney Ltd. [Kearney, 1986] covering 500 companies in Europe showed that logistics costs constitute from 8 to 22 per cent of the value of sales of the investigated companies depending on the sector of the economy in which the companies operate (see Table 1). Other estimates based on different methodology yielded similar orders of magnitude of the logistics costs expressed in proportion to the value of output.

The greater portion of logistics costs is represented by transportation and inventory costs. Energy crises have contributed to the growth of the transportation costs and soaring interest rates have greatly increased the costs of holding stocks. Since the potentials of production and marketing for productivity increases have been largely exploited so far, it is logistics improvements that can contribute to the growth of productivity and competitiveness of firms and nations.

Table 1: Logistics Costs as a Percent of Sales

	Cost as a Percent of Sales				
Industry	Transportation	Warehousing	Inventory Carrying Costs	Administration	Total
Aerospace/Machine tools	1.49	2.44	2.05	1.84	7.82
Agricultural/ Construction/Transport	3.33	2.31	1.57	1.53	8.74
Appliance/ Electronic Equipment	1.64	1.34	3.93	1.32	8.23
Beverage / Food	10.36	5.08	2.51	3.37	21.32
Building Materials	6.89	1.22	12.15	0.95	21.21
Chemicals / Petroleum	8.31	2.52	1.36	1.24	13.43
Pharmaceuticals	2.92	2.36	6.92	0.55	12.75
Clothing / Textiles	8.02	2.45	2.14	1.07	13.68
Paper / Rubber	4.61	2.56	3.96	0.85	11.98
General Merchandise	6.81	3.99	3.83	4.41	19.04
Overall	5.88	2.96	3.33	2.11	14.28

Source: A.T. Kearney, 1986.

Figure 3 illustrates author's estimates of the potentials for investment savings in the manufacturing industries of the various countries due to inventory reduction, assuming that the investigated countries reach the relative inventory level of the leading in this respect country—Japan—and under the current rates of investment in the manufacturing industries of the respective countries. If the other countries investigated here, reach the relative inventory level found in Japan, they could finance their investments in manufacturing industry for from nearly one year (in the case of USA) to more than 4.5 years (in the case of Hungary), with the funds generated from released capital.

The third group of factors is related to the "supply" of new technologies and managerial concepts, facilitating logistics improvements. A whole range of factors are contributing in this respect:

- the development of new manufacturing (Computer Integrated Manufacturing–CIM), transport (high speed vehicles, traffic informatics, multimodal transport) and communication (Electronic data interchange, electronic mail) storage and handling (automated warehouses, automated loading and unloading) and packaging (standard containers, transmodal capsules, escort memories) technologies and infrastructures:
- the enormous progress in the computer hardware and software (especially microcomputer) accompanied by a constant decrease of prices:
- the emergence and the wider spread of new managerial concepts like Just-in-time (JIT), Material Requirements Planning (MRP), Manufacturing Resource Planning

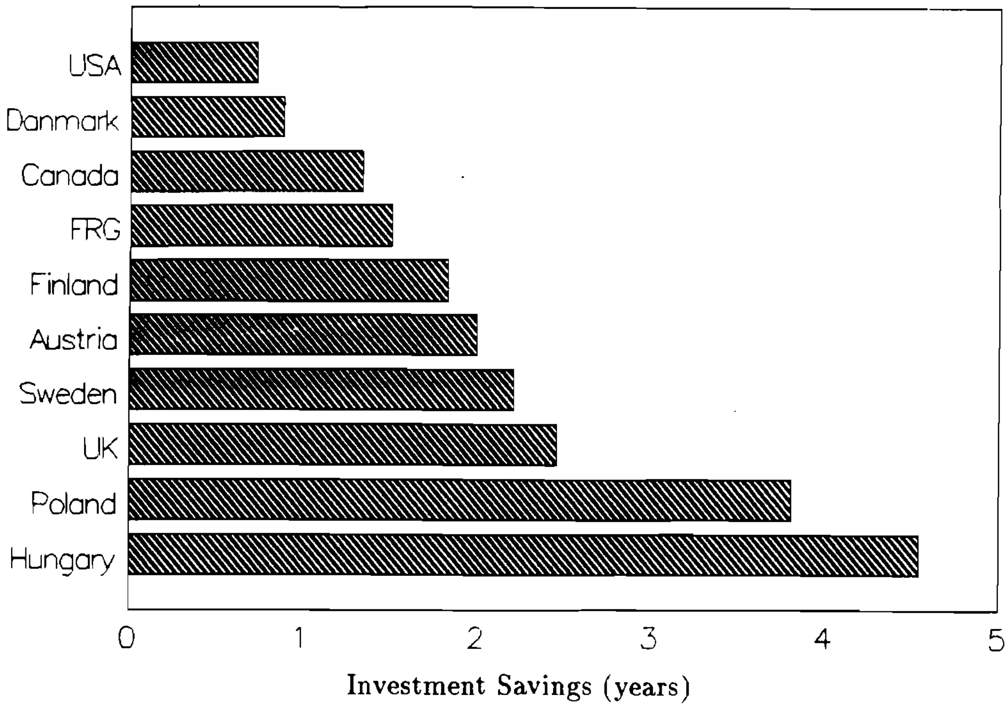

Figure 3: Potential Investment Savings in Manufacturing Industry (Due to Inventory Reduction).

(MRP II), Optimized Production Technology (OPT), Distribution Resource Planning (DRP) etc.

The introduction of CIM technologies and especially Flexible Manufacturing Systems contributes to the growth of production flexibility and the ability of the manufacturing systems to quickly respond to fluctuations in demand. The analysis of IIASA's FMS data bank which contains data for about 80% of the installed FM systems in the world shows that the implementation of an FMS reduces the lead time (the time from order to delivery) on average by a factor of four in comparison with the conventional technology and simultaneously, inventories are reduced by approximately the same factor. Product assortment is increased and yet production and delivery lots are decreased [Tchijov, 1989], [Dimitrov, 1989].

Kling and Grimm [Kling and Grimm, 1988] have presented extended evidence of the growing application of microcomputers in transportation and logistics. New concepts of intracompany relations, (the so called "Value added partnership") based on advanced computer applications are emerging and quickly spreading [Johnston and Lawrence, 1988].

New different managerial and technological strategies are being applied in the logistics field. The most popular and fastest spreading is the Just-In-Time philosophy. According to this only what is needed (in amount and quality) is produced, transported, distributed etc. JIT philosophy is supported by a wide range of physical improvements (changing plant lay-out, cutting set-up times etc.) and socio-managerial rationalizations (introducing Total Quality Control (TQC), creating a flexible work force, close co-operation with vendors and customers) aimed at increasing the flexibility and the responsiveness of the whole manufacturing logistics chain [Schonberger, 1982; Hutchins, 1988; Lubben, 1988]. The Manufacturing Resource Planning (MRP) system has been developed and modified into Distribution Resource Planning (DRP) system to serve the needs of the management of the distribution processes.

These new technologies and managerial strategies along with the market pressure and the greater awareness of the logistics potential for productivity growth are providing an impetus to logistics developments. The basic hypothesis is that the role, structure and the organization of the logistics activity is and will continue to radically change in the near future. There is a great potential for accelerated development by efficiently harmonizing the various logistics activities and wise investments to overcome bottlenecks and barriers in logistics technologies and infrastructure.

Case studies and surveys show that the leading companies are implementing the new logistics technologies and strategies with great benefits for them. A number of studies [Shapiro and Haskett, 1985], [Mortimer, 1986 and 1988], [Voss, 1987], [Jansen and Warnecke, 1988] indicate that this has become a conventional approach of the leading Japanese and Western companies. There is enough evidence to believe that logistics improvements provide strategic advantages for the adopting firms as well as for whole regions and nations. The competitive advantage of the Japanese firms to a great extent can be explained by the far better logistics system.

The available statistical data already shows considerable differences in logistics performance among nations [Dimitrov, P., Wandel, St. 1988]. If these trends are preserved in the future they will contribute to the uneven development of countries and whole regions, to the growing gap between West and East, North and South. This in turn will be a restricting factor for the future harmonization of the World's economic life.

It has to be pointed out that logistics improvements require long-term strategic decisions and investments, since while it might be comparatively easy to transfer manufacturing technology or a managerial system, the same does not hold true for the transfer of logistics infrastructures.

The basic conclusion to be drawn from the foregoing is that the introduction of new logistics technologies and strategies on a broad scale will mean fundamental change both in the organizations implementing these technologies, and in the economy as a whole. These changes and their consequences should be anticipated as early as possible and the implications for management and policy making drawn.

2 IIASA'S New Logistics Technologies (NLT) Activity: Objectives and Research Focus

The objective of New Logistic Technologies[2] (NLT) Activity is to reveal the current state, the major logistics trends and strategies, and the influencing factors, as well as the socio-economic consequences. The ultimate goal is to assess the characteristics of future logistics and its impact on the society and to present these in a form suitable for business and policy making. The basic goals of the NLT Activity are:

[2]The term New Logistic Technologies is used here in a very broad sense to denote the whole set of innovations of technological, organizational, economic and managerial character in production trade, transportation and communications aimed at the improvement of the efficiency of logistics.

1. To provide hard facts (data, cases, analysis etc.) which exemplify the major logistics trends, the influencing factors as well as the socio-economic consequences of developments in logistics;

2. Analyze the dynamics of change in the logistics structures and strategies, and reveal the driving forces, hindering, or accelerating factors;

3. Carry out cross-country comparisons (both in statics and dynamics) to identify commonalities and differences in logistics structures, strategies and performance among countries, sectors and over time;

4. Translate the research findings into recommendations for policy making and management.

Logistics can be studied on different levels of aggregation—micro level (shop floor to factory), meso (company organization and industry) and macro (national economy—world economy). Since most of the studies in the field have concentrated on case studies and the micro-economic aspects, the focus of IIASA's NLT study is on the macro and meso level. The micro level is studied only with the goal of revealing the micro foundations of the macro logistics trends.

The New Logistics Technologies Activity of the International Institute for Applied Systems Analysis (IIASA) focuses on long-term changes in the logistics structures, performance and strategies at the macro-economic level and their cross-country comparative assessment. In so doing the NLT Activity is structured in the following way with a series of complementary studies:

1. "National Logistics Systems".

   This research activity contains country studies (National reports), based on a pre-described synopsis, on logistics structures and strategies in the different countries, as well as macroeconomic and survey studies on special logistics problems.

2. "Cross-National Comparison of Logistics Structures and Strategies".

   Based on the information obtained from the National reports as well as from published sources, international comparisons are carried out in the following logistics areas: logistics costs, inventories and warehousing, distribution channels and patterns, transportation systems, labor resources, managerial structures and strategies etc.

3. "Micro-Foundations of Macro-Logistics Trends".

   This study contains theories, case studies and surveys of new logistics technologies and their socio-economic impacts as well as forecasts and future scenarios of new logistics technologies. Studies on the following research topics have been completed or are under way:

- Logistics impacts of Computer Integrated Manufacturing (CIM);
- Transport consequences of New Logistics Technologies (NLT);
- Electronic data interchange (EDI)—diffusion and advantages;
- Logistics managerial practices.
- Case studies on distribution systems of various products (through several companies) as well as on logistics systems of production and wholesale companies.

This book reports on the results of the study on National Logistics Systems, and some background information regarding the methodology and the organization of the study as well as a summary of the major findings follows.

3 The Study on National Logistics Systems

3.1 Short history and organization of the study on National Logistics Systems

The preparatory work of the study on National Logistics Systems was initiated during the second half of 1986 by Professor Sten Wandel of Sweden who was a leader of IIASA's New Logistics Technologies Project till June 1988. The actual work began in March 1987 when researchers from twelve countries and IIASA met in Laxenburg at a Task Force meeting, to discuss collaboration in the logistics field. In May-August 1987 a Synopsis for National Reports on Logistics Structures and Strategies (see Appendix 1) was developed, revised and distributed among the collaborating groups and specialists from the various countries.

The first extended versions of the reports were presented and discussed in December 1987 at the Workshop on New Logistics Technologies in Buck (Hungary). Since June 1988 the New Logistics Technologies Project was incorporated as an Activity with Dr. Pavel Dimitrov in charge (who joined IIASA's NLT Project in March 1987) into the Computer Integrated Manufacturing (CIM) Project. In that period Guidelines for the preparation of short versions of the national reports were prepared and distributed among the collaborators. The purpose of these guidelines was to ensure a unified structure and format of the final publication of the National Reports on Logistics Structures and Strategies. In parallel, the work on Cross-National Comparisons of Logistics Structures and Strategies began. The short versions of the National reports were presented and discussed in April 1989 at a Workshop on Cross-National Comparisons of Logistics Structures and Strategies in Nozvaj (Hungary). The revised versions of the reports (according to the recommendations of the Workshop and editorial remarks) were presented to IIASA at the end of 1989. Most of them are included in the book in the form as prepared by the authors, with minor additional editing.

The organization and major highlights in the study on the National logistics systems were:

- In-house research: methodology, cross-national comparisons, summary of results, CIM-logistics related issues;

- Contracted study agreements (Bulgaria, Hungary, GDR, Poland): national studies, cases, cross-national comparative studies;
- Collaboration with research institutions and individual scientists (USA, UK, the Netherlands, Japan, Finland, Sweden, CSSR, Yugoslavia);
- Meetings: March 1987 (IIASA), December 1987 (Bük, Hungary), April 1989 (Nozvaj, Hungary).

3.2 Methodological issues

The problem of analyzing logistics at the macro-economic level have not been sufficiently addressed in the literature. The lack of theories and models, as well as examples of such analysis, made it necessary to accept some working definitions and to concentrate on the acquisition and analysis of hard facts and representative data. These described the current state, the major logistics trends, the influencing factors, as well as the socio-economic consequences. This was rather than making an in-depth elaborate analysis, or developing advanced theories.

The scope of the analysis of logistics on a national economy level depends upon the accepted definition of logistics. For the purposes of this study logistics is treated in its broader sense as all activities related to the flow of goods in the national economy, e.g. transportation, handling, storage as well as the related managerial and information processes. From the perspective of the national economy as a whole, these activities are carried out both by specialized sectors (logistics or logistics related sectors such as: freight transport, wholesale and retail sales, communication) as well as by the production and non-production sectors.

For the purposes of this study the national economy is defined as material flows and stock system, which involves numerous material flows and points (economic units) of inventory formation. Material flows connect the separate economic units in a united economic organism, whilst material stocks ensure the continuity of the reproduction process by smoothing the time, space and volume, non-coincidence of production and consumption. This system is analyzed from two points of view:

(a) as a physical system, represented by the actual material flow processes (transportation, storage, handling) and the related technologies, infrastructures, human resources etc., and

(b) as an administrative system—the managerial and institutional structures and their strategies and policies, information and communication technologies, etc.

Since the spread of the logistics concept is quite different in the various countries the approach chosen was to concentrate on the developments of the individual activities that comprise logistics attempting, however, to evaluate them from the overall logistics point of view. Another reason for this approach is purely pragmatic—traditionally data and analysis are available on the separate logistics activities, rather then the logistics system as a whole.

The following unified structure of the national reports and the following topics for detailed analysis were accepted:

1. Physical Logistics Structures
   (a) Inventories in the national economy
   (b) Transportation systems
   (c) Distribution channels and patterns
   (d) Warehousing, materials handling and packaging
   (e) Logistics costs and efficiency
2. Managerial structures and strategies
   (a) Organizational and institutional structures
   (b) Economic regulation of logistics activity
   (c) Information technologies
   (d) Human resources and education
   (e) Research projects

Each part is intended to reveal the history, the state of the art and the future of the studied phenomenon, as well as the new technologies applied, their penetration rates, economic and social impacts, using the most representative data and facts for the time period 1970 (or earliest available)–1987 (or latest possible). The focus is on the logistics evaluation of the basic trends, the socio-economic impacts and the implications for management and policy making. This requires relevant statistical data. Unfortunately, such data for a number of logistics indicators is not available. This made it necessary to use the officially published data, making the required recalculations and transformations, and also to collect data that has not been published in the official statistics.

3.3 Achieved and expected results

The intention to obtain full reports (for all research topics) from each of the investigated countries, however, was not entirely accomplished. The reasons for that can be found in difficulties with data acquisition, different interests and understanding of the logistics issues, uneven research potential and resources in the different countries—in some of the countries the studies were carried out under contracted study agreements by large research teams; while in others by individual scientists.

Another point, which is worth mentioning, is that despite of the fact that the National reports were developed on the basis of a unified format—The Synopsis for National Reports on Logistics Structures, Strategies and Prospects—they are quite different in content (research topics covered and depth of analysis), terminology used and data presented. Nevertheless, they give a quite comprehensive picture of the various activities and strategies that comprise the logistics systems of the respective economies. Together with a great deal of background material—extended versions of the reports, case studies and statistical data—they are a good base for more in-depth studies and cross-national comparisons.

The work on harmonization of the data, analysis etc., included in the reports, with a view to carrying out cross-national comparisons has already been initiated. Until the results of the cross-national comparative studies are completed and made available to the wider audience, it is left to the reader, by going through the national reports, to identify in more detail the common logistics trends as well as the differences in logistics structures, strategies and performance among the different nations.

4 Logistics Structures and Strategies: State of the Art and International Trends—a Preview of the Results

Cross-country comparative studies in the fields of: inventories and warehousing, transportation systems, distribution channels and patterns, logistics costs, labor resources and managerial structures and strategies have already been initiated and the collaborating research teams and scientists from the NLT network are involved and responsible for the different studies. This work will continue outside IIASA but in close co-operation with IIASA's Technology, Economy, and Society Program.

However, in the following parts of this chapter, some of the results of the editor's personal research on cross-national comparisons of various logistics issues are highlighted. They are presented basically as hard facts, without trying to identify causal relationships or make deep conclusions. In one way or another, this complements the national studies and gives some insights into the ongoing research.

4.1 Inventories in the national economy

The analysis on inventories is based on data from UN Industrial statistics, [on tape received from UNIDO], as well as data provided by NLT collaborators. The data base on inventories covers 15 countries with different economic systems over a period of 10–20 years. The sample is limited to those countries for which reasonably harmonized data could be obtained. The data is structured according to the 3-digit level of the International Standard Industrial Classification (ISIC) of All Economic Activities [ISIC 1968]. For each of the investigated countries inventory data was collected for about 25 ISIC sectors of manufacturing industry. Inventories are subdivided into raw materials, works in progress and finished goods. Additionally, data for inventories of the Wholesale and the Retail Sales sectors of several countries was collected.

This data base provides broad analytical possibilities. The analysis carried out so far is restricted to the inventories in the manufacturing sector as a whole, as well as sectors of the machining industries (ISIC 38): Metal Products (ISIC 381), Machinery n.e.s. (ISIC 382), Electrical Machinery (ISIC 383), Transport Equipment (ISIC 384) and Motor Vehicles (ISIC 3843). These are the sectors which are reported to be more intensively implementing new manufacturing and logistics technologies.

The value added inventory ratio, as well as estimates for the days of stockholding, have been used as measures for inventory productivity. The following general conclusions can be drawn from the analysis carried out so far:

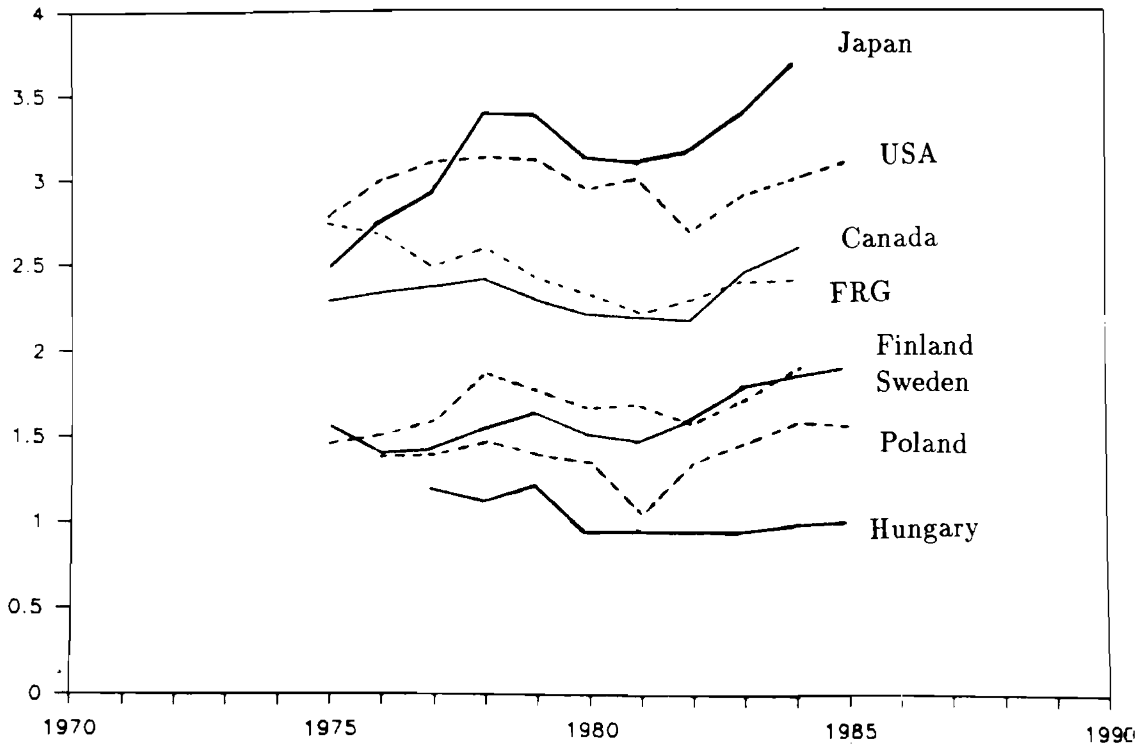

Figure 4: Value Added/Inventory in Manufacturing Industry (ISIC 300)

1. There exist stable differences in inventory performance (the value added inventory ratio) between the different countries. This is true for the whole manufacturing industry as well as for the different manufacturing sectors (Figure 4 and 5). Japan leads as a rule, followed by the USA, the greater part of West European countries (FRG, Denmark, UK, Ireland) and Canada, the Scandinavian countries (Sweden, Finland, Norway) and Austria and the East European countries (Poland, Bulgaria, Hungary) and Portugal. The major differences between Japan and the rest of the countries can be identified when analyzing inventory levels in terms of days of stock-holding for the whole manufacturing industry (Figure 6) and especially for the motor vehicles industry (Figure 7).

2. Despite cyclical variations in most of the countries (with the exception of FRG, Portugal and the Eastern countries) there is a trend of steady improvement of inventory productivity. At the same time the gap between Japan and the other countries is widening. The different trends in inventory productivity require special attention, since if they are preserved it may be expected that in the near future the Scandinavian countries will reach the inventory productivity of the Western countries but at the same time the gaps between Japan and the USA, between them and the rest of the countries, between the Western and the Eastern countries will increase.

3. Completely different patterns of inventory formation between the Western (with the exception of Finland) and Eastern countries is identified regarding inventory structure e.g. the breakdown of inventories into raw materials, work-in-process and finished goods (see Figures 6 and 7).

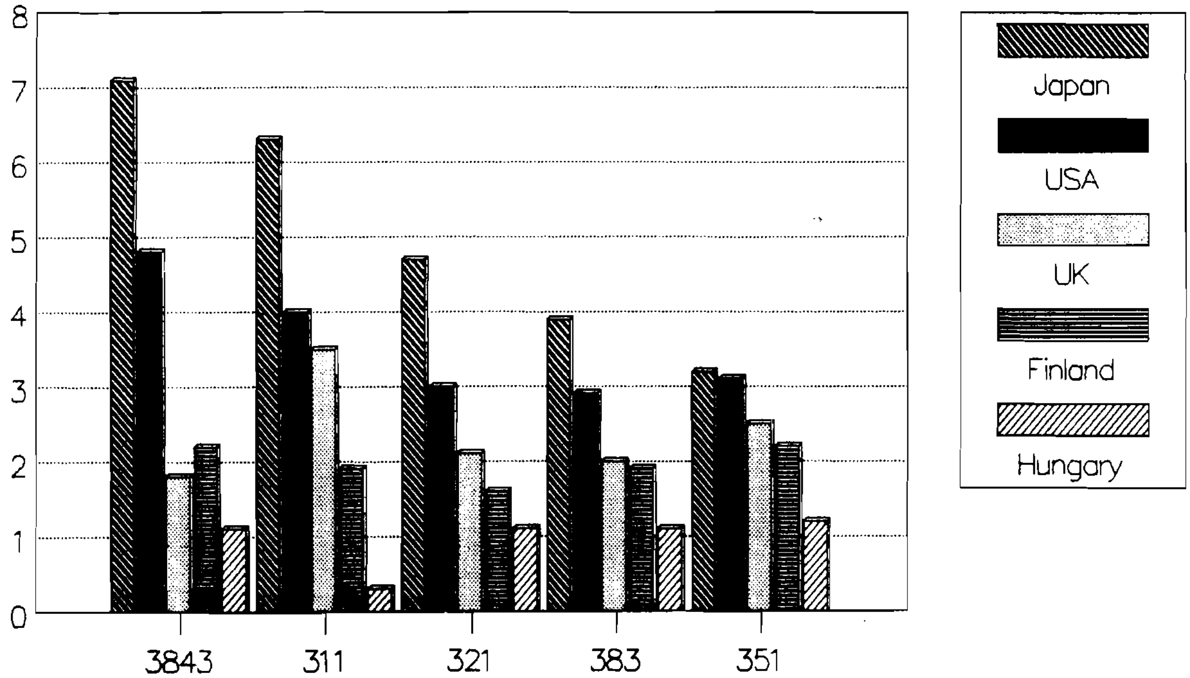

Figure 5: Value Added/Inventory (in some Manufacturing Industries)

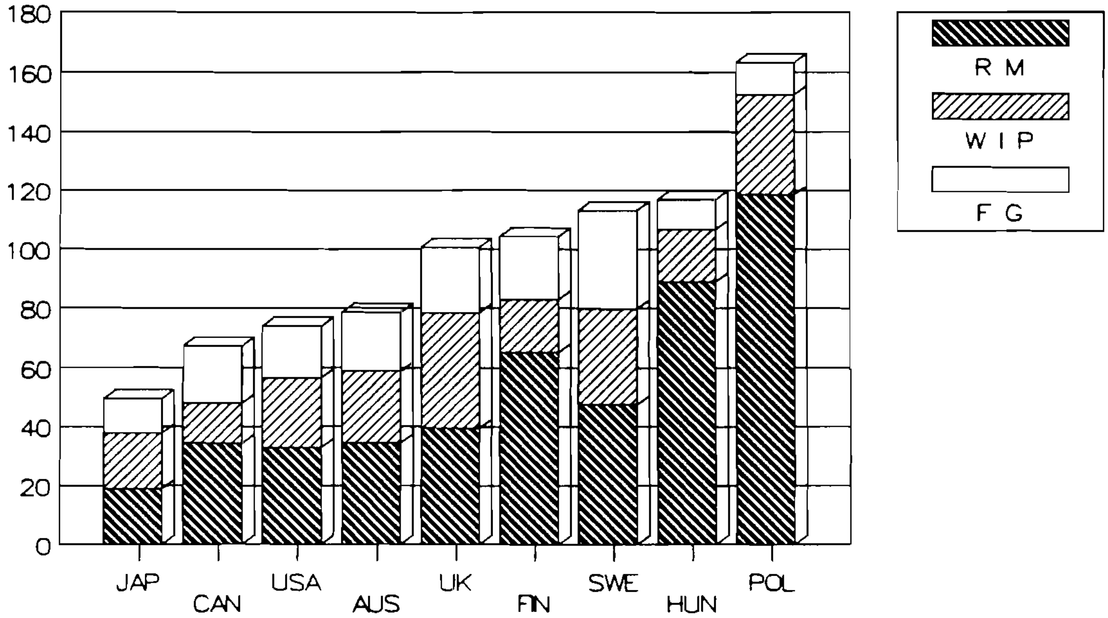

Figure 6: Inventory in Days in Manufacturing Industry (ISIC 300)

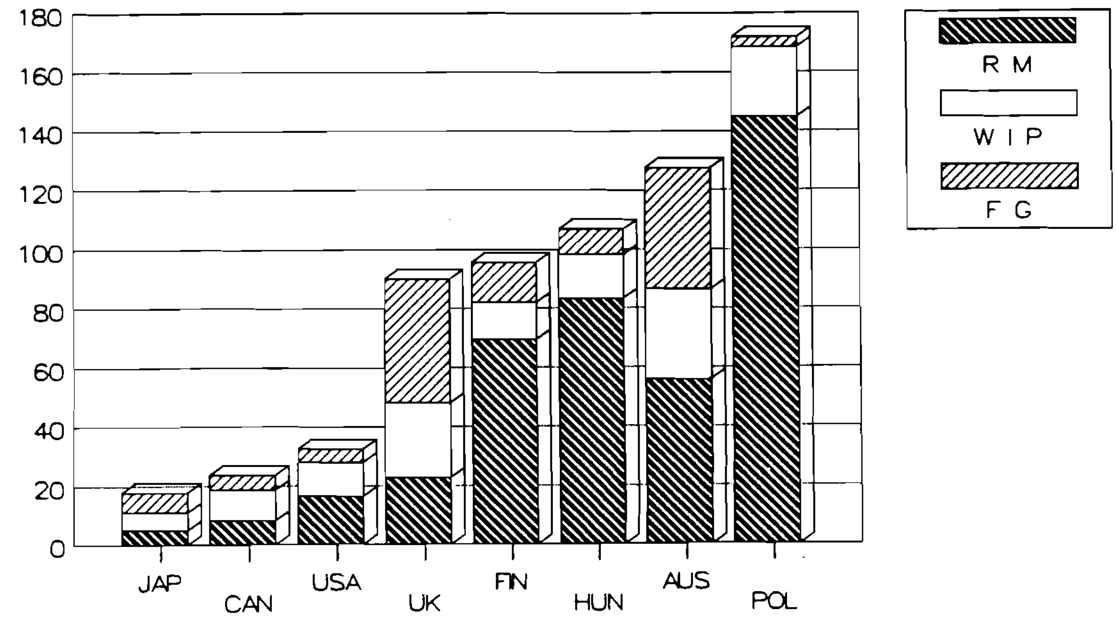

Figure 7: Inventory in Days in Motor Vehicles Industry (ISIC 3843)

The greater part of the inventory stock in the Eastern countries is kept as raw materials and supplies, while in the Western countries the distribution of the manufacturing stock among the above indicated three groups is almost equal. A typical trend for the Western countries is the growing share of the finished goods inventories on behalf of the share of the raw materials inventories. Just the opposite is the trend in the Eastern countries. This pattern of inventory formation to a great extent reflects the conditions on the production goods market in the different economic environments.

Between the inventory level and the structure there exist close relations and dependencies. In order to evaluate these, it is necessary to analyze inventories not only in one sector but to trace the whole material flow to the end user e.g. to include inventories in the trade sector. Unfortunately, the lack of such data in the international statistics does not allow comprehensive analysis in this respect. However, the available data is indicative of this relation (Figure 8). The greater share of finished goods and trader's inventories and the lower share of raw materials inventory contribute to the lower relative aggregate inventory level. In the countries with the lowest relative aggregate inventory level, Japan and the USA, the greater part of the inventories is kept as finished goods and trader's inventory.

Inventory levels depend upon a whole set of interrelated and interdependent factors. An extended list of these factors and their analysis on country and international data is presented in [Dimitrov, 1984 and Chikan et al., 1986]. However, the logistics related factors play a decisive role in inventory formation. In this respect the inventory gaps between the different countries can be considered as a proxy measure for the differences in logistics performance.

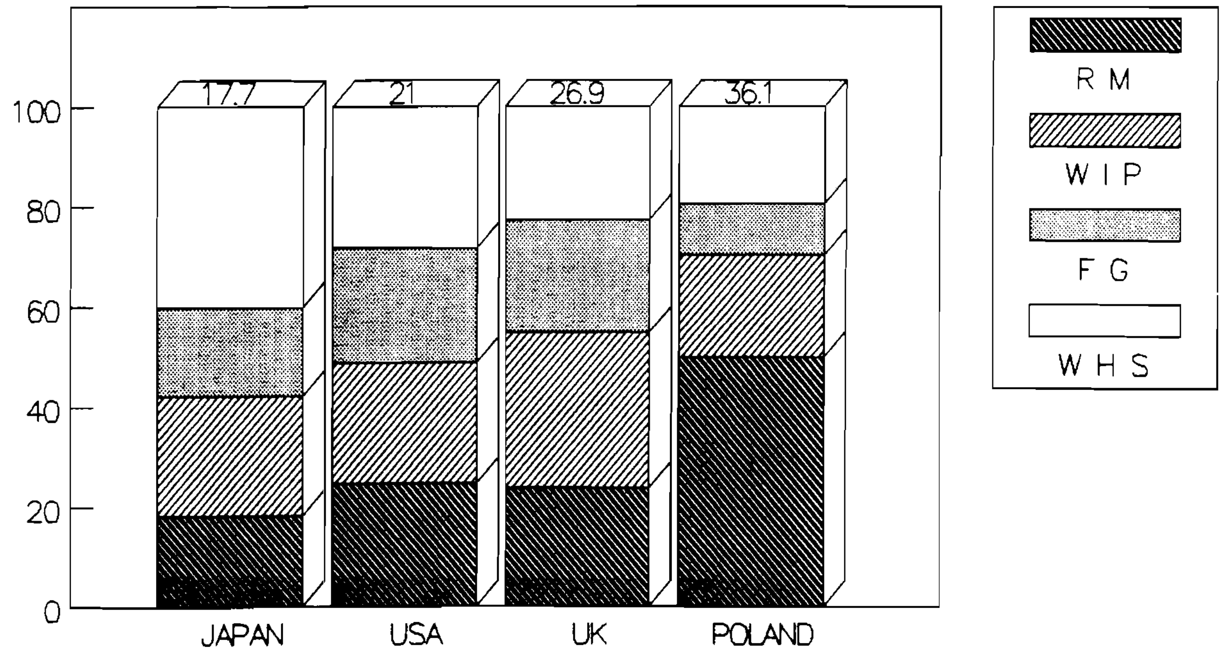

Figure 8: Aggregate Inventory (Manufacturing & Wholesale) Level & Structure

4.2 Transportation Trends

Logistics performance is directly dependent on transport activity. An analysis of the evolution of transport infrastructures shows a general shift towards faster and more reliable transport. During the last several decades dramatic changes have taken place in the transportation systems. Figure 9 shows the development of transport modal split in some OECD countries over a period of approximately 25 years. The demand for fast, punctual and reliable transport has triggered an enormous development of road transport at the expense of rail transport. Correspondingly, dramatic changes in the transport infrastructure have taken place. This trend is accompanied by a number of technological innovations in all modes of transport resulting in a decisive increase in their speed and loading capacity. Among the common trends for all the countries are:

- rapid development of combined transport systems;
- modal split changes, especially for high value goods (the shift from rail to road and air);
- integration with production and trade (the emergence of so called production-transport chains);
- unification of the transport, packaging and load/unload equipment;
- changes in the criteria for evaluation of transport performance from "price" and "cost" criteria towards quality, punctuality, flexibility, reliability, minimization of damage or loss of goods.

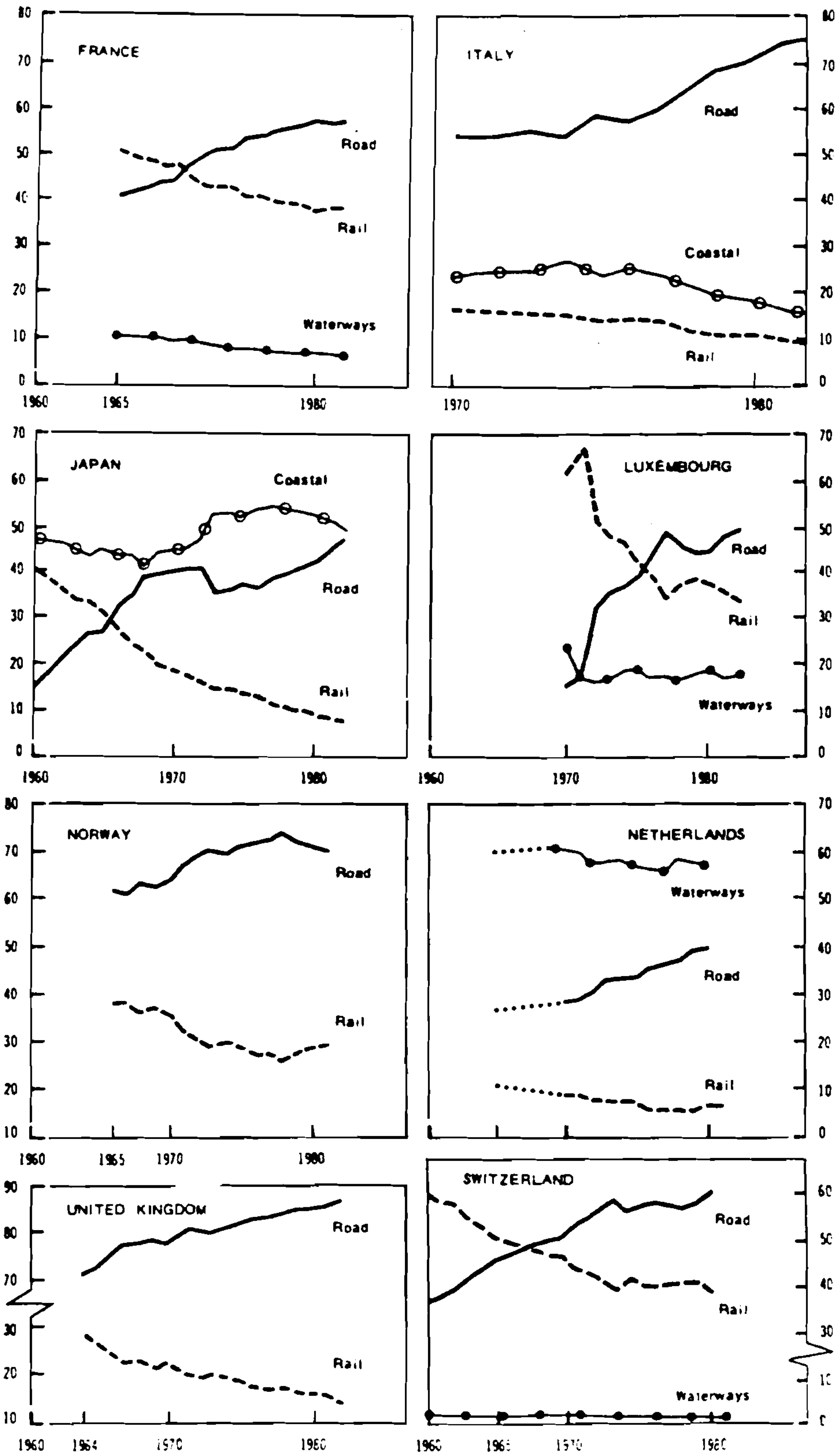

Figure 9: Development in Transport Modal Split. Source: (OECD 1986), Future of European Transport

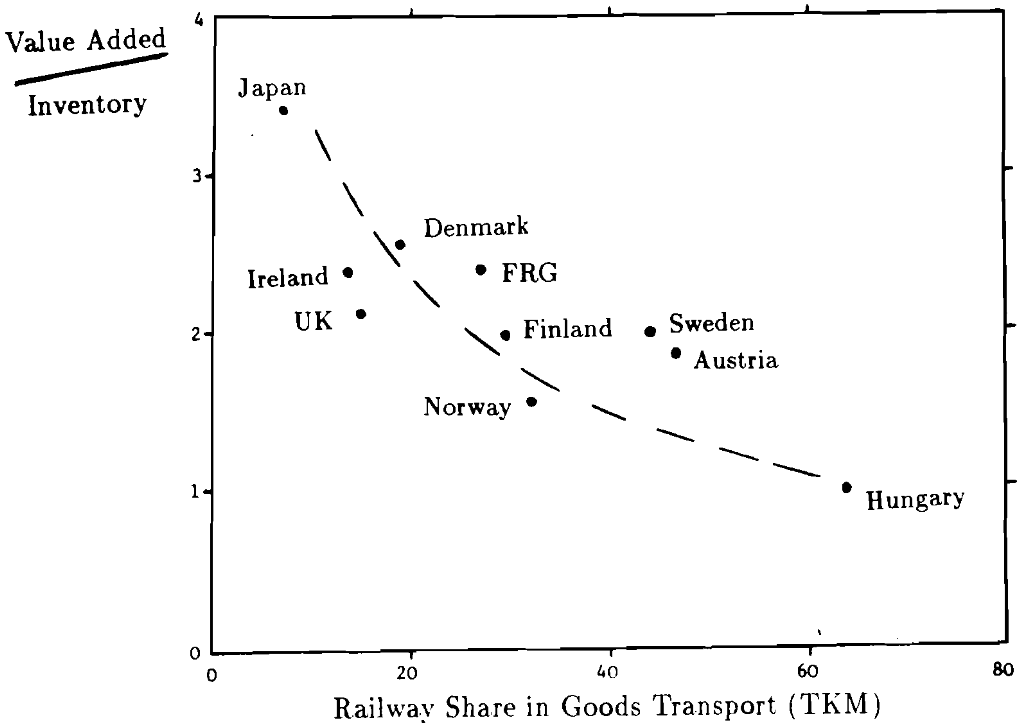

Figure 10: Value Added/Inventory—Rail Share (1984)

Within these general trends, common for all of the investigated countries, there exist quite considerable differences in the different countries regarding the technological level of the different transport modes and their performance, the prevailing modal split as well as the state of development of the transport infrastructure. The most striking difference in this respect is the difference in the transport modal split between the Western and the Eastern countries (where in the latter, rail transport still dominates in freight transport). The strong correlation between transport modal split and logistics performance—measured as value added inventory ratio (shown in Figure 10) indicates that the state of the development of the transport system is one of the decisive factors for the strategic logistics advantages of some nations over others.

4.3 Distribution channels and patterns

A distribution channel (or a marketing channel) is usually defined as "the set of all firms and individuals that cooperate to produce, distribute and consume particular goods or services of a particular producer". A distribution channel reflects the organizational channel through which the ownership of goods flows from producer to final consumer via one or more intermediary. A logistical (or a physical distribution) channel is composed of terminal nodes, such as factories and shops; intermediate nodes, such as warehouses; and the links between them, represented by freight movements [McKinnon, 1989]. In such a way the notion of a logistical channel is related to the physical flow of goods.

One important question in the analysis of the distribution channels is related to the role of the intermediaries. Statistical data and studies indicate an overall trend of decline of the wholesaling. There business is contracting as a consequence of the absorption of their logistical functions by producers and/or multiple retailers. A comparison of the structures of the UK consumer goods marketing channels in 1938 and 1983 revealed that the flow of consumer goods (by value), which was passing through the wholesalers had decreased from 47% in 1938 to 36% in 1983 [McKinnon, 1989].

However, this trend is not uniform across all trades and countries. The analysis carried out to reveal the relation between the participation of the wholesale sector in the flow of goods in the economy and the logistics performance (Figure 11) revealed a quite contradictory picture.

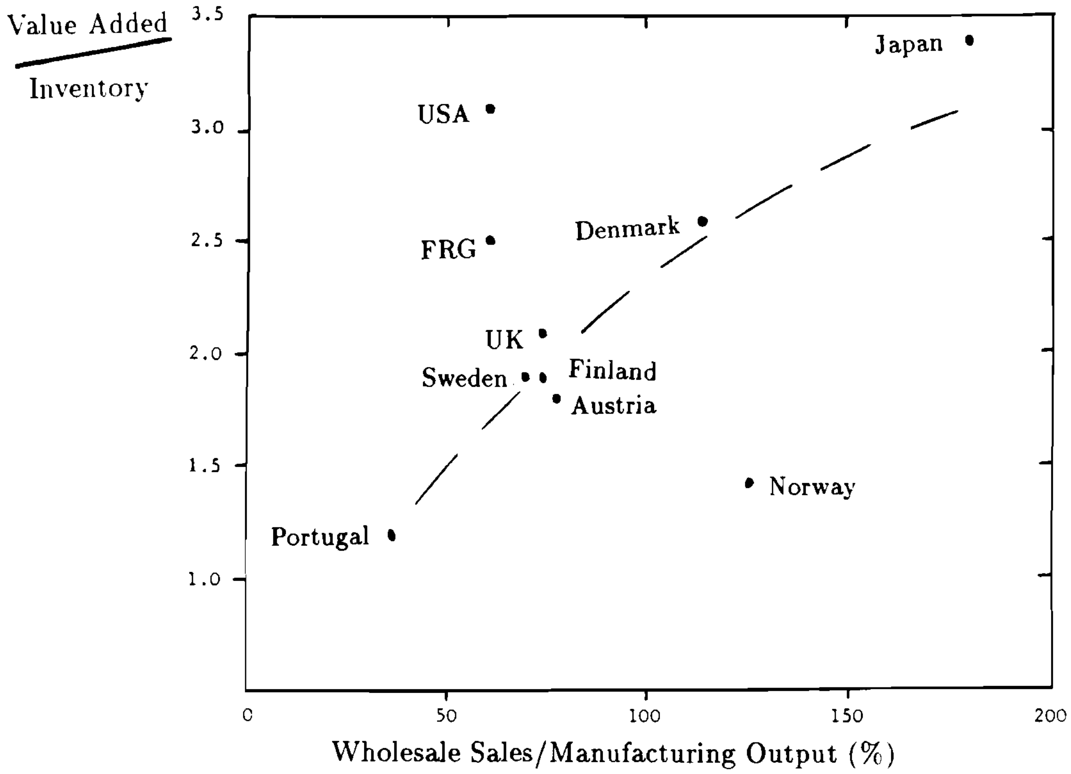

Figure 11: Value Added/Inventory—Wholesale Sales/Manufacturing Output (1984)

Surprisingly enough, countries with completely different distribution pattern (participation of wholesaling in the flow of goods) like Japan and the USA or FRG and Denmark manifest relatively similar logistics performance. At the same time countries with similar distribution patterns like the USA and FRG show large differences in logistics performance.

However, the fact that the country with the highest inventory productivity (Japan), is leading in the participation of the wholesaling sector deserves more attention. In Figure 12, the structure of the flows (in value) of a Japanese regional wholesaler is represented. In 1985 about 64% of the incoming flows of the wholesaler in question originate from other wholesalers and 31% of the out flowing goods are delivered to other wholesalers.

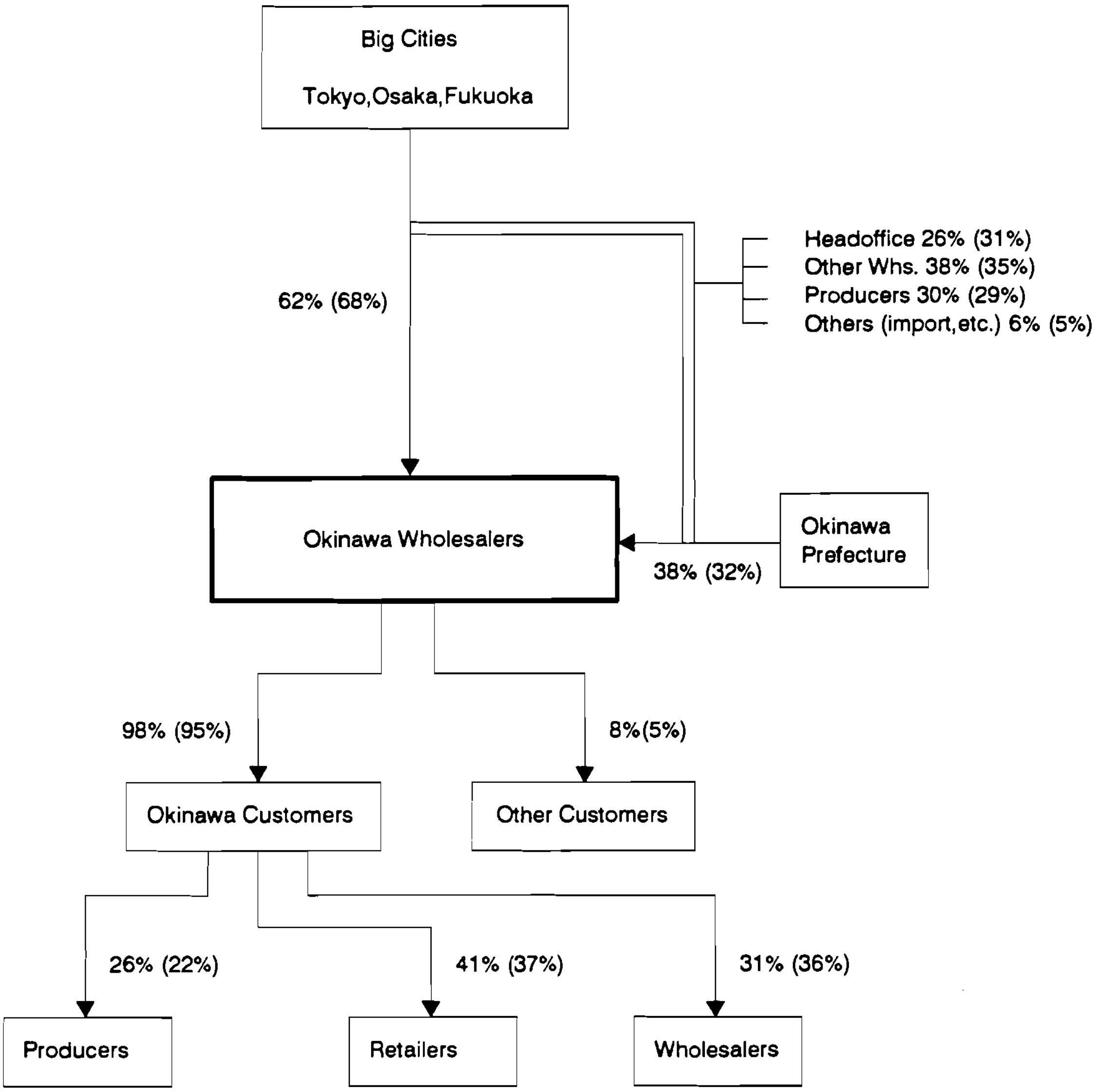

Figure 12: Structure of a Japanese Regional Distribution System in 1985 (1982). (Source: Census of Commerce 1985, MITI).

These figures indicate the existence of a complicated distribution pattern in Japan, which ultimately contributes to high logistics performance.

Recent studies indicate that this system is in a process of reconfiguration and many producers have turned to developing their own distribution system [Yamashina and Masumoto, 1989]. However, the Japanese experience in this area, like in many other areas, requires further evaluation with the goal of defining the real role of the wholesalers in the national logistics systems.

4.4 Labor in logistics

The problem of analyzing logistics labor in relation to macro-economic and sectoral levels have not been addressed so far in the literature. In some publications [Chinderley, 1980] aggregate figures on the share of those employed in logistics as a proportion of the total number of those employed in the economy are presented, using quite rough methodology of estimation. To the best of our knowledge, there exists no cross-country comparative studies on logistics labor.

The problem of analyzing logistics labor in a cross-country context requires internationally comparable data. The analysis in this paper is based on the internationally comparable occupation-by-sector labor matrixes, prepared by H-U. Brautzsch for the CIM Project [Brautzsch, 1988]. These labor matrixes have been prepared on the basis of the respective national labor matrixes. The latter have been transformed in a way that:

- the occupational categories are classified according to the 2-digit level of the "International Standard Classification of Occupations (ISCO)", [ISCO,1969];
- the economic sectors are grouped according to the 2-digit level of the "International Standard Classification of All Economic Activities (ISIC)", [ISIC 1968].

In such a way the columns of these labor matrixes represent the different sectors of the economy, classified according to the 2-digit level of ISIC and the rows show the different occupations, classified according to the 2-digit level of ISCO. The internationally comparable labor matrixes have been prepared by the use of conversion lists between the respective national classification systems and the international classification systems—ISIC and ISCO. (For more detailed descriptions of the problems and the methodology of elaboration of the internationally comparable labor matrixes see [Ayres et. al., 1987] and [Brautzsch, 1988]).

As a result internationally comparable labor matrices for the following countries and years are available: Austria (1970, 1981), Finland (1980), FRG (1950, 1961, 1970, 1982), the Netherlands (1985), Sweden (1970, 1980), the USA (1984).

Additionally, for the purposes of trend analysis the national labor matrices for Japan (for the years 1950, 1960, 1970, 1980, 1985), prepared by Uno [Uno, 1988] have been used. It has to be pointed out that the estimations based on these labor matrixes are not directly comparable to the respective estimations for the countries listed above. They have been done just to exemplify the logistics labor trends in the country with one of the highest logistics performance.

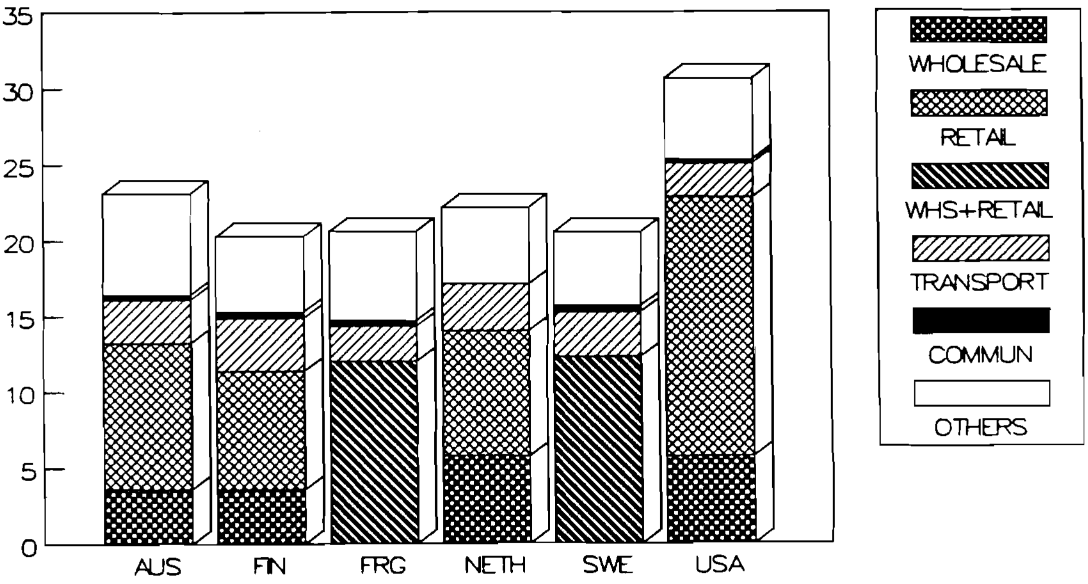

Figure 13: Employed in Logistics (in % of total number of employees)

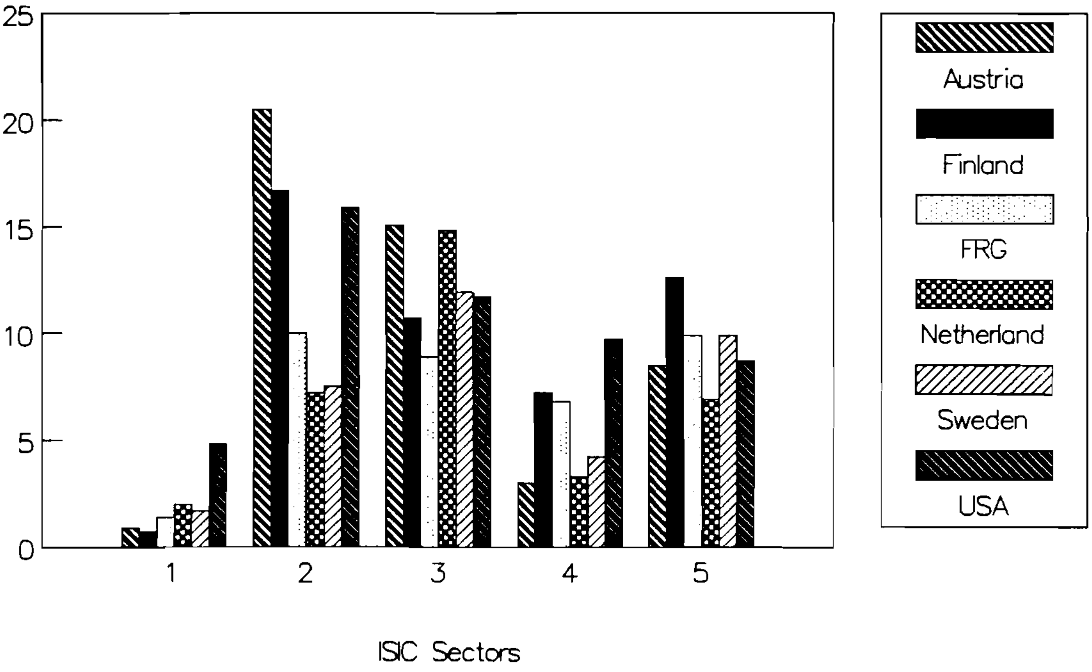

Figure 14: Employed in Logistics by ISIC Sectors (in % of sector employees)

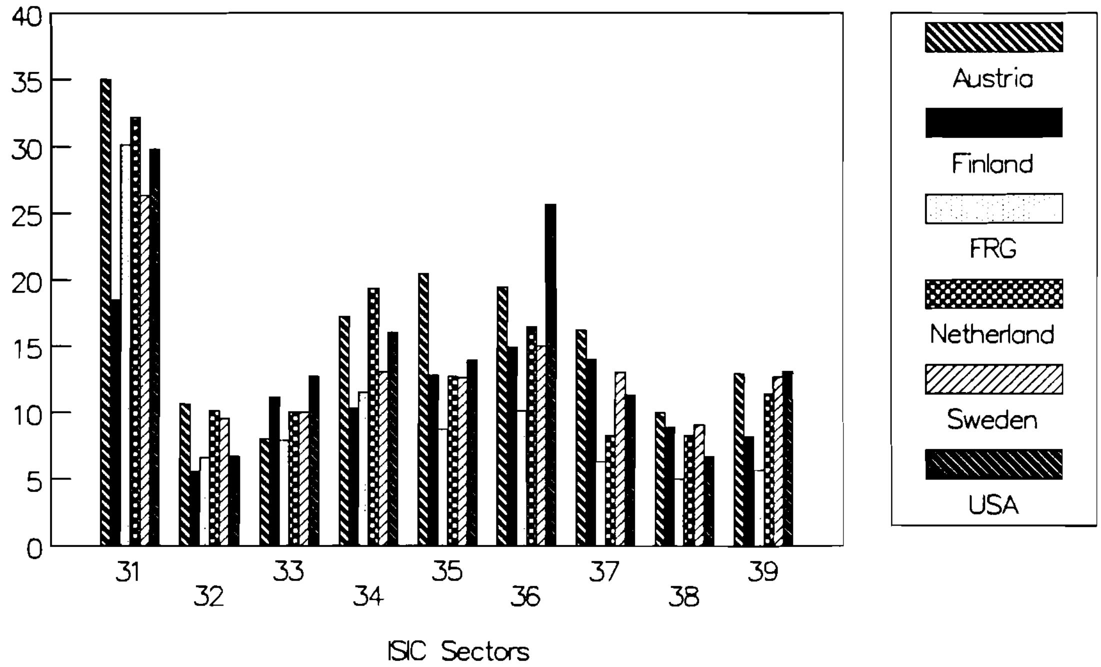

Figure 15: Logistics Labor in Manufacturing (in % of sector employees)

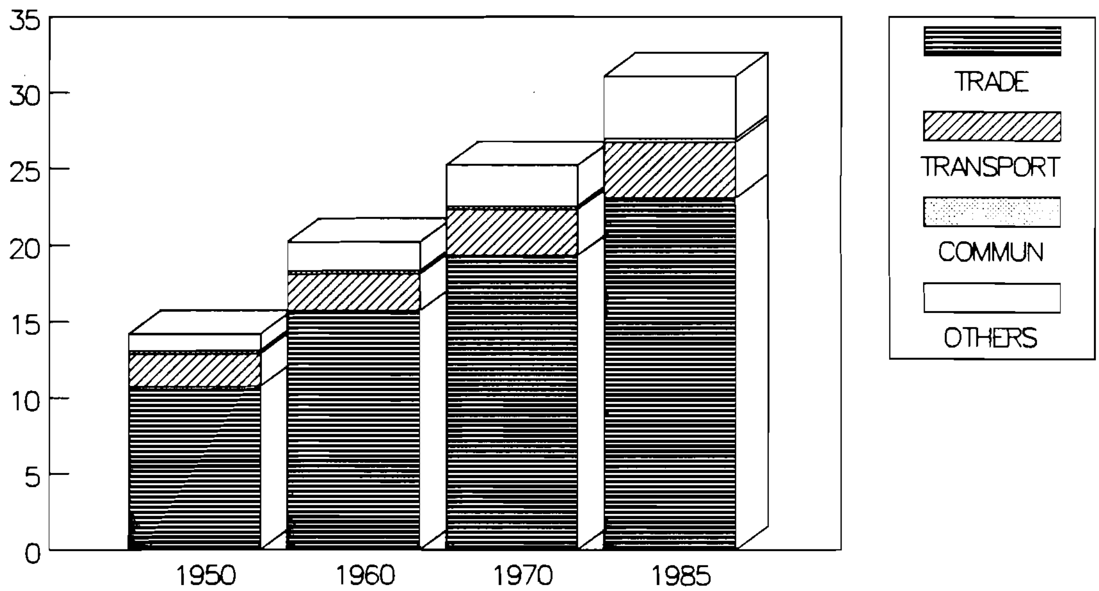

Figure 16: Employed in Logistics (Japan) (in % of total number of employees)

The described data base provides broad analytical possibilities. However, the analysis in this chapter is focused on estimating the share of the logistics labor (on macro and sector level) as well as the analysis of its dynamics rather then making an in-depth study on the labor impacts of new logistics technologies. There follows a summary of the major findings, and some topics for possible future research directions.

1. From an employment point of view, logistics plays an important role in the national economy. Logistics activities provide employment for about 20-25% of the working population in the analyzed countries (Figure 13). These figures are quite consistent with the figures for the share of the logistics costs in GDP. The same holds true for the different sectors of the economy (Figures 14 and 15). Surprisingly, there exist no large differences between the countries on the national economy level. One exception is the retailing sector in the USA—the share of those employed in this sector is about twice as large as in the other countries.

2. The upward trend of the share of the employed in logistics in Austria, FRG and, especially in Japan (see Figure 16 for Japan) corresponds to the growing importance of logistics related activities in the national economy. This in turn puts forward social and educational pressures. The data base provides broad analytical possibilities in this respect, since the subdivision of the logistics labor force by occupations and sectors (which is the case in the internationally comparable labor matrices) has the advantage that establishes direct connection to educational planning.

One promising approach of analysis in this respect is to compare the occupational changes with the changes in the educational programs in a cross-country perspective. This aspect of analysis goes beyond the purpose of this paper, however, it is worth mentioning that a study made for the European Logistics Association on education in the field of logistics showed that a good deal of the European universities are offering logistics courses, which corresponds to the growing demand of the logistics professions.

Another interesting aspect of future research is the analysis of the impact of new logistics technologies on employment and the demand for new professions. The spread of the logistics concept and new logistics technologies, like any other innovation, creates demand for new professions. However, in order to capture these changes more detailed data is needed. Due to the comparatively high level of aggregation of occupations (2-digit level of ISCO) the internationally comparable labor matrices cannot reflect new qualification requirements manifested in new occupations. That is why this aspect of analysis has to be carried out on a country-by-country basis using detailed national labor matrices.

4.5 Logistics costs

The study on logistics costs has not been completed yet. A new methodology has been developed to estimate and analyze the logistics costs based on data from the Input/Output tables, complemented by data for inventories of the respective economic sectors. The total logistics costs are subdivided into the following groups:

- transportation costs;
- trade costs;
- communication costs;
- costs of holding inventories.

The first three groups represent logistics services, bought by each sector, while the fourth group represent the costs made within the sector itself. It was assumed that the inventory holding costs are equal to 20% of the inventory value (the cost of storage, handling and opportunity cost). It was further accepted that 20% of the communication services bought by each sector are associated with logistics, while all of the transportation and trade services bought by the sector are considered to be logistics costs. In such a way the total logistics costs of each sector equals the sum of: a) transportation, b) trade and c) communication (20% of them) services, bought by the sector, as well as d) 20% of the value of the inventory stock held by the sector.

As already mentioned, the analysis is based on data from Input/Output tables. For the time being Input/Output tables (from different sources) for the following countries and years have been collected: the USA (1972, 1977, 1981), Japan (1970, 1975, 1980, 1985), Sweden (1970, 1980), Hungary (1975, 1980), Poland (1975, 1980, 1985), Bulgaria (1970–1985). Unfortunately, the collected data base does not allow the estimation of logistics costs for the economy as a whole, due to the lack of inventory data for all sectors of the economy (one exception, in this respect, is the data for Bulgaria). That is why the analysis is restricted to the estimation of the logistics costs of various sectors of the manufacturing industry. Since the study has not been completed yet, only some of the preliminary results will be presented here in order to provide an idea of the form of the study and the expected results.

The estimations of the logistics costs in percentage terms of the output for some manufacturing industries of the USA and Japan for a span of about ten years are presented at Figures 17 and 18. These results show approximately the same order of magnitude of logistics costs (in % of output) in the manufacturing industry of both countries. The figures obtained are quite consistent with the reported results of other studies [Kearney, 1986] using different methodologies (compare with Table 1). They are also quite similar to the estimates of the share of the logistics labor force in the respective sectors.

The contradictory trends (the upward trend in the case of the USA and the downward trend in the case of Japan) requires a closer examination of the structural changes of logistics costs in these countries. When looking at the changes of different components of logistics costs, the classical trade-off between transportation (and communication) costs and inventory costs is identified. In Japan, the share of transportation and communication costs had increased on behalf of the inventory element. As a result the total logistics costs have decreased. Just the opposite had happened in the USA. This has significant theoretical and practical implications. The effort to create more sophisticated transportation and communication systems will be re-paid by savings in inventories in the consumer sectors. The spread and the application of the Just-in-time concept in Japan leading to dramatic reductions in inventories is associated with considerable improvements in the transportation and the communication systems.

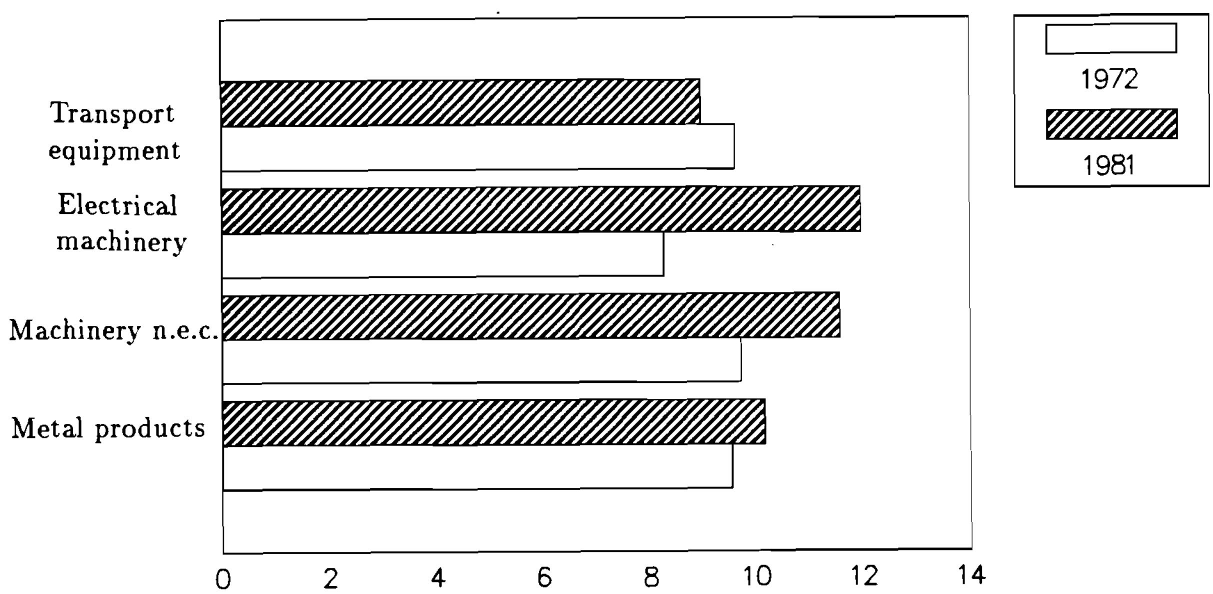

Figure 17: Logistics Costs (USA) (in % of Output)

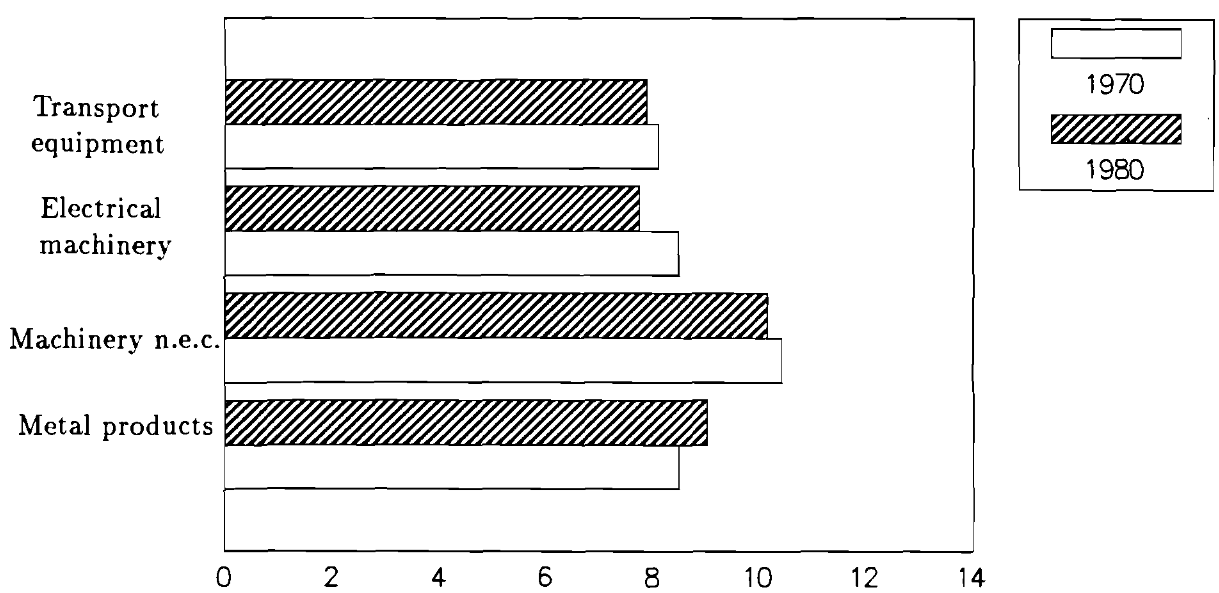

Figure 18: Logistics Costs (Japan) (in % of Output)

5 Conclusions and Future Research

Undoubtedly, logistics will play an increasing role in the competitive growth of firms, sectors, nations and whole regions. Logistics activities contribute some 20-30% of the GDP of industrialized countries and provide employment to 20-30% of the working population. It has been empirically proven (for the case of the USA) that logistics developments are responsible for the greater part of the economic growth of a nation. [Abel and Szekely, 1989].

In most of the investigated countries there are positive trends in the development of the individual activities that comprise logistics. However, there exist large differences between nations, regarding both the components of the physical logistics structures and the managerial strategies, resulting in different logistics performance. If the existing trends are preserved in the future the gap between different countries and whole regions will increase.

Between the individual logistical activities there exist strong relations and dependencies which affect the overall logistics performance. An explorative analysis of the factors that might influence the logistics performance of a nation [Dimitrov, Wandel, 1988] resulted in the conclusion that approximately 85% of the variations of logistics performance among the different nations can be explained by differences in the performance of transportation, production and communication systems as well as the structure and the pattern of the foreign and domestic trade flows.

Without underestimating the role of the economic environment and the application of advanced managerial technologies and concepts, it is quite obvious that the technological level of the "physical elements" of the national logistical system have decisive implications for its performance. However, the creation of a physical system on a high technological level requires more effort (in terms of costs), longer periods of time, and strategic investment decisions. Even if the logistical performance of an individual company can be improved considerably by adopting new management principles—as many case studies and surveys indicate—the technological level of the physical elements of the logistical system sets the limits of these improvements for whole industries, nations and regions.

The results and the conclusions of the study have far reaching implications for business and policy making and for future research. The dramatic changes in the World that we are experiencing today—the shift of the Eastern countries towards market economy, the integration processes in West Europe and Asia and others—are giving impetus to the globalization of the business activities. The uneven logistics development of the different countries and regions will be a bottleneck in this process. Various logistics problems are often cited among the important reasons for the slow penetration rates of East-West joint ventures. The historical possibility of all European integration (facilitated by the dramatic changes in the East European countries) will be confronted, and to a great extent hampered by the gap in the development of the national logistics systems (along with a number of other factors). Logistics activity is international in its nature. Though giving competitive advantage, it is of common interest that the state of the development of the logistics systems and the logistics practices of the different countries and regions are harmonized. This, in turn, opens an interesting area of future research.

The great variety of managerial and policy solutions, the different strategies in the development of the physical and the administrative and managerial elements of the logistics system in the different countries is valuable experience which has to be summarized and evaluated in the context of the future development and harmonization of the World economic life. The dynamics of developments in the logistics field requires constant monitoring with the idea of early identification of the emerging new trends. The research in this direction (on a large international collaborative basis) has already been initiated with the goal of periodical (biannually) publication of a standard report on "Logistic Structures and Strategies: State of the Art and International Trends".

The implementation of new logistics technologies and strategies will inevitably be associated with unexpected and unintended societal and environmental impacts. Just to name two of them:

(a) The wide spread of advanced logistics technologies will have major impacts on employment. It will, from one side, decrease the demand for low skilled logistics professions (material handlers, dockers and other related occupations) as well as rail transport employees, and from the other raise the demand for a new profession e.g. "the logistician".

(b) The shift from rail to road raises many problems related to road safety, environment protection etc. A feasibility study on the unintended impacts of new logistics technologies, which will identify the "hot" research issues is planned for 1991.

It is our strong belief that the work reported in this book as well as the planned research activities are of relevance to the requirements of the World's economic development.

References

Sources of Statistical Data:

United Nations Industrial Statistics Yearbook. UN New York.

United Nations Statistical Yearbook. UN New York.

Annual Bulletin of Transport Statistics for Europe. UN New York.

Trucking in Japan from Statistical Point of View. Japan Trucking Association, 1986.

Ritz, P.M., Roberts, E. P., Young, P. C. (1979). Dollar Value Tables for the 1972 Input-Output Study. Survey of Current Business, April 1979.

Planting, M. A. (1987). Input-Output Accounts of the U.S. Economy 1981. Survey of Current Business, January 1987.

Papers and Books:

Abel, I., Szekely, I. (1989). *Technical Progress and New Logistics Technologies.* WP-89-21. IIASA, Laxenburg, Austria.

Agren, B. (1983). *Cost for Transport, Handling and Storage in the Various Branches—Measurement of Efficiency and Rationalization Possibilities.* Research report No. 130. Linkoping University, Sweden (in Swedish).

Ayres, R. (1991). *CIM: Revolution in Progress.* Volume I of CIM Final Report. To be published in 1991 by Chapman & Hall, U.K.

Ayres, R., H.-U. Brautzsch and S. Mori (1987). *Computer Integrated Manufacturing and Employment: Methodological Problems of Estimating the Employment Effects of CIM Application on the Macroeconomic Level.* WP-87-19. IIASA, Laxenburg, Austria.

Brautzsch, H.-U. (1988). *The Occupational Structure by Sectors in Selected Countries.* Report to the International Institute for Applied Systems Analysis, Laxenburg, Austria.

Childerley, A. (1980). *The Importance of Logistics in the UK Economy.* International Journal of Physical Distribution and Material Management, **10** (4) : 185–192.

Christopher, M. (1988). *Global Logistics for World Markets.* In: J. Mortimer(1988) "Logistics in Manufacturing".

Corstjens, M., Gautschi, D. (1983). *Joint Production in Distribution.* In Gautschi, D., Productivity and Efficiency in Distribution Systems. North-Holland.

Chikan, A. et.al. (1986). *Macroeconomic Factors Influencing Inventory Investments—An International Analysis.* In A. Chikan (Ed.), Inventory in Theory and Practice, Akademiai Kiado, Budapest, pp 55-71.

Dimitrov, P. (1984). *Classification and Analysis of Factors Influencing Aggregate Inventories.* In A. Chikan (Ed.), New Results in Inventory Research, Akademiai Kiado, Budapest, pp 91-100.

Dimitrov, P. (1989). *Implementation Strategies and Logistics Impacts of CIM.* Paper presented at the UN Seminar on Computer-Integrated Manufacturing, Botevgrad (Bulgaria).

Dimitrov, P. and S. Wandel (1988). *An International Analysis of Differences in Logistics Performance.* WP-88-31. IIASA, Laxenburg, Austria.

Hutchins, D. (1988). *Just in Time.* Gower Technical Press.

ISIC (1968). International Standard Industrial Classification of All Economic Activities (ISIC). UN, Statistical Papers, Series M, No. 4, Rev.2, New York.

ISCO (1969). International Standard Classification of Occupations (ISCO). UN International Labor Organization, Geneva.

Jansen, R., Warnecke, H. (1988). *Just-in-Time Manufacturing.* IFS Publications and Springer-Verlag.

Johnston, R. and P. R. Lawrence (1988). *Beyond Vertical Integration—the Rise of the Value-Added Partnership.* Harvard Business Review, July-August 1988, page 94-101.

Kearney, A. T. Inc. (1984). *Measuring and Improving Productivity in Physical Distribution.* National Council of Physical Distribution Management (NCPDM). Chicago.

Kearney, A.T. Inc. (1986). *European Logistics Productivity Survey.* Draft Report. Brussels, Belgium, September 1986.

Kling, J., Grimm, C. (1988). *Microcomputer Use in Transportation and Logistics.* Literature Review with Implications for Educators. Journal of Business Logistics, Volume 9, Number 1 : 1-13.

Les Couts Logistiques en France (Logistics Costs in France) (1981). *Manutention*, **33**, January/February 1981.

Lubben, R. (1988). *Just-in-Time Manufacturing. An Aggressive Manufacturing Strategy.* Mc Graw-Hill Book Company.

McKinnon, A. C. (1989). *Physical Distribution Systems.* Routledge, London and New York.

MITI (1985). Census of Commerce 1985. Ministry of International Trade and Industry (MITI), Japan.

Mortimer, J. ed. (1986). *Just-in-Time. An Executive Briefing.* IFS Publications and Springer-Verlag, 1986.

Mortimer, J. ed. (1988). Logistics in Manufacturing. IFS Executive Briefing. IFS Publications and Springer-Verlag.

OECD (1986). Future of European Transport, OECD, Paris.

Ranta, J. and Wandel, S. (1988). *Economics of Scope and Design of Flexibilities in Manufacturing Logistic Systems.* Paper presented at the 5th International Working Seminar on Production Economics. Igls-Innsbruck, Austria.

Schonberger, R. (1982). *Japanese Manufacturing Techniques. Nine Hidden Lessons in Simplicity.* The Free Press.

Shapiro, R. D., Heskett, J. L. (1985). *Logistics Strategy. Cases and Concepts.* West Publishing Company, St. Paul, New York, Los Angeles, San Francisco.

Tchijov, I. (1989). *FMS World Data Bank.* WP-89-33. IIASA, Laxenburg, Austria.

Uno, K. (1989). *Measurement of Services in an Input-Output Framework.* Elsevier Science Publishers B.V.

Wandel, S., Hellberg, R. (1987). *Transport Consequences of New Logistics Technologies.* RR-87-17. IIASA, Laxenburg, Austria.

Yamashina, H., Masumoto K. (1989). *Prerequisites for Implementing CIM–Moving Towards CIM in Japan.* Paper presented at the UN Seminar on Computer-Integrated Manufacturing, Botevgrad (Bulgaria).

CHAPTER II

LOGISTICS IN THE WESTERN ECONOMIES

Logistics in the United Kingdom

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Logistics in the United Kingdom

Introduction

a) Geographical background: The most salient features of Britain's geography, from a logistical standpoint, are its island status, modest size, subdued relief and uneven distribution of population and economic activity.

As an island and major trading nation, Britain relies heavily on international sea and air links. Ports and airports generate and attract a substantial proportion of total freight traffic. The road, rail and waterway networks carry virtually no international traffic in transit between foreign origins and destinations.

Given the country's physical dimensions and the concentration of population and industry in central and southern England, freight hauls are relatively short. This has important implications for the freight modal split, delivery lead times and inventory levels. The vast majority of freight is transported by road, largely because the railway, waterway and air freight systems have little opportunity to exploit their long haul advantage. Around 85% of the UK population can be reached by road within 4 hours from facilities located in the English Midlands. As delivery times are short, relatively small volumes of stock are tied up in transit.

Most of the population and industry in the UK is concentrated in areas where there are few physical barriers to movement. Distribution is more difficult and costly in the Northern and Western periphery where population is sparse, the terrain mountainous and transport links often poor.

b) Economic background: Britain had a GDP of $670 billion in 1987. Its GDP per capita of $11,765 was significantly below the OECD average of $13,921, though the country has been experiencing rapid economic growth in recent years. Table 1 shows the contribution of different sectors to total GDP in 1987. As in other developed countries, the relative importance of manufacturing industry has been declining both in terms of output and employment. Between 1977 and 1987, its share of total employment fell from 40% to 30%, while that of the service sector increased from 57% to 68%.

I. Physical Logistics Structures

I.1 Inventories in the National Economy.

Stock levels in the British economy have traditionally been high relative to those in other industrialised countries [1]. Christopher [2] in 1980 argued that excessive amounts of inventory accumulated in the UK primarily for three reasons:

(a) The introduction in 1974 of tax relief on the appreciation in the value of stock during a period of high price inflation, effectively giving firms a fiscal incentive to stockpile.
(b) A tendency on the part of British manufacturers to diversify their product ranges to a greater extent than foreign competitors.

Table 1: Sectoral Break-down of GDP, 1987.

	£ billion	%
Agriculture, Fisheries and Forestry	5901	1.6
Energy, Water	24184	6.4
Manufacturing	85552	22.7
Construction	21524	5.7
Distribution, Hotels, Catering, Repairs	48963	13.1
Transport	16227	4.3
Communications	9688	2.6
Finance, Banking and Insurance	63903	17.0
Public Administration	24895	6.6
Education	31681	8.4
Other Services	22366	6.0
Ownership of Dwellings	20180	5.4
Total	375064	

Table 2: Ownership of Inventory in the UK Economy, 1986:

	£ million	%
Manufacturers	42,688	46.7
Wholesalers	15,139	16.6
Retailers	14,832	16.2
Others	19,073	20.9
Total	91,457	

Source: UK National Accounts, 1986.

(c) Low standards of inventory management, coupled in many firms with an inadequate knowledge of stock levels, stockturn rates and stockholding costs.

Delivery lead times in British industry were also long and unreliable, making it necessary for firms throughout the logistical channel to carry large volumes of cycle and safety stock. A survey of delivery performance undertaken by the British Institute of Management in 1975 revealed that 25% of the firms consulted claimed to deliver less than half their orders on time [3]. Subsequent research by New and Sweeting [4] suggested that the BIM study over-estimated actual delivery performance.

The problem of over-stocking appears to have been most acute in the manufacturing sector. Manufacturers have traditionally owned around half the total volume of inventory in the UK economy, though this proportion has fallen over the past decade (Table 2). Christopher [5] argues that, proportionally, the manufacturing sector tends to shoulder a greater responsibility for stockholding in the UK than in other countries because distribution channels are short and, in many trades, dominated by a few large multiple retailers that use their bargaining power to push the burden of inventory onto their suppliers.

Inventory levels fell sharply between 1980 and 1982, mainly as a result of three factors [6]:

(i) Sharp increase in interest rates and decline in financial liquidity following the introduction of tight monetary policy in 1979.
(ii) Drop in business confidence during the recession.
(iii) Withdrawal of tax relief on stock appreciation in 1981.

Referring mainly to 1983-4 data, Waters [7] found that British manufacturing industry was marginally over-stocked relative to its foreign counterparts. He estimated that these above-average stock levels would, in isolation, make British manufactured goods 1-2% more expensive than those produced in the US, Canada and West Germany, and 3.1% dearer than Japanese goods. Since 1982, real interest rates in the UK have stayed at a relatively high level and this has continued to depress stock levels. Standards of inventory management have improved in recent years and there is today much greater awareness of the need to economise on stock. Between 1976 and 1986 the average book value of stock fell from 34.6% of GDP to 28.7%. While inventory management in the UK has clearly improved in absolute terms, it remains poor relative to that of other developed countries. A recent comparison of inventory levels in British and American industry, for instance, indicated that in many industrial sectors, particularly publishing, furniture and vehicle manufacturing, British firms are still substantially over-stocked [8].

Recent surveys in the UK have revealed quite widespread application of Materials Requirements Planning (MRP) among larger manufacturing firms. Of a broadly-based sample of 131 manufacturers surveyed by Oakland and Sohal [9], just under half (48.5%) claimed that they made some use of MRP. Another survey by the Ingersoll Engineers [10] of a wide range of manufacturing firms established that around 60% used MRP `in one form or another'. This study discoverd, however, that, as a result of poor implementation, MRP often failed to yield significant inventory savings. A survey by Voss and Robinson [11] of the application of the Just in Time (JIT) principle in UK manufacturing found that around 57% of the 132 respondents were either implementing or planning to implement some aspects of JIT. Further investigation revealed that many firms were attempting only a partial implementation and often neglecting those aspects which posed most difficulty yet could potentially offer the greatest benefit. The authors concluded that "many firms would seem to be implementing various aspects of JIT on an ad hoc basis whilst few are applying JIT techniques as part of a planned and integrated manufacturing policy". This finding was partly confirmed by the Ingersoll Engingeer's study. While 80% of the manufacturers they consulted believed that JIT techniques were relevant to their business, only 21% intended to apply them comprehensively across their operations. Overall, this study concluded that, while British manufacturers are keen to reduce inventories and interested in new inventory management principles, `real achievements and current plans look distinctly unimpressive against world standards'. Two explanations are offered for this situation:

`Either British industry is simply paying lip-service to (these) principles - backed by the occasional desultory attempt to apply them - or there is a genuine gap between strategic thinking and the actual skills required to implement change.'

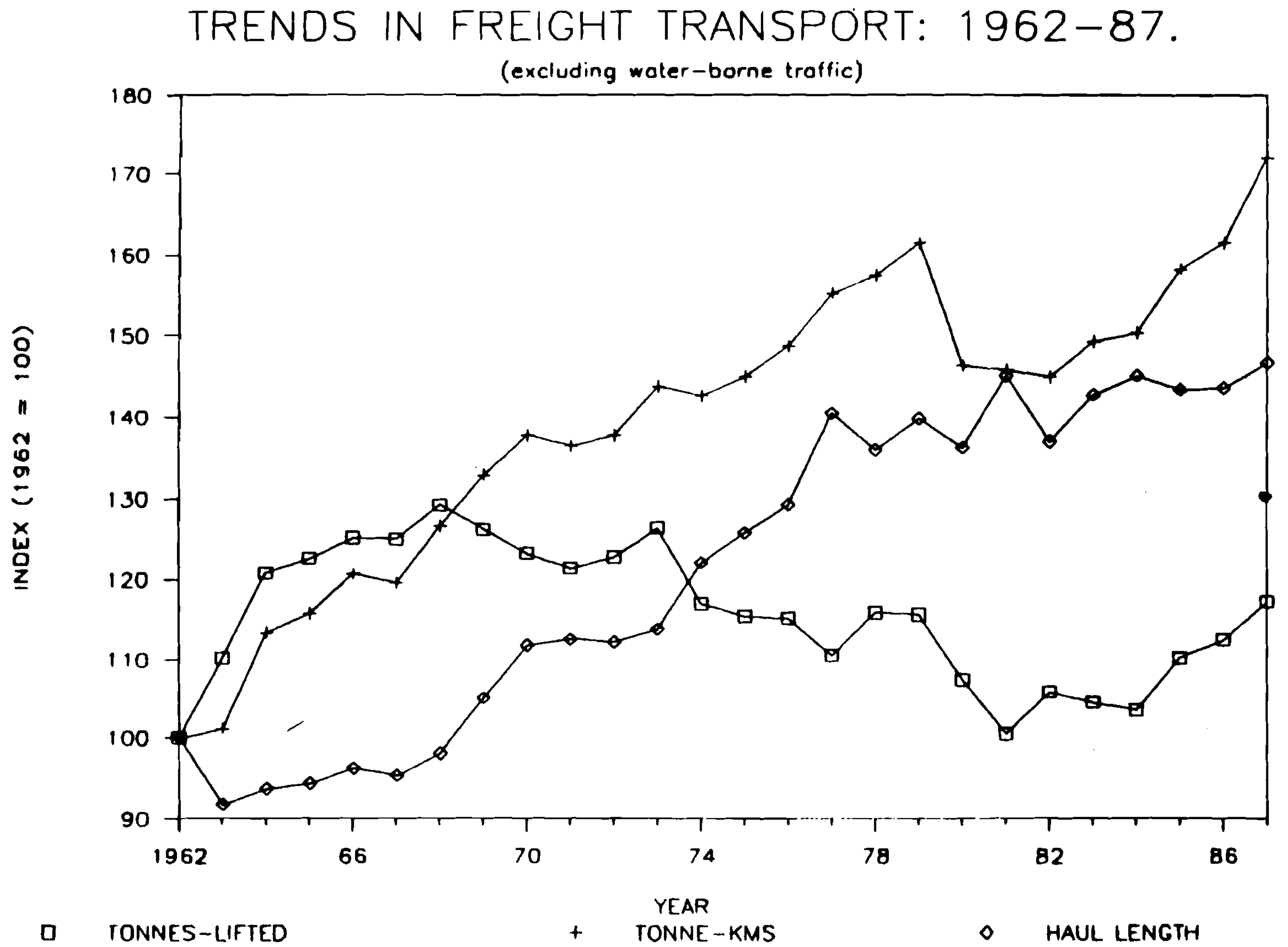
I.2. Transportation Systems

Total volume of freight

Up until the early 1980s, the two main measures of freight traffic, tonnes-lifted and tonne-kilometres moved, followed divergent trends (figure 1) [12]. The tonnes-lifted statistic was particulary erratic, though the underlying trend clearly downward. Short term fluctuations in this index are partly associated with cyclical variations in the level of economic activity. The most likely explanation of the longer term trend was that logistical channels were becoming more streamlined and goods making fewer journeys between raw material source and final point of sale. As the tonnes-lifted figure records the weight of consignments loaded onto vehicles at the start of a journey, it partly reflects the number of separate journeys comprising the through-movement. Since 1984, the tonnes-lifted figure has risen sharply, largely reflecting the recent growth in demand for heavy primary products, such as crude minerals, chemicals, iron and steel and building materials, which together account for a large proportion of total freight tonnage.

In contrast to tonnes-lifted, the number of tonne-kms has been increasing steadily except during the 1979-80 recession, when it dropped by roughly 10%. Since 1982-3, it has again risen steeply, though as a result of a different growth process to that which prevailed in the 1970s. In this earlier period, the increase in tonne-kms was due to an increase in average length of haul, which more than offset the decline in freight tonnage. This lengthening of hauls occurred almost entirely on the road network, with average length of haul for road freight increasing from

Figure 1


TRENDS IN FREIGHT TRANSPORT: 1962–87.
(excluding water-borne traffic)
INDEX (1962 = 100)
180
170
160
150
140
130
120
110
100
90
1962
66
70
74
78
82
86
YEAR
TONNES-LIFTED
TONNE-KMS
HAUL LENGTH

43kms to 71kms between 1962 and 1983. Cundill and Shane [13] and McKinnon [14] examined the possibility that the mean haul length was rising as a result of structural changes in the economy placing greater emphasis on goods whose production and distribution was highly transport-intensive. Available evidence suggested that this was not the case. Instead it seems that haul lengths have increased primarily as a consequence of three essentially spatial processes [15]:

a) Concentration of production and stockholding
b) Enlargement of market areas
c) More circuitous routeing of flows via intermediate processing and stockholding facilities further from the direct route between raw material source and final point of sale.

The rate of increase in the average length of haul has moderated over the past decade. In the case of road freight, for instance, it rose by only 6.2% between 1977 and 1987 in comparison with an increase of 52.3% over the previous ten years. This suggests that the spatial processes listed above are becoming less active, though as they have not been subject to close monitoring, there is little hard evidence to confirm this.

The gradual stabilisation of the average length of haul has not been reflected in the tonne-km trend in recent years as rapid economic growth has generated a substantial increase in total freight tonnage. This sharp reversal of the earlier trend in tonnes-lifted is likely to prove temporary, though, and be followed by a period when the volume of freight movement grows much more slowly, if at all.

Official forecasts of road freight traffic in the UK are compiled using a model developed by the Department of Transport in the late 1970s. This model effectively translates projections of the level of output from major industrial sectors into estimates of tonnes-lifted, tonne-kms and vehicle-kms, using three critical ratios:

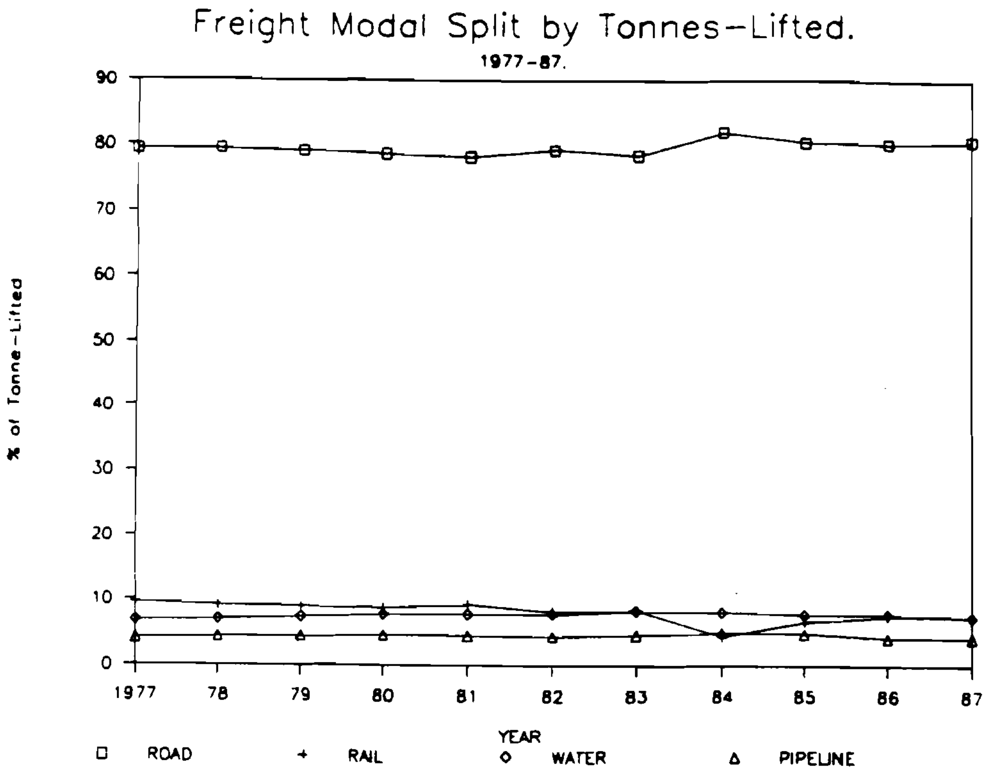
1. Tonnes-lifted:total weight of goods produced (known as the 'handling factor')
2. Tonnes-lifted:tonne-kms (i.e. average length of haul)
3. Tonne-kms:vehicle-kms

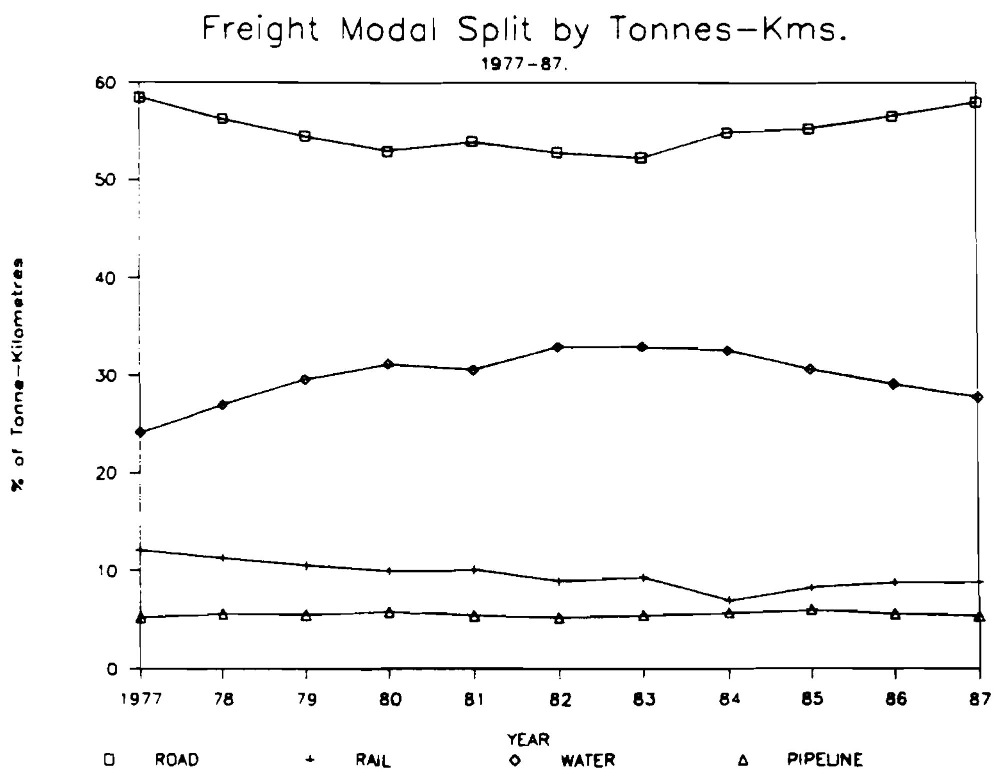
The most recent forecasts of road freight traffic [16] prepared in 1984 seriously under-estimated the increase in heavy goods vehicle traffic. This under-estimation appears to have been the result of a pessimistic projection of economic growth and inaccurate assumptions about the relationship between GDP and tonne-kms. The forecasts are soon to be revised.

Modal split

As shown in figure 2, Britain sends a very large proportion of its freight by road, in terms of both tonnes-lifted and tonne-kms. The allocation of freight traffic between modes has remained reasonably stable for over a decade. Between 1977 and 1987, the road network maintained a consistent 80% share of tonnes-lifted. Its proportion of tonne-kms fell slightly as coastal shipping (included in the 'water' figures) benefitted

Figure 2: Freight Modal Split in the UK, 1977-87.





from the exploitation of the North Sea oil fields. Over the past decade, British Rail (BR) has suffered a temporary loss of freight traffic during periods of industrial action, but has otherwise maintained it modest share of the freight market. Inland waterways accounted for only 3% of total tonnes-lifted in 1987. Just over half of their freight tonnage (53%) was travelling to or from a foreign port and thus represented international trade passing through ports such as London, Manchester and Hull that require waterway access.

An ambitious attempt was made by Bayliss and Edwards [17] to develop a probabilistic model capable of forecasting the modal choice of individual freight consignments. This work achieved limited success and has been rendered largely obsolete by major changes in the British freight market since the late 1960s. More recent research [18] has taken greater account of the logistical framework within which modal choice decisions are made. A major study is currently underway to explore modal decision-making in the UK using `stated preference' methodology [19].

Road Transport

(i) Infrastructure: Since 1960, some 3000kms of motorway have been constructed in the UK and many other roads built or upgraded to dual carriageway standard. Almost all the major centres of population and economic activity now have a motorway link. Plans for future road construction have three objectives [20]:

1. Improving road links between industrial areas (especially in the Midlands) and ports on the east and south coasts serving the European mainland.
2. Inserting a few remaining strategic links (eg. M40 London-Oxford motorway, M1-A1 link).
3. Providing bypasses to relieve problems of congestion and environmental intrusion in towns and villages.

Road networks in several parts of the country, particularly Greater London, are seriously congested at peak periods and this severely retards the movement of freight. The Confederation of British Industry recently estimated that, nationally, road congestion is costing £15bn per annum, while in the South East of England it adds an extra 20% to delivery, service and selling costs [21]. Since the curtailment of the urban motorway programme in the early 1970s, for financial and environmental reasons, highway authorities have made only piece-meal additions to road capacity in built-up areas, placing greater emphasis on traffic management.

(ii) Vehicle Fleet: The total number of lorries (over 2 tonnes ULW) registered in the UK has been declining for many years. Between 1973 and 1982, it fell by 21%. Over the same period, the number of lorries in the heaviest weight class (over 10 tonnes ULW) doubled and their share of road tonnes-lifted and tonne-kms increased from 19.8% to 35.5% and 40.3% to 60.5% respectively. Between 1977 and 1987, the total annual distance travelled by heavy vehicles (with 4 or more axles) rose by 62%, while total lorry kilometres increased by only 12%. Many operators have taken advantage of the increase in maximum vehicle weight from 32 tonnes to 38 tonnes in 1981. In 1987 almost 40% of road freight tonne-kms were handled by 38 tonners. It has been officially estimated that the use of 38 tonne lorries saved British industry around £100 million in 1986.

Road-train formations, comprising a tractor unit and two or more trailers, are illegal in the UK, though it is permissible for a rigid vehicle to haul a draw-bar trailer. Drawbar-trailer combinations equipped with demountable vehicle bodies (or swap-bodies) are becoming increasingly common as they enable firms to break-bulk without incurring the cost of using a depot [22].

(iii) Structure of the Road Freight Industry: Around 96,000 firms in the UK hold licences to operate lorries of over 3.5 tonnes GVW [23]. The vast majority of these operators run five or fewer vehicles. In 1980 such operators accounted for 87% of the total; less than 1% had more than 50 vehicles. Most firms operated their lorries mainly on an 'own account' basis to carry their own traffic. In 1985, roughly 37,000 companies ran vehicles principally for 'hire and reward' [24]. Since its early days, the road haulage industry has been highly fragmented. Since the liberalisation of the UK haulage industry in 1970, entry barriers have been low, competition intense and profit margins slender, particularly in the general haulage sector. The inability of many of the smaller firms in this sector to secure longer term contracts leaves them vulnerable in times of recession. Many of the larger hire and reward operators have over the past 15 years broadened their range of services to include storage, materials handling, order processing etc. to offer clients an integrated distribution package rather than a basic transport service. This has proved an effective means of increasing volume and profitability and of securing longer term contracts. Public warehousing firms, freight forwarders and the 'in-house' distribution departments of manufacturing and retailing firms have also begun to provide integrated distribution on a third-party basis.

Although the distribution services industry is relatively young, there is already quite a high degree of specialisation by product, range of services, geographical area and client group. An important distinction has emerged between the provision of distribution services on a dedicated basis for individual firms (aimed particularly at multiple retailers) and the consolidation (or groupage) type of operation in which several clients' traffic shares the same vehicles and depots. The growth of contract distribution services is discussed more fully in section II.1.

Railways

There are approximately 14,900 route kilometres of railway in the UK open to freight traffic. The route distance has declined by about 40% since 1962. Over the same period, the number of rail freight depots has dropped from 590 to 123 and private sidings from around 6000 to 1100. Relative to other European rail networks, BR is poorly endowed with freight terminals and private sidings. During the postwar period, much of Britain's manufacturing and warehousing capacity has been realigned with respect to the road network, leaving only a small proportion of industrial premises in railside locations. This seriously constrains BR's ability to secure freight traffic as over 90% of its tonnage is generated by railside premises.

British Rail's freight operation has been transformed over the past twenty years. The traditional wagon-load operation involving the remarshalling of wagons at several points en route has been abandoned. A large proportion of BR's freight traffic is today carried by the train-load in trains contracted by individual firms ('company trains') and travelling directly between source and destination to a tight schedule. Most of the rolling stock on these trains is either owned or leased by the client firm. Indeed only around 20% of BR's freight traffic is today carried in its own wagons. Much of its tonnage is generated by 'merry-go-round' trains circling between coal mines and power stations. BR's remaining wagon-load services, Speedlink and Freightliner, provide direct, scheduled connections between major industrial centres, the former using standard wagons, the latter handling containers. In September 1988, BR decided to combine these two operations.

Since 1981, BR has offered shippers an integrated distribution package based upon it Speedlink network and operated jointly with numerous warehousing/road haulage firms around the country [25]. The latter provide a storage/break-bulk services at railhead warehouses and collection/delivery by road where required. This initiative is helping BR to attract larger volumes of manufactured goods and thereby reduce its heavy dependence on bulk traffic, much of which has limited growth prospects.

Intermodal Systems

The British rail network has a significantly smaller loading gauge than most other European rail networks. This has imposed tight limits on the carrying capacity of British rolling stock and prevented the development of conventional piggy-back services similar to those on the European mainland. For the past 20 years, containers have served as the main unit of road-rail interchange in the UK. As the opening of the Channel Tunnel will create a large potential demand for intermodal and bimodal services to and from the UK, the need to ease this loading gauge restriction has become all the more pressing [26]. This could be done by increasing the clearance at bridges, tunnels and stations to permit the through-movement of larger European rolling stock. BR contends, however, that even opening up a single spinal route through the country to the Berne gauge would be prohibitively expensive and very unlikely to earn an adequate rate of return.

Instead, BR is promoting the development of new types of rolling stock that should greatly increase the scope for intermodal and bimodal services on its existing network. The main innovation is the small-wheeled bogie which reduces the height of the wagon platform by about 30 cms, thus permitting the through-movement of the new generation of 2.8 metre containers and 2.6 metres swap bodies. New bimodal systems include a piggyback vehicle and a 'road-railer' system called Trailertrain, comprising trailers that can have their road wheels retracted and be slung onto railway bogies. These bimodal vehicles will have less cubic capacity than their European counterparts and are likely to have more limited application than the swap-body.

I.3 Distribution Channels and Patterns

The British distributive system is characterised by a high degree of concentration at the retail level and a strong tendency for producers to deal directly with retailers.

Figure 3 indicates the allocation of retail sales between the main marketing channels in 1983. In that year, multiple retailers (comprising 10 or more stores) held roughly 56% of the market and obtained almost all their supplies directly from producers/importers. Wholesalers handled 36% of all supplies destined for retail outlets (by value), 3% of them collected by small retailers from cash and carry outlets. Small unit retailers (defined as retail organisations with fewer than 10 stores) received only around a quarter of their supplies directly from the producer.

Multiple retailers' involvement in physical distribution has greatly increased over the past 30 years as a result of two related processes [27]:

(i) increase in their market share (making the UK retail sector one of the most concentrated in the world) (Table 3)
(ii) increase in the proportion of their supplies channelled through warehouses under their control

A survey by Simpkin et al. [28] of 200 major retail chains indicated that the majority directed in excess of 80% of their turnover through central warehouses (Table 4). Earlier research [29], nevertheless, showed that there were wide inter- and intra-sectoral variations in multiple retailers' relative dependence on central warehouses (Table 5). Retailers' motives for channelling supplies through central warehouses are listed in Table 6.

In recent years several large supermarket chains have been developing, usually in association with contractors, systems of `composite distribution', in which products with different temperature requirements are assembled in the same distribution centre and delivered in consolidated loads to branch stores in special compartmentalised vehicles. This has enabled these retailers to control the inflow of a much higher proportion of their supplies, while achieving greater economies of scale in their storage and distribution operations.

The extension of multiple retailers' control back along the distribution channel is affecting the logistical activities of manufacturers in several ways:

a) By feeding their output into warehouses controlled by large retail chains, small producers can gain access to a wide market.
b) Multiple retailers are increasingly using their strong bargaining power within the marketing channel to dictate delivery requirements to manufacturers. Many have also developed extensive ranges of own label products, taking on full responsibility for their marketing and distribution.
c) Multiple retailers' preference for central warehouse delivery has been a major factor contributing to the contraction of manufacturers' shop delivery networks.

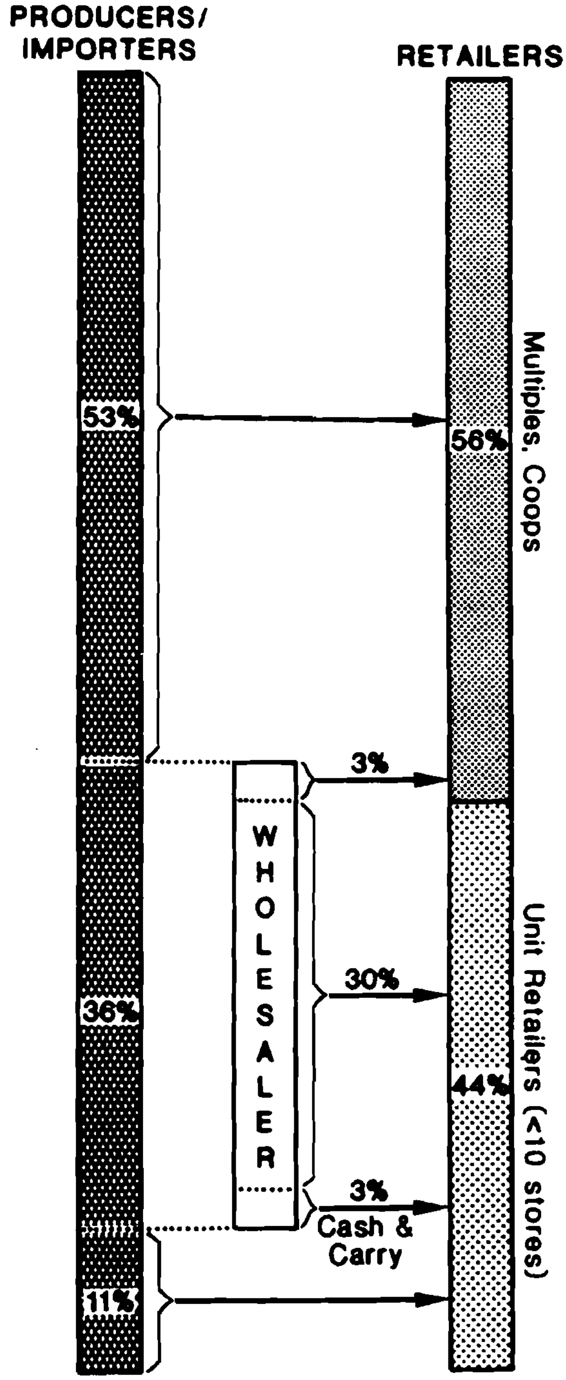


Figure 3: Allocation of Retail Sales Among UK Distribution Channels, 1983.

Table 3: Distribution of Retail Sales by Type of Organisation.

	% of total retail sales 1976	1986
Single outlet retailers	33.9	28.7
Small multiples (2-9 shops)	15.6	12.1
Large multiples (10 or more shops)	51.2	59.1

Table 4: Proportions of Turnover Channelled through Retailer-Controlled Warehouses: Multi-sectoral Survey of 200 Large Retailers

% through Warehouse	% of Retailers
> 80	54
50 - 80	25
1 - 50	15
0	6

Source: Simpkin et al., 1987.

Table 5: Sectoral Variations in the Proportion of Turnover Channelled through Retailer-controlled Warehouses, 1983

Sector	% through Warehouse
Electrical goods	48
Alcoholic drinks	49
Clothing	57
Footwear	59
Food	62
Furniture	73
Tobacco	73

Source: NEDO, 1985.

Table 6: Advantages to the Retailer of Channelling Supplies through a Central Warehouse:

I Strengthening of Retailer's Negotiating Position with Suppliers

1. Bulk discounts for warehouse delivery.
2. Reduction in `backdoor congestion' and delivery refusal rates.
3. Centralisation of the buying function to permit more professional and aggressive dealing with suppliers.
4. Easier computer link-up between retailer and supplier.

II Improving the Efficiency of the Retailing Operation.

5. Higher labour productivity in goods handling at stores due to:
   a) arrival of supplies in fewer, larger loads.
   b) tighter scheduling of deliveries.
   c) use of handling systems tailored to retailer's needs.
6. Reduction in stock levels as a result of:
   a) centralisation.
   b) shorter and more reliable lead times for store delivery.
   c) tighter stock control at central warehouse.
7. Release of storage space in shops for sales and display purposes.
8. Lower storage costs in less expensive warehouse sites.
9. More efficient central processing of orders and invoices.
10. More effective shop management as store managers spend less time dealing with suppliers' sales representatives.
11. Better able to exploit the advantages of electronic point of sale (EPOS) technology.
12. Reduced stock-loss through theft and damage.

III Improving Customer Appeal.

13. Reduced risk of stockouts (ie. greater product availability).
14. Improved quality control.
15. Wider range of products, especially of own-label and imported lines.

Adapted from ref. [30]

Table 7: Reduction in Shop Numbers, 1976-86:

Type of Organisation	Numbers of Outlets 1976	1986
Single outlet retailers	231 111	217248
Small multiples (2-9 shops)	78670	65783
Large multiples (10 or more shops)	81355	60353
	391136	343387

The number of delivery points on these networks has also been reduced by the closure of shops (both independents and multiples' branch stores) (Table 7) and the concentration of retail floorspace in larger outlets. There has been an extensive development of superstores, hypermarkets and retail warehouses in the UK since 1970, many of them at sites on the urban periphery to which delivery vehicles can gain easy access. In recognition of the high cost of making small drops, particularly in inner urban areas, manufacturers have curtailed deliveries to small outlets, mainly by raising minimum order sizes. An increasing proportion of manufacturers' output is being distributed in bulk loads directly from the factory to retailers' and wholesalers' warehouses and to some of the larger retail premises.

While there has been considerable decentralisation of grocery, furniture and DIY retailing in the UK, local planning authorities, with central government approval, have resisted the development of large out-of-town shopping centres (or `megacentres'). There is only one such centre in the UK at present, the `Metrocentre' near Newcastle upon Tyne. Most comparison and speciality shopping is still concentrated in and around town centres, where goods reception facilities are often poor and access roads badly congested.

Many wholesalers have also rationalised their delivery operations, though as they supply consolidated orders, it remains profitable for them to deliver to large numbers of small independent outlets. A large proportion of these shops, particularly in the grocery and pharmaceutical trades, are affiliated to wholesale voluntary groups. Over the past 25 years there has been a sharp increase in the proportion of independent retailers making regular use of cash and carry warehouses. In obtaining supplies from this source, they assume responsibility for the traditional wholesale functions of transport and order picking.

As a result of the changes detailed above, there has been an increase in the proportion of retail supplies arriving at shops in consolidated loads. Rushton [31] estimated that in 1978 around 78% of supplies arriving at retail outlets were consolidated (i.e. combining the products of different producers). Since 1978, this proportion and the degree of consolidation are likely to have increased considerably. There has been a corresponding reduction in the number of drops per journey and increasing use of large vehicles in a shop delivery role.

I.4 Warehousing and Materials Handling.

For many years, warehousing has been the main growth sector in the English commercial property market. Between 1974 and 1985, the expansion of warehouse floorspace exceeded that of shops and offices and compared with a 2% reduction in factory floorspace [32]. There was a steady decline in the amount of new construction between 1980 and 1985, though this was largely offset by empty factories being redesignated as warehouses, presumably to improve their chances of re-letting.

Aggregate floorspace trends conceal important structural changes in the warehousing sector. Older multi-storey buildings in inner city locations have been vacated as firms have decentralised their storage/distribution operations to single storey premises on the urban periphery. Even many of the modern warehouse units speculatively built to standard construction over the past 10-15 years lie vacant. Much of the recent demand has been for large, purpose-built premises at which firms can centralise their storage/distribution operations. Large distribution centres have gravitated to points of high accessibility on the motorway network, contributing to the steep inflation of rental and land values in some areas, particularly around London.

The UK has lagged well behind Japan, the United States and West Germany in the development of warehouses with automated storage and retrieval systems (AS/RS). There were estimated to be 175 such systems in operation in the UK in 1982 by comparison with over 750 in West Germany and over 3000 in Japan [33]. A more recent survey by Frost and Sullivan [34] indicated that Britain accounted for 19% of the European market in automated handling systems in 1987, placing it marginally ahead of Italy and France with 16% and 15% respectively, but well behind West Germany's 37% share. This study accused British industry of being myopic in its assessment of the potential benefits of automated systems, being preoccupied with labour savings and expecting payback over too short a period. Frost and Sullivan contend that, in this context, `strategic questions such as getting ahead of the competition are, as yet, rarely given practical expression in the UK'. British firms have, on the whole, preferred to mechanise their warehousing operations incrementally, with automated guided vehicles, mechanical stacker cranes and various conveyor systems proving popular [35].

Firms have been concentrating their storage operations in fewer larger warehouses to reduce inventory levels and take advantage of economies of scale. This trend has been most pronounced among manufacturers, though also in evidence in the wholesale and retail sectors. Many firms have completely centralised their stockholding/distribution operations and serve the whole country from a single location, usually within a triangular zone in central England bounded by the M1/M6, M4 and M5 motorways. To maintain the efficiency of their transport operations, firms with highly centralised stockholding systems often channel goods through regional break-bulk points. This spatial separation of the stockholding and break-bulk functions helps them achieve a more efficient trade-off between stockholding and transport costs. Many parcel carriers have centralised their sorting operations at large `hub' warehouses and downgraded outlying depots to the status of `satellite' collection and distribution points [36].

Considerable research has been done in the UK on the optimisation of warehouse location [37]. Attempts have also been made to establish the sequence in which depot locations should be added or removed from a distribution system as the degree of stock dispersal changes [38].

I.5 Logistical Expenditure

The first attempt to calculate total logistical expenditure in the UK was made by Childerley [39] using 1976 data. When this calculation was updated by McKinnon [40], using 1986 data it was found that net logistics

Table 8: UK National Expenditure on Logistics, 1976 and 1986 (at current prices)

	1976		1986	
	£m	% of GDP	£m	% of GDP
Inventory (excluding appreciation)	9,955	8.7	21,896	6.9
Storage/Materials Handling	11,448	10.1	25,179	8.0
Transport	9,940	8.7	25,478	8.0
Total Logistics Expenditure	31,343	27.5	72,553	22.7
Appreciation in the value of inventory	6,557		2,331	
Net Logistics Expenditure	24,786	21.8	70,222	22.0
Gross Domestic Product (at factor cost, expenditure-based)	113,790		319,089	

Notes: a. At current prices.
b. Based on average interest rates of 15% in 1976 and 14% in 1986.
c. Assumes (as in the calculation by Childerley, 1980) that the ratio of storage/materials handling costs to inventory costs was 1.15:1 in both years. As the cost of financing inventory was lower in 1986 than 1976, this allows for some improvement in the productivity of warehousing and materials handling. Productivity gains accruing from the installation of new handling systems, computerisation and better management may have been partly offset by a reduction in the utilisation of warehousing facilities following destocking. The cost estimate for this logistical component is, therefore, highly approximate.
d. Includes a revised estimate of £10 million for internal air-freight in 1976 and excludes expenditure on pipelines in both years.

Source: ref [60]

costs were almost identical in these two years, at around 22% of GDP (Table 8), despite the fact that in the intervening period stock levels had fallen and the productivity of the freight transport system been improved. This apparent anomaly was the result of a sharp fall in the rate of inflation from an average rate of 16.5% in 1976 to 3.4% in 1986. In the mid-1970s, high rates of inflation offset most of the financial cost of holding stock and thereby kept net logistics costs artificially low.

Several key elements in the logistical mix were excluded from both the 1976 and 1986 calculations. No account was taken of the cost of packaging, administration, pipeline movement and the transmission and processing of information. Incorporating these activities would significantly raise logistics' share of GDP. In 1986, for example, British firms spent a total of £6.3bn. on packaging materials, while a recent US study has estimated that administration accounts for roughly 4% of total logistics expenditure [41].

The Institute of Logistics and Distribution Management (ILDM) commissions an annual survey of distribution costs in the UK. These surveys are based on very small samples of firms (c.60) which are not stratified by industrial sector. They cannot, therefore, be used as a basis for generalising about distribution costs across UK industry as a whole. Among the firms participating in the 1986/7 survey, distribution costs averaged 7.6% of sales revenue, though underlying this mean were wide inter- and intra-sectoral variations (Table 9) [42]. In earlier research on physical distribution in the UK wide cost differentials were cited as evidence that comparable firms operated their distribution systems at markedly different levels of efficiency [43]. Cost variations also, however, reflect differences in firms' involvement in physical distribution, the range of activities they include in the cost calculation and accounting practices.

Survey results during the 1980s appear to indicate that average distribution costs have been declining as a proportion of sales revenue (Table 10). These average figures are not strictly comparable, though, as the composition of the sample changes from year to year. The distribution costs incurred by a core group of regular respondents to the survey have nevertheless been declining in recent years relative to sales revenue, primarily as a result of savings in inventory and storage.

No attempt has been been made to assess the overall efficiency of the British logistical system.

I.6 International Logistics

Britain is a major trading nation with exports and imports representing 20% and 23% respectively of its GDP in 1987. This has several important implications for the UK logistical system:

(i) Ports and airports generate and attract a substantial proportion of total freight traffic.
(ii) Longer lead times for imported goods necessitate the holding of larger stocks.

Table 9: Physical Distribution Costs in the UK, 1986/7

	% of sales revenue
Transport	3.6
Inventory	1.1
Storage	1.7
Administration/other	1.2
Total	7.6

Source: ref [42]

Table 10: Trends in Physical Distribution Costs: 1981-1986/7:

Survey	Date	Sample Size	% of sales
McKibbin	1981	57	12.8
CPDM	1983	66	12.3
CPDM	1984	67	11.6
IPDM	1985	-	8.3
ILDM	1986/7	-	7.6

Table 11: Maximum Weight and Dimensions of Lorries Permitted on UK Roads:

Height	4.2 metres
Width	2.5 metres
Length:	
Rigid	11.0 metres
Articulated	15.5 metres
Axle Weights	
Single	10.5 tonnes
Double	20.0 tonnes
Max. Gross Weight	38.0 tonnes

(iii) Foreign manufacturers have considerable logistical involvement in the UK. The size of the British market and its island status leads foreign firms to establish separate stockholding/distribution bases in the UK. They are also major users of contract haulage, storage and distribution services [44].

(iv) In theory, Britain's heavy reliance on manufactured exports ought to be reflected in a high level of managerial concern for the cost and quality of international logistics. In practice, however, many firms regard export management as a low order function and prefer to relinquish responsibility for international distribution to the foreign customer [45]. Recent studies [46] have shown that the majority of British exporters sell on either an ex works or FOB basis. Their affinity for these pricing schemes has been partly attributed to Britain being an island and its long history of trading with distant, colonial markets. Although Britain has been a member of the European Community (EC) for 16 years, few manufacturers have extended their domestic policy of delivered pricing onto the European mainland. The choice of transport mode and route for much export traffic therefore rests with the foreign customer and/or his freight agent.

The pattern of export and import movements within the UK has been substantially altered over the past 20 years as a result of the realignment of the nation's trade away from the deep-sea routes towards the European mainland. In the mid-1960s only about a quarter of Britain's trade was with other European countries; this proportion has now risen to around 45%. There has been a reorientation of international traffic from the traditional deep-sea ports of Glasgow, Liverpool, Bristol and London towards the roll-on roll-off (RoRo) and lift-on lift-off (LoLo) ports on the East and South coasts. British deep-sea ports have also been losing traffic to other European ports, most notably Rotterdam and Antwerp, where goods destined for Britain are transhipped onto smaller vessels and enter the country through East coast ports [47]. It has been suggested that once the Channel Tunnel is open a reversal of this transhipment operation may develop with deep-sea container traffic bound for the European mainland being transferred onto rail wagons at a British West Coast port (such as Glasgow or Liverpool) and completing their journey by land. A feasibility study [48] commissioned by the Clydeport Authority has, however, cast serious doubt on the viability of such an operation.

The Channel Tunnel, which is scheduled to open in 1993, will physically link Britain's rail network with that of mainland Europe, permitting the through-running of rail wagons for the first time and offering lorry traffic an alternative means of Channel crossing to the RoRo ferry. Through rail transit times should be significantly shorter than those currently achieved by road and rail services, especially from more peripheral parts of the UK. For example, through rail services from Glasgow to Frankfurt and Marseilles will be, respectively, 45% and 58% quicker than present driver-accompanied lorry services on these routes; 60% and 64% faster than current rail services [49]. Freedom from weather restriction will also enhance the reliability of the Channel crossing. The lorry shuttle service to be provided by Eurotunnel will be slightly faster and more reliable than the current RoRo ferry services, though drivers' hours regulations will prevent some hauliers from deriving much operational benefit from the shorter crossing times. It is anticipated that competition between the Tunnel and the ferries will reduce cross-Channel lorry charges by around 10% in real terms. The main benefit of the Channel Tunnel is, nevertheless, likely to accrue to the railways, with BR forecasting that it will increase its share of the unitised cross-Channel freight traffic from 8% in 1988 to around 20% in 1993-4.

Such a modal shift might be constrained by the liberalisation of international road haulage within the EC in 1993, which is expected to force down rates and improve service quality. It is doubtful, however, that the proposed regulatory changes will have a large impact on road haulage services between Britain and the rest of the EC. Many foreign hauliers will continue to be discouraged from coming to the UK by the large trade imbalance between the UK and other EC countries, and hence lack of return loads, the highly competitive nature of the UK haulage market and the correspondingly low level of haulage rates [50]. British road haulage operators are likely to be more strongly influenced by the harmonisation measures that are likely to accompany the liberalisation of the European haulage market. British hauliers would benefit from an alignment of UK lorry weight/size limits and vehicle taxation with EC norms [51].

II.1 Organisational Structure

Functional Integration: A survey by Whitehead Consultants [52] indicated that by 1974 around 22% of British manufacturers had established a separate distribution department. This study and a later one by A.T.Kearney Ltd. [53] in 1979 found wide discrepancies in what firms deemed to be distribution functions. Inventory and order processing, for example, frequently remained under the control of other departments. Since 1980, more and more firms have begun to manage logistical activities integrally and to co-ordinate these activities more closely with production, marketing and sales. No surveys have been undertaken to assess the generality of these trends (cf. the Kearney studies of logistical integration in the US [54]). The status of logistics within corporate hierarchies has clearly risen with an increasing number of firms giving logistics/distribution representation at board level.

Externalisation of Logistical Functions: This has been one of the most pronounced trends in the UK logistical system in recent years. Producers and multiple retailers have become increasingly reluctant to undertake transport, storage and associated tasks on an own account basis, for a number of reasons [55]:

i) Financial considerations: Many prefer not to invest capital in what is generally regarded as an ancillary activity. Once contracted out, distribution becomes a current rather than capital expenditure item on the balance sheet. A change in the system of company taxation, outlined in Section II.2 has given firms an additional financial incentive to externalise this function. Some of the larger contractors now have the capital resources to buy out clients' 'in-house' distribution systems and thereafter operate them exclusively on their behalf. This makes it easier for firms to release capital tied up in own account distribution facilities for more productive use elsewhere in their business.

ii) Technological factors: As computerisation and the advent of highly mechanised handling systems has made logistics more capital-intensive, increasing numbers of firms have decided that it would require too large an investment to keep their in-house distribution operations abreast with new technological developments. To be operated efficiently much of the new equipment must be operated at a level of throughput in excess of that in many own account systems.

iii) Structural change in the distributive channel: As retailer-controlled warehouses have captured an increasing proportion of the flow of finished goods, manufacturers have found it increasingly difficult to operate their systems of decentralised storage and shop delivery efficiently. Many have responded by contracting out the diminishing volume of local delivery work. Meanwhile, in expanding their physical distribution operations, the large retail chains have shown a high propensity to externalise the distribution function. In an effort to rationalise the inflow of supplies to their shops, some have also compelled producers to make use of the consolidation services of nominated carriers.

iv) Increased import penetration: Foreign manufacturers rely heavily on outside contractors to distribute their products in the UK. A recent survey of 55 foreign firms found that over 70% of their total sales in the UK were delivered to wholesale and retail outlets in contractors' vehicles [56]. The increase in import penetration in many sectors of the British consumer goods market is likely, on balance, to have augmented demand for contract services.

Two attempts have been made to assess the degree to which the distribution function is externalised. The first, carried out by Kae Developments Ltd. [57], was based on a sample of 80 firms in the grocery, confectionery, drink, pharmaceutical and household goods trades. It indicated that only a small minority of firms were totally dependent on own account systems and that roughly half the manufacturers and multiple retailers sampled preferred to supplement their in-house operation with some use of contractors. The second, by stockbrokers Kitcat and Aitken [58], estimated that third party operators held about 27% of the total distribution market (by value) in 1985, a proportion predicted to rise to 60% by 1994.

II.2 Regulation of Logistics Activity.

Transport Regulation: Since the abolition of the quantitative licensing of commercial road vehicles in 1970, the UK has had one of the most liberal freight markets in the world. To obtain a goods vehicle license, it is necessary to satisfy local traffic commissioners that you have professional competence, adequate financial resources and an awareness of drivers' hours regulations, operate from suitable premises and are willing to maintain your vehicles to the specified standard. These requirements present little obstacle to entry into the road haulage industry.

Table 11 sets out the current restrictions governing the weight and dimensions of lorries in the UK. The British government currently has a derogation from the EC to allow it to retain a maximum weight limit below the Community norm until an extensive programme of bridge strengthening is completed.

Taxation: The system of lorry taxation is based on gross vehicle weight and related closely to the government's estimate of the road track cost attributable to each vehicle weight class. In a recent survey, British hauliers complained that the level of vehicle excise duty was significantly higher than that in other European countries, placing them at a disadvantage in the international haulage market [59].

Between 1984 and 1987, the government phased out capital allowances on new investment, while reducing the level of corporation tax on company profits. These measures have had the effect of redirecting tax incentives away from simply owning assets towards maximising the amount of profit they earn. As mentioned in the previous section, these tax changes are discouraging firms from investing in in-house transport/distribution operations and promoting the growth of external contract hire and leasing services [60].

The introduction of a new local property tax (known as the National Non-Domestic Rate) in 1990 and the associated revaluation of industrial and commercial premises for tax purposes will considerably increase the cost of operating distribution facilities in many parts of the country. It has been predicted, for example, that large distribution centres in strategic locations in the South East of England may incur rate increases of 160%, equivalent to a 9-10% increase in operating costs [61].

Local Controls: The Heavy Commercial Vehicle (Controls and Regulation) Act of 1974 gave local authorities the power to confine lorries of over 3 tonnes ULW to routes which were judged to be more environmentally suitable for this traffic. By 1981, some 450 lorry routeing schemes were in force, though many of these affected only short stretches of road [62]. Access restrictions in town centres are much more common and pose a greater hindrance to delivery operations. A night lorry ban was introduced in Greater London in 1986 with the aim of diverting through traffic onto the M25 orbital motorway.

Railways: British Rail was released from common carrier and freight pricing obligations in the 1950s, though it did not fully exploit its commercial freedom until the 1970s. The government now sets BR the financial objective of running its freight operation profitably on a full self-funding basis. The only state subsidy to the rail freight system is the provision of grants (of up to 60%) for the installation of rail sidings and acquisition of related equipment, where it can be demonstrated that environmental benefit will result from the use of rail rather than road. Since this 'Freight Facilities' Scheme was introduced in 1975 around 180 grants have been awarded worth, in total, about £70 million [63]. Traffic secured or retained by means of these grants accounts for around a fifth of BR's total freight tonnage and represents a diversion of approximately 3 million lorry loads per annum onto the rail network.

Regional Policy: Central government has, since the 1930s, tried to reduce wide regional variations in levels of unemployment and income. A key element in regional policy has been the improvement of road links to and within assisted areas such the North East of England, South Wales and Scotland. Overall, however, regional policy measures have achieved only a modest redistribution of the nation's manufacturing capacity. During the 1980s, the scope and resourcing of the government's regional development programme has been substantially reduced. No attempt has yet been made to assess the logistical impact of regional policy at a general level. Case studies have been used to show how firms encouraged/coerced to locate in peripheral areas have had to draw a large proportion of their supplies over long distances and incur higher transport costs in distributing the finished product [64]. Higher transport costs do not appear, however, to place such firms at a significant disadvantage [65]. Regional development grants were available for distribution facilities where their operators could prove that they had a geniune choice of location between an assisted area and the rest of the country. As this proved a difficult condition to satisfy, storage and distribution premises have received very little regional assistance.

Planning Policies: Central government has no short or long term plan for the development of logistical activities in the UK, other than a general commitment to ensure free and fair competition in the freight market and to expand and improve the road network.

The English counties and Scottish regions drew up 'structure plans' in the mid-1970s and subsequently updated them in the early 1980s. These set out the general framework for future development in their areas, though most made little specific reference to either freight transport or warehousing. A heavy demand for warehouse sites around the main strategic locations for distribution has prompted local planning authorities to impose restrictions on this type of development. Such policies have been defended on the grounds that warehousing has a low employment density, generates excessive volumes of lorry traffic and is often unsightly. Today, however, there is greater recognition in planning circles that warehousing/distribution facilities make an essential contribution to local economies and several local authorities are actively promoting their areas as good bases for distribution [66].

II.3 Information Technology (IT)

(i) Data Collection: There were around 100,000 electronic points of sale (EPOS) in retail outlets throughout the UK in 1987 [67]. This number is forecast to grow steadily to around 400,000 by 1993. Only about a third of large retailers have EPOS terminals, though it is anticipated that this proportion will rise to 80% by 1993. The continuous monitoring of the outflow of stock through EPOS terminals is enabling, inter alia, retailers to manage inventory more tightly.

The collection of data on inventory levels has also been greatly facilitated at shop, depot and factory levels by the use of portable data entry terminals (PDET), feeding information directly into computers. There are several examples of 'paperless warehouses' in the UK, though no comprehensive surveys have been done of the application of IT in warehousing.

The use of tachographs in lorries has been obligatory in the UK since 1981. Many firms now analyse tachograph records to measure the efficiency of their transport operations. Specialist agencies have emerged to undertake this analysis on firms' behalf.

Research into automated vehicle tracking systems using road-based sensors is well advanced in the UK [68], but there have as yet been no practical applications of this technology.

British Rail has operated a computerised freight traffic monitoring system, known as the Total Operations Processing System (TOPS), since the mid-1970s. A similar system (called COPS) is used by Freightliner to provide progress information about container movements. These systems are being integrated into the European-wide freight monitoring system, HERMES.

(ii) Data Transmission: The largest Electronic Data Interchange (EDI) system in the UK is TRADANET, managed by INS Ltd, a subsidiary of ICL/GEISCO. At the start of 1989, around 950 firms were linked into the network, and this number is expected to grow to around 5800 by 1993 [69]. Table 12 shows the sectoral break-down of firms connected to the Tradanet system. Separate EDI systems have been developed in the motor and pharmaceutical industries.

A government survey of 400 large and medium-sized firms in 1986 revealed that 80% had never heard of EDI, while 70% claimed to have no interest in this technology. This prompted the Department of Trade and Industry to launch its Vanguard Project with the aim of stimulating interest in EDI, particularly in a series of target sectors such as food wholesaling, electrical equipment, construction, pharmaceuticals, brewing and transport.

Large British exporters, freight forwarders and shipping companies are also joining international EDI networks. The British 'Article Number Association' is closely involved in the development of international EDI protocols and collaborating with its US counterparts in setting up the Joint Electronic Data Interchange (JEDI).

Table 12: Sectoral Breakdown of Firms Connected to the Tradanet EDI Network (Jan. 1989):

Sector	% of Firms
DIY, builders merchants, construction	29.3
Clothing	22.2
Food	10.9
Electronic/electrical equipment	8.7
Chemical,pharmaceutical cos., retail chemists	7.3
Publishing	5.0
Home shopping/mail order	3.6
Export/international transport	3.4
Public utilities	2.6
Other	7.0

Table 13: Growth in the Number of Distribution Software Packages, 1965-1988:

1965	10
1975	25
1980	60
1986	278
1987	335
1988	500

Table 14: Functions of Distribution Software Commercially Marketed in 1987.

Function	No. of Packages
Stock Control	203
Order Processing	196
Warehouse Operations	158
Transport Management	71
Importing and Exporting	56
Fleet Management	44
Strategic Planning	35

Source: ILDM `1987 Guide to Distribution Software'.

Table 15: Percentages of Firms Using Distribution Software.

Purpose	Cranfield study	Huddersfield Poly study
Vehicle Costing	20	33
Tachograph Analysis	4	25
Vehicle Maintenance	13	24
Fleet Management	6	18
Vehicle Scheduling	6	12
Other (incl Warehouse Management, Depot Location)	13	19

Source: Parkin and Probert, ref [74]

Table 16: Application of Distribution Software in the UK.

Function	No of UK Users	%
Strategic Planning	567	21.8
Fleet Management	484	18.6
Total Management	388	14.9
Import/Export	356	13.7
Stock Location/Rotation	218	8.4
Tachograph Analysis	208	8.0
Routeing/Scheduling	169	6.6
Route Networks	128	4.9
Operations	81	3.1

Source: ref. [76]

(iii) Data Processing: Table 13 shows how the amount of distribution software available in the UK has grown exponentially since the mid-1960s. In 1988, around 500 packages were commercially marketed [70]. The majority of packages in use in 1987 supported order processing and stock control functions (Table 14) [71]. More recently developed packages can simulate an entire distribution operation and be an invaluable tool in strategic planning. Elaborate software has also been developed to enable firms to simulate accurately the internal design and workings of warehouses prior to their construction or the installation of new operating systems [72]. Other models can simulate entire distribution systems allowing firms to assess the logistical implications of strategic changes, such as increasing minimum drop size or relocating depots [73]. Direct Product Profitability (DPP) packages now enable manufacturers and distributors to evaluate the contribution of individual products to profitability, attaching considerable weight to distribution costs. The main DPP package in the UK has been developed by the Institute of Grocery Distribution.

Recent surveys [74] have, nevertheless, indicated that most firms are making only limited use of IT in their transport/distribution operations (Table 15). This research may also exaggerate the level of usage as non-users of computers would be less likely to return the questionnaires. The demand for distribution software is, nevertheless, growing strongly [75]. Slater [76] found the main application of this software to be in the field of strategic planning, closely followed by fleet management (Table 16).

II.4 Human Resources/Education

It is estimated that around 10% of the British workforce was engaged in logistics in 1981 (excluding shop employees). Between 1971 and 1981, employment in the seven sectors most closely associated with logistics experienced a growth of 7%, in contrast to the decline of 4% in total employment [77]. Wholesale distribution (broadly defined to include distribution contractors as well as wholesale traders) is forecast to be the third largest source of new employment in the UK over the next few years [78], though it is likely that some of this employment growth will be achieved at the expense of job losses from manufacturers' and retailers' in-house logistical operations.

The Institute of Logistics and Distribution Management (founded in 1981 as the Institute of Physical Distribution Management and renamed in 1986) has around 6000 members. It organises conferences, branch meetings and short courses, and awards diplomas to managers passing its professional exams. Many transport and distribution managers belong to the longer established Chartered Institute of Transport, which performs a similar range of functions to the ILDM, but is less concerned with logistical activities other than transport.

Only two institutions currently run specialist degree courses in physical distribution/logistics. Huddersfield Polytechnic has an undergraduate course and Cranfield Institute of Technology a postgraduate MSc course. Logistics modules are also incorporated in some MBA programmes, MSc courses on transport and undergraduate courses in business studies. Concern has recently been expressed that British universities and polytechnics are not equipping enough graduates with the specialist skills required to manage distribution operations.

II.5 Research Effort

There is no national programme of research on logistics in the UK. The Transport and Road Research Laboratory (TRRL), which is funded by central government, has undertaken research on various aspects of the movement of freight, though has seldom given much consideration to the wider logistical framework. The National Materials Handling Centre at Cranfield Institute of Technology is the main centre for research on warehousing/handling systems in the UK.

The two main government-sponsored research councils with an interest in this area, the Science and Engineering Research Council (SERC) and Economic and Social Research Council (ESRC), fund research projects in the field of transport, though in recent years the study of freight movement has received little financial support. In 1985, the House of Lords Committee on Science and Technology reviewed current research on transport and concluded that the study of freight distribution merited greater funding from both public and private sources.

Research is currently being undertaken in British universities and polytechnics into a range of logistics-related topics including freight modal split, the impact of the Channel Tunnel, the implications of the Single European Market for transport and distribution, just-in-time systems, warehouse simulation models, information technology in road transport and the development of customer service policies.

Conclusion.

The management and operation of logistics in the UK has been transformed over the past 30 years. Many factors have promoted and/or facilitated this revolution in the way products are moved, stored and handled:

1. Conceptual change: a) growing recognition of the fact that logistical activities make an important contribution to competitiveness and profitability.
   b) gradual acceptance throughout industry of the principle that logistical functions should be planned, costed and managed integrally.
   c) increasing concern for the standard of customer service, which is largely a function of logistical support.

2. Technical change: adoption of management techniques, such as MRP, DRP and JIT, and application of OR methods in the fields of stock control, depot location and vehicle scheduling.

3. Technological change: particularly in the areas of information technology and materials handling.

4. Regulatory change: the liberalisation of the road haulage industry in 1970; increases in maximum lorry weights.

5. Infrastructural change: principally the development of the motorway network, RoRo and LoLo ports and inland container terminals.

6. Structural change in the economy: increasing resources and market power of multiple retailers, enabling them to exert greater control over the supply chain; growing tendency for firms to contract out logistical functions.

7. Socio-economic changes: mainly associated with increasing affluence. The rising level of car ownership and consumers' increasing propensity to buy less frequently in greater bulk from more distant shops has facilitated the concentration of retailing in fewer, larger outlets and the decentralisation of retailing within urban areas.

Most of these factors are still actively reshaping the logistical system. The modern principles of integrated logistical management and supporting range of technical skills are still diffusing through British industry. Logistical technology is still evolving and much of that currently available yet to be adopted by large sections of British industry and commerce. Major infrastructural improvements are in prospect with the government currently expanding its road development programme, the Channel Tunnel under construction and BR committed to some upgrading of track and terminals to handle Tunnel-related freight traffic. The structural changes outlined above are forecast to continue well into the 1990s. The main regulatory changes in the short- to medium-term will be the liberalisation of international road haulage in the EC and accompanying harmonisation of vehicle limits and taxation.

As the structure of the logistical system is strongly influenced by the pattern of retailing, future changes in shopping behaviour could have a major impact on the supply chain. The most radical change currently envisaged is a substantial growth in teleshopping, where people order goods electronically from their homes and have them delivered either to their doorstep or to a neighbourhood collection point. The recent experience of teleshopping schemes in the UK has, however, been disappointing [79], suggesting that conventional forms of retailing will continue, for the foreseeable future, to handle all but a small proportion of consumer purchases.

REFERENCES:

1. Ray,D.(1981) `Assessing UK Manufacturing Industry's Inventory Management Performance', Focus on Physical Distribution Management, no.27, 5-11

2. Christopher, M.C. (1981) `Logistics and the National Economy', International Journal of Physical Distribution and Materials Management, 11, 4, 1-29

3. New, C.C. (1976) `Managing Manufacturing Operations', BIM Survey Report no.35, British Institute of Management, London.

4. New,C.C. and Sweeney,M.T. (1984) `Delivery Performance and Throughput Efficiency in UK Manufacturing Industry', International Journal of Physical Distribution and Materials Management, 14, 7, 1-48.

5. Christopher, op. cit.

6. Pratten,C.(1985) Destocking in Recession, Gower, Aldershot

7. Waters,C.D.J.(1988) `How Effective is UK Inventory Management' in J.C. Cooper (ed.) `Logistics and Distribution Planning: Strategies for Management.' Kogan Page, London, 169-79.

8. Financial Times, 28th February, 1986.

9. Oakland, J.S. and Sohal, A. (1987) `Production Management Techniques in UK Manufacturing Industry: Usage and Barriers to Acceptance.' International Journal of Operations and Production Management, 7, 1, 8-37.

10. Ingersoll Engineers (1988) `Procurement, Materials Management and Distribution' Focus on Physical Distribution and Logistics Management, 7, 2, 12-21.

11. Voss, C.A. and Robinson, S.J. (1987) `Application of Just-in-Time Manufacturing Techniques in the United Kingdom' International Journal of Operations and Production Management, 7, 4, 46-52.

12. Unless otherwise stated, statistics presented in this section come from `Transport Statistics: Great Britain' or `The Transport of Goods by Road in Great Britain.', both published annually by HMSO.

13. Cundill,M.A. and Shane,B.A.(1980) Trends in Road Goods Transport, 1962-77, Supp.Report no.572, TRRL, Crowthorne

14. McKinnon,A.C. `The Growth of Road Freight in the UK' International Journal of Physical Distribution and Materials Management, 19, 4 (forthcoming).

15. ibid.

16. Department of Transport (1985) National Road Traffic Forecasts 1984. London.

17. Bayliss, B.T. and Edwards,S.L.(1970) Industrial Demand for Transport, HMSO, London

18. Pike,J.(1982) Major Factors Influencing Modal Choice in the UK Freight Market, Research Report no.52, Transport Operations Research Group, University of Newcastle upon Tyne

19. Fowkes, A.E., Nash, C.A., Tweddle, G. and Whiteing, A.E. (1987) 'Forecasting Freight Mode Choice' Focus on Logistics and Distribution Management, 6, 7, 20-28.

20. Department of Transport (1987) 'Policy for Roads in England: 1987' HMSO, London.

21. Financial Times, 30th March, 1989.

22. Cooper,J.C. and Doganis,R.S. (1982) 'The Economics of Demountables in Distribution' Research Report no. 7, Transport Studies Group, Polytechnic of Central London.

23. MIL Research Ltd. (1986) 'The Commercial Vehicle Market: Who, What, Why, Where.' Business Press International, London.

24. British Business, 17 July 1987 (Department of Trade and Industry, London).

25. McKinnon, A.C. (1982) 'Distribution by Rail in the United Kingdom', Geography, 67, 1, 51-4

26. Steer, Davies and Gleave Ltd. (1989) The Right Tracks to Europe: The Regional and Environmental Impact of the Channel Tunnel. Transport 2000, London.

27. McKinnon, A.C. (1986) 'The Physical Distribution Strategies of Multiple Retailers', International Journal of Retailing, 1, 2, 49-63

28. Simpkin,L.P.,Maier,J. and Lee,W.M.(1987) 'PDM and Inventory Management', Retail and Distribution Management, 15, 1, 57-59

29. NEDO (1985), Factors Affecting the Cost of Physical Distribution to the Retail Trade, Unpublished report, EDC for the Distributive Trades, London.

McKinnon, A.C. (1985) 'The Distribution Systems of Supermarket Chains', Service Industries Journal, 5, 2.

30. McKinnon,A.C. (1986) `Multiple Retailers' Distribution Strategies: Effects on Patterns of Land Use and Traffic Flow' The Planner, 72, 7, 16-20.

31. Rushton,A.(1979) Improving Goods Delivery, National Materials Handling Centre, Cranfield

32. McKinnon, A.C. (1987) `Recent Trends in Warehousing Location' in J.C. Cooper (ed.) `Logistics and Distribution Planning: Strategies for Management.' Kogan Page, London, 120-31.

33. Williams,J. `Automated Storage and Retrieval Systems' Logistics Today, 1, 2, 4-6.

34. Frost and Sullivan (1988) `Automated Materials Handling Systems in Europe' London (Report summarised in Materials Handling News, May 1988).

35. Anon (1986) `Automated Warehousing: Opting for the Evolutionary Approach', Retail and Distribution Management, 14, 4, 49-53

36. Scott,C. and Cooper,J.C.(1985) `Hub Operations in UK Parcels Distribution', Logistics Today, 4, 4, 4-10

37. e.g. Watson-Gandy, C. (1987) `Planning the Location of Depots' in Cooper,J.C. (ed.) Logistics and Distribution Planning: Strategies for Management, Kogan Page, London, 120-31.

38. Stoker,R.B.(1978) `Incorporating Market Characteristics into Physical Distribution Models', European Journal of Operational Research, 2, pp.232-45

McKinnon,A.C. (1989) Physical Distribution Systems. Routledge, London.

39. Childerley,A.(1980) `The Importance of Logistics to the UK Economy', International Journal of Physical Distribution and Materials Management, 10, 4, 185-92

40. McKinnon,A.C. (1988) `National Expenditure on Logistics in the UK' Focus on Physical Distribution and Logistics Management, 7, 8, 23-7.

41. Delaney,R.V. (1984) `Distribution Productivity: Old Myths and New Realities' paper cited in Coyle,J.L., Bardi,E.J. and Langley,C.J., The Management of Business Logistics, West Publishing Co., St. Paul.

42. O'Brien,J.(1987) `1986/7 Distribution Cost Survey', Focus on Physical Distribution and Logistics Management, 6, 5, 3-6

43. Whitehead Consulting Group Ltd.(1974) A National Survey of Physical Distribution Management, London

44. McKinnon, A.C. (1986) 'Distributing Imported Goods To British Consumers', Retail and Distribution Management, 14, 5, 86-91

45. Davies,G.(1984) Managing Export Distribution, Heinemann, London

46. Centre for Physical Distribution Management (1984) 'Survey of Current Practices: UK Exporters to Europe', Focus on Physical Distribution Management, 3, 6, 3-5

Davies,G., Fitchett,J. and Gumbrell,K. (1988) 'The Benefits of Delivered Pricing' European Journal of Marketing, 22, 1, 47-56.

47. Department of Transport/British Ports Association (1986) Transhipment of UK Deep Sea Trade, London.

48. PIEDA (1987) Eurowestport: Pre-feasibility Study. Clyde Port Authority, Glasgow.

49. PIEDA (1989) Channel Tunnel: the Impact on Scotland. Scottish Development Agency, Glasgow.

50. Maeso-Castrillon,J. (1987) 'The Liberalisation of Cabotage Restrictions in the EC and its Impact on the UK Domestic Road Haulage Industry.' Unpublished MSc. Dissertation, Polytechnic of Central London.

51. Cooper,J.C, Browne,M. and Gretton,D. (1987) Freight Transport in the European Community: Making the Most of UK Opportunities, Transport Studies Group, Polytechnic of Central London.

52. Whitehead Consulting Group Ltd., op.cit.

53. Kearney, A.T. Ltd. (1980) Improving Productivity in Physical Distribution, CPDM, London

54. Bowersox, D.J. and Daugherty,P.J.(1987) 'Emerging Patterns of Logistics Organisation' Journal of Business Logistics, 8, 1, 46-60

55. McKinnon, A.C. (1988) 'Physical Distribution' in Marshall,J.N. et al., Services and Uneven Development, Oxford University Press, Oxford, pp.133-160.

56. McKinnon (1986) 'Distributing Imported Goods to British Customers', op.cit.

57. The Grocer, 19th July, 1986.

58. Kitcat and Aitken (1987) Distribution - A Revolution in Motion. London.

59. Cooper et al., (1987) op.cit.

60. McKinnon, A.C. (1989) Physical Distribution Systems, op.cit.

61. Green,M. (1988) 'Distribution Cost Survey.' Focus on Physical Distribution and Logistics Management, 7, 7, 3-7.

62. Christie, A.W., Prudhoe, J. and Hornzee,R.S.(1982) Dykes Act Lorry Controls: Their Use and Effects, Lab.Report no.1058, TRRL, Crowthorne

63. McKinnon,A.C. (1989) `Rail Freight Facilities Grants: Past Trends and Future Potential' ILDM Yearbook, Kogan Page, London. 97-100.

64. Watts, H.D. (1981), The Branch Plant Economy: A Study of External Control, Longman, London.

65. PIEDA (1984) Transport Costs in Peripheral Regions. ESA Research Paper no.9 Industry Department for Scotland, Edinburgh.

66. Buchanan,C. and Partners (1986) Warehouse Development Trends, Department of the Environment, London

67. ICL Ltd. (1987) Retailing Today, ICL, Slough.

68. Davies,P., West,P.O. and Schmitt,L.A. `Automatic Vehicle Identification for Transportation Monitoring and Control' in Transport for Tomorrow's Transport Requirements, Proceedings of the World Conference on Transport Research. Centre for Transportation Studies, Vancouver.

69. ICL Ltd., op. cit.

70. Willmott,A. (1988) `The 1988 Distribution Software Guide' Focus on Physical Distribution and Logistics Management, 7, 5, 38-40.

71. Institute of Logistics and Distribution Management (1987) 1987 Guide to Distribution Software, Corby.

72. Clarke,M. (1989) `The Evaluation of Materials Handling Systems: Warehouse Simulation - Challenge of the 1990s.' ILDM Yearbook, Kogan Page, London.

73. Slater,A. (1986) `A CALM Approach to Distribution' Focus on Physical Distribution and Logistics Management, 5, 5, 8-14.

74. Parkin, J. and Probert, S. (1987) `Information Technology in Road Haulage and Distribution' Focus on Logistics and Distribution Management, 6, 8, 14-26.

Peters,M. (1988) `Information Technology in Distribution' in Cooper,J.C. `Logistics and Distribution Planning: Strategies for Management.' Kogan Page, London, 218-31.

75. Willmott, op.cit.

76. Slater, A. (1986) Handbook of Physical Distribution Software, Kogan Page, London.

77. McKinnon, A.C. and Pratt, A.C. (1985) Jobs in Store: An Examination of the Employment Potential of Warehousing, Occasional Paper no.11, Dept. of Geography, University of Leicester

78. Rajan,A. and Pearson,R.(1986) UK Occupational and Employment Trends to 1990: An Employer-Based Study of the Trends and Their Underlying Causes, Butterworths, London

79. McKinnon, A.C. (1989) Physical Distribution Systems, op.cit.

Logistics in Sweden

by

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Introduction

Geographical Background

Sweden has a total area of 410 928 sq km. As regards size, it means that Sweden is one of the largest countries in Europe. However, considering the number of inhabitants Sweden has a less outstanding place. In 1986 the population was 8 381 515, which in turn means a density of population of 20.1[1] inhabitants per sq. km. But two thirds of the population lives in the middle and the south parts of Sweden.

Figure 1 shows the geographical position of Sweden in Europe and the characteristics of the country. The most distinguished of these are the long and narrow shape, the fact that it is separated from its largest market, EEC, with water barriers, and the transport on the Baltic as well on land is disturbed by ice and snow during a large part of the year.

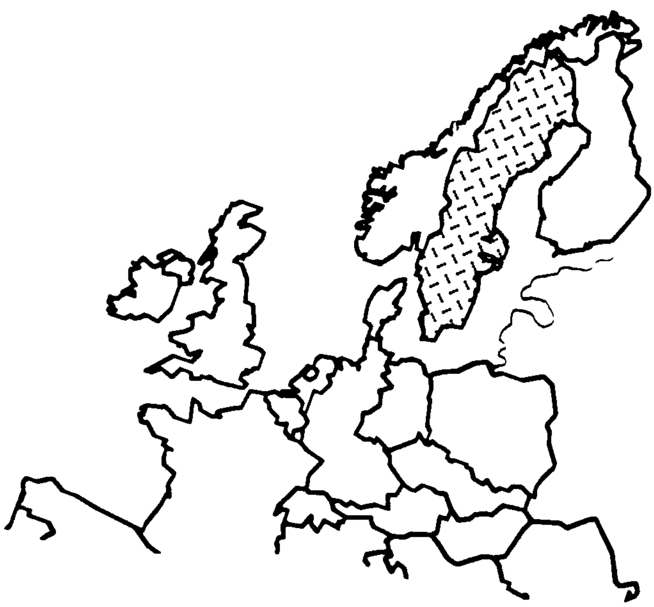


Figure 1 The Geographical Position of Sweden.

[1] Statistical Abstract of Sweden (1988, p 31).

Economical Background

In 1985 Sweden had a GDP of 763.4 millions of SEK. Per capita the GDP was 91 400 SEK[1] which is about 10 % above the OECD average of 81 600 SEK[2].

During the twentieth century the share of occupation in the agricultural and forestry sector has stepwise decreased, figure 2.

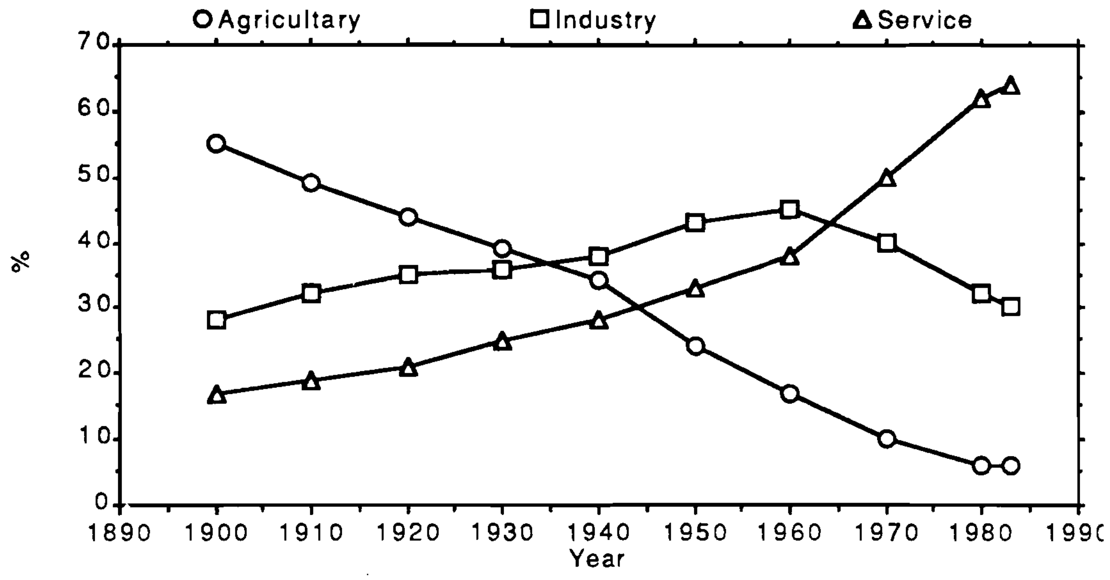


Figure 2 The Share of Employment by Sectors in Sweden.

At the same time in the service sector, trade, communications, private and public services, increase significant of the share of occupation. The share of the industry sector increased to the first year of 1960, then there was a trendbreak and the share started to decreased.

Sweden is an open economy. It is indicated by the share of the export of the GDP. The rate of export in market price in 1986 was approximately 28 %. If we look at the share of import, the average rate was 35 %.

1 SCB National accounts; Statistiska meddelanden, serie N.
2 Statistical Abstract of Sweden (1988, p 494).

Earlier, raw materials and semi finished goods such as ore and pulp were very important to the Swedish export, but today goods with high value added dominate the export, and the manufacture of fabricated metal products is the most important sector. This change has occurred during the last twenty years. In 1960 the manufacture of fabricated products accounts for 25 % of the Swedish export, and twenty years later more than 50 %.

More than 50 % of the Swedish export is destinated to traditional markets, especially to the Scandinavian countries and the EEC. EFTA and EEC countries constituted together two thirds of the value of trade in 1979 as well as 1984. The corresponding quantity of shares are 67 and 71 per cent respectively. The share of import from these countries has increased considerably due to the fact that Sweden has changes suppliers of oil from the Middle East to Norway and Great Britain. However the shares of export have decreased somewhat. The European countries consequently forms an essential market for Swedish trade.

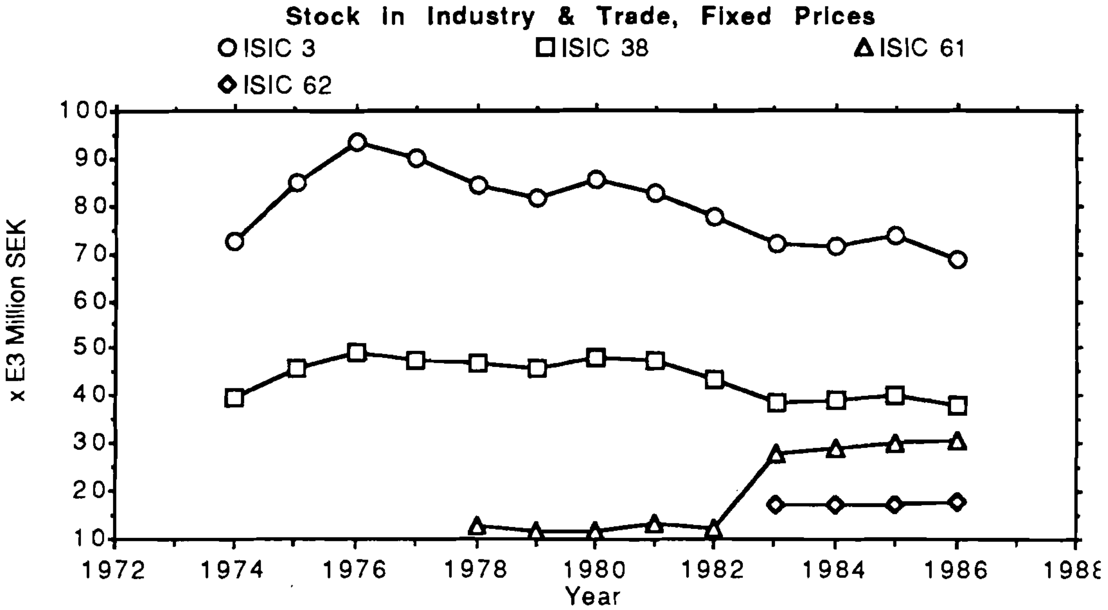
Compared to the competing countries within the OECD Sweden has, during the last ten years, lost shares of export on the world market. A great part of the decrease is due to a relative increase in labour cost per unit. In the long run the shares of export to Asia and also to the United States will hopefully increase.

Roughly speaking it is considered that the manufacturing industry has consolidated its market in Europe and expanded gradually in the United State, South America and the Far East. The trend is toward using more refined products in the manufacturing industry. The export of the wood industry to Europe, where it is firmly established, is expected to more or less keep it market shares.

I. Physical Logistics Structures

I.1 Inventories in the National Economy

Figure 3 shows the inventory development in some sectors of the Swedish economy. During a period of ten years both ISIC 3 and ISIC 38 have a downwards trend in the volume of the total inventory. The Swedish trade of ISIC 61 and ISIC 62 show in contrast to the manufacturing sector a more constant and a weak increase of the inventories. Noticeably, is the development of the wholesales volume of inventory between 1982 and 1983, during which years a three times increase volume has occurred. The official statistics gives no comments of what has happened. What we know is that the calculation of the fixed inventory volume is based on the index of producers prices.

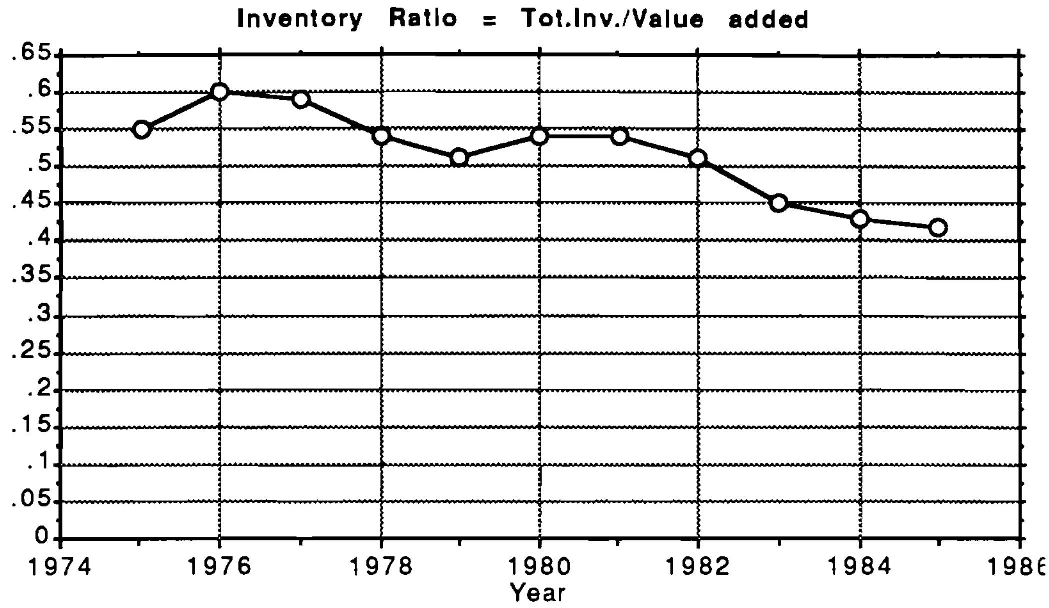


Source: Industrial Statistic, SCB Stocks Industry I 1977:2.2, I 1978:2.5, I 1982:4.1, IB 10 SM 8502

ISIC 3 Manufacturing, ISIC 38 Manufacture of fabricated metal products, machinery and equipment, ISIC 61 Wholesales trade, ISIC 62 Retail trade.

Figure 3 Stocks in Industry and Trade, In Fixed Prices (1980).

Figure 4 gives us the general picture of recent inventory trends in the Swedish manufacturing industry, ISIC 3. It shows the development of the inventory ratio (total inventories divided by value added of production).

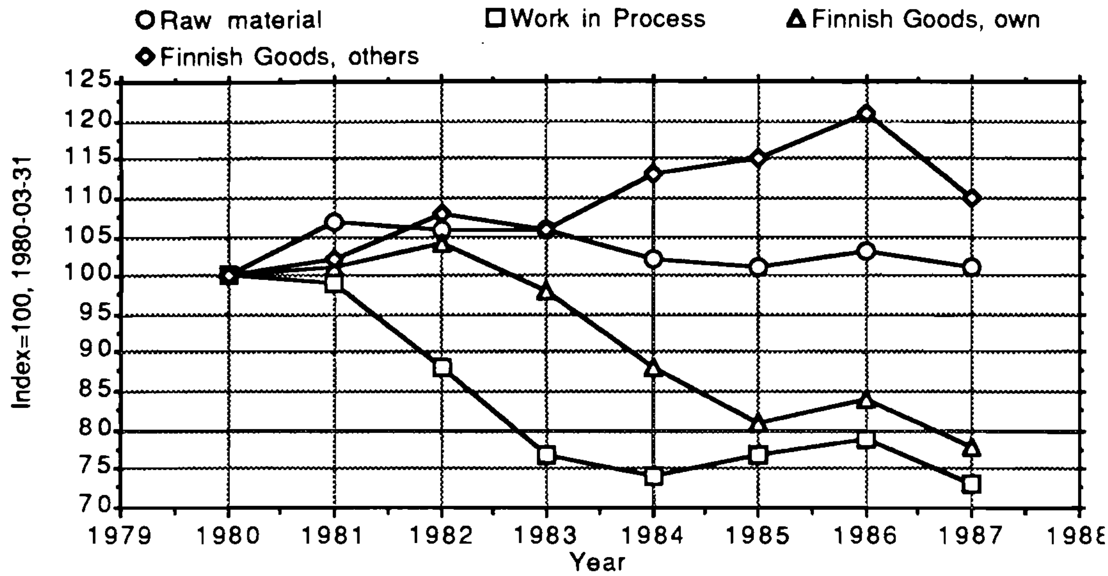


Source: Industrial Statistic, SCB Stocks Industry I 1977:2.2, I 1978:2.5, I 1982:4.1, IB SM 8502, Industry 1975 - 1985

Figure 4 Inventory Ratio in Manufacturing Sector, ISIC 3.

We can observe that the inventory intensity at an aggregated level has decreased over a period of ten years. However this ratio could have been affected by the structural changes in the manufacturing industry in Sweden. The increase in specialization at each plant should have reduced the ratio, while the growth of metal and mechanical industry should have increased the inventort/value added ration.

Figure 5 shows the structural development of the inventories in ISIC 3, manufacturing sector, between 1980 and 1987 in fixed prices (1980=100).The most dramatic inventory changes have taken place in finished goods of companies own production, as well as work in process, while raw material stock have been almost constant over this period of time.



Source: Industrial Statistic, SCB Stocks Industry I 1982:4.1, IB 10 SM 8502, IB 10 SM 8702

Figure 5 The Structural Development of the Inventories in the Manufacturing Sector, ISIC 3.

Let us now look somewhat more closely at the different sectors in the manufacturing industry. Table 1 shows the total inventory turnover in days in 1975, 1980, and 1985. This twenty-six sectors represented in 1985 72 % of the value of production, 80 % of the number of workers, and 78 % of the total inventories of the entire manufacturing industry.

ISIC	Sector	Year	Total	Change, +.-	
3	Manufacturing	1975	169		
		1980	154	- 8.8	
		1985	116	- 24.6	(- 31.4)
311	Food	1975	41		
		1980	46	+ 12.2	
		1985	44	- 4.4	(+ 7.3)
313	Beverages	1975	166		
		1980	116	- 30.1	
		1985	78	- 32.8	(- 53.0)
321	Textiles	1975	151		
		1980	194	+ 28.5	
		1985	168	- 13.4	(+ 11.3)

322	Clothes	1975	151		
		1980	163	+ 7.9	
		1985	186	+ 14.1	(+ 23.2)
323	Leather	1975	186		
		1980	149	- 19.9	
		1985	136	- 8.7	(- 26.9)
324	Footwear	1975	118		
		1980	150	+ 27.1	
		1985	161	+ 7.3	(+ 36.4)
33111	Sawing	1975	*		
		1980	142	*	
		1985	113	- 20.4	(*)
332	Furniture	1975	113		
		1980	134	+ 18.6	
		1985	142	+ 6.0	(+ 25.7)
34111	Pulp	1975	*		
		1980	99	*	
		1985	104	+ 5.1	(*)
34112/3	Paper & Wall Board	1975	*		
		1980	57	*	
		1985	51	- 10.5	(*)
3412/9	Paperpacking	1975	91		
		1980	95	+ 3.4	
		1985	67	- 29.5	(- 26.4)
342	Printing	1975	59		
		1980	65	+ 10.2	
		1985	64	- 1.5	(+ 8.5)
351	Chemicals	1975	101		
		1980	87	- 13.9	
		1985	71	- 18.4	(- 29.7)
355	Rubber	1975	153		
		1980	131	- 14.4	
		1985	103	- 21.4	(- 32.7)
356	Plastic	1975	76		
		1980	101	+ 32.9	
		1985	96	- 5.0	(+ 26.3)
361	Pottery	1975	236		
		1980	293	+ 24.2	
		1985	248	- 15.4	(+ 5.1)
362	Glass	1975	155		
		1980	147	- 5.2	
		1985	139	- 5.4	(- 10.3)
369	Mineral	1975	123		
		1980	116	- 5.7	
		1985	109	- 6.0	(- 11.4)

371	Iron & Steel	1975	257		
		1980	234	- 8.9	
		1985	121	- 48.3	(- 52.9)
372	Non-ferrous	1975	130		
		1980	111	- 14.6	
		1985	101	- 9.0	(- 22.3)
381	Metal products	1975	176		
		1980	230	+ 30.7	
		1985	153	- 33.5	(- 13.1)
382	Machinery	1975	300		
		1980	338	+ 12.7	
		1985	200	- 40.8	(- 33.3)
383	Electrical machinery	1975	303		
		1980	318	+ 5.0	
		1985	287	- 9.7	(- 5.3)
3841	Shipbuilding	1975	380		
		1980	510	+ 34.2	
		1985	463	- 9.3	(- 9.2)
385	Instrument	1975	288		
		1980	246	- 14.6	
		1985	145	- 41.1	(-49.6)

Source: Borg, Pirtillä (1988)

Table 1 Inventory Turnover Times, in Days, in Sweden 1975, 1980, and 1985. Values in Parenthesis are the Difference between 1975 and 1980. (values marked by "*' were not available).

One thing we can observe is that the total levels of the inventory turnover differ between the sectors. Between the highest and the lowest level the difference is more then eight times as big. Some explanatory factors can be given[1]:

1. Many of the companies have a high share of export. It amounts to 80 to 90 % of the total turnover. Swedish companies are at a long distance from their market which for instance means that the lead time from order to delivery to the customer is long. This causes the manufacturer to increase their output inventory in order to be able to keep pre-arranged dates of delivery.

2. Because of the uncertainty in the market the total inventory stock is higher than normal. Totally this makes the inventory turnover low.

3. The considerable difference in inventory turnover level is caused by the production technology in the sector. Industries with process technology has lower inventory turnover in days than sectors with mainly batch production.

[1] Borg, Pirtillä (1988).

4. Within the Swedish industry great efforts have been made to reduce the capital of goods. A drastic reduction in the inventory levels have been reported for parts of plants or individual business units in Sweden caused by the introduction of new manufacturing and logistics techniques[1]. The best principle seems to be first to simplify the material flow with flow shop layout and JIT inside the plant, then to automate with robots, FMS, and other CIM technologies.

Some other causes are suggested[2]:

5. In 1976 the Swedish government subsedized the industry it they build up inventories with the purpose of keeping the level of unemployment low.The companies needed longer periods of time than usual to reduce the inventories and many of them stored too too much of the wrong products, which, naturally, caused problems.

6. The real rate of interest. The cost of borrowed capital i.e. the interest rate minus inflation, increased drastically from the beginning of the seventies and onwards. The rentability of measures taken to reduce the capital tied up increased therefore considerably.

7. Solidity. Apart from the cost of borrowed capital, the negative trend of the solidity in Swedish industry has also influenced the development .

8. Profitablity. The poor profitability in Swedish industry calculated as returns on own capital.

In a study of the 77 of the most important Swedish companies during the period 1965 - 77 there was a need of 0.33 SEK in capital of inventory for each of turnover SEK[3]. During the period 1983 to 1984 the corresponding relation was 0.23 SEK, figure 6. This reduction is equivalent with 33 % less inventories or 50 000 million SEK less capital if adjusted for expected impacts of business cycles. These large companies gained approximately 6 % lower production cost via the lower inventories, if all other costs were equal and inventory cost we assumed to be 30 %.

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[1] Wandel (1988a).

[2] Karlöf et al. (1986).

[3] Karlöf et al (1986).

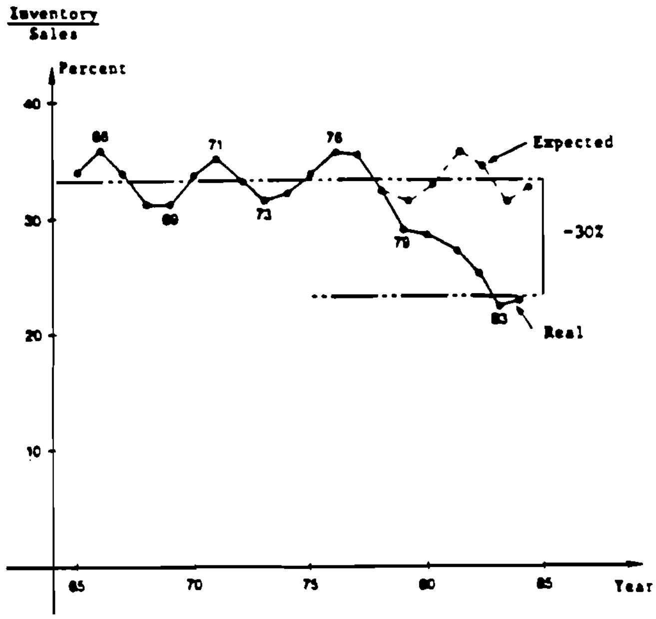


Figure 6 Inventory/Sales Ratios for the 77 Largest Companies on the Swedish Stock Exchange. (Karlöf et al 1986, p 73)

A list of the top eight Swedish companies in inventory reduction looks like this:

Company	Product	% Reduction 1975 - 85
Nobel	Chemical	62
Sandvik	Metal	50
SKF	Rollbearing	43
Atlas Copco	Drills	41
Ericson	Telecom	40
SCA	Pulp Paper	35
Volvo	Car, Trucks	33
SAAB Scania	Car, Trucks, Aircraft	33
Electrolux	White Products	29

Source: Karlöf et al (1987, p 85)

I.2 Transportation Systems

Infrastructure and Operator Structure

The Road Network

In Sweden the government, the municipalities, and private groups are each responsible for their parts of the road network.

In 1986 the Swedish Road Administration was responsible for 98 174 km of public roads. And it offers financial resources for construction and maintenance of the most important municipal roads.

The total length of the public road network can be divided up by the type of surface used. In 1987 the distribution was approximately 46 % asphalt roads, 24 % oil graveled roads, and 31 % gravelled roads. Between 1950 and 1986 the total length of the network increased from 90 000 km to some odd 98 000 km. In 1950 only 7 % of the public road network was surfaced. During the 1960´ies the share of surfaced roads increased considerably, mostly due to the fact that the oil gravel started to be used this time.

Also, since 1950 the carrying capacity of the road network has increased due to increases in the allowed maximum axle loads. This rise was caused by on one hand of improvement of the road surface, and on the other hand on the capacity of the embankments. The limitation of the capacity of bridges and road overpasses is the main restriction to further increase in the carrying capacity of the road network.

The maximal length for truck and trailer combinations is 24 meter, which is considerable longer than 18 meter in EEC and 22 meter in Finland. The maximal gross weight is 52.4 ton.

The traffic flow on the public road network are concentrated to the most important roads, and around the big cities.On the public roads the average of the traffic flow amounts to

1 000 pairs of axles per twenty-four hours. In the county of Stockholm the traffic flow is approximately 3 000, while in the north part of Sweden and on the island of Gotland it amounts to about 500 pairs of axles per twenty-four hours[1].

The long haul trading is dominated by three forwarders and short haul by small lorry centrals. Most operators have one or a few lorries. However, larger operators are increasing their market shares.

Railway Network

In 1986 the total length of lines amounted to 11 715 km. Out of this lines, 64 % were electrified. During a period of ten years the length of lines decreased by 3 %. Regarding the rolling stock, in 1986 the freight carrying cars were 37 824, which is a reduction of 23 % since 1976. The total loading capacity was, in 1986, more than 1 million tons distributed between covered cars and open cars, 28 % and 72 % respectively. In 1988 the Swedish Road Administration was divided into two separate organizations one responsible for the infrastructure, the other for operations and the rolling stock.

Sea Transport and Ports

Since the Second World War the Swedish merchant fleet has expanded dramatically.

During the latter part of the 1960´ies and the beginning of the 1970 ies the Swedish merchant fleet suffered an extensive structural change and reduction partly due to the relatively increase in labour costs.

The aim was to reach large economy of scale advantages for ships, material handling, and harbour facilities. Large amounts of money were invested in transportation systems which consisted of containers and other unit load freight carriers. The specialization had far-reaching consequences for the structure of Swedish harbours. Furthermore restructuring involves extensive international cooperation between Swedish and foreign shipping companies. Today Swedish shipping companies are among the most modern in the world. The major part is engaged in international traffic, which is of great importance to the Swedish balance of trade.

[1] Transportrådet (1982:4)

In Sweden there are approximately 250 harbours, but only 25 of them are used as harbours for the Swedish trade. Since almost all harbours are run by the municipals there is an oversupply of harbours. There is an oversupply of ports facilities which partly due to the fact that municipals are responsible for the most parts.

Since the increase of the minimal volume of goods required to keep up direct calls of liner shipping, the diversified harbours serves as central harbours for a large surrounding area. For instance, the harbours in Gothenburg and Helsingborg serve as central harbours. Compared to the harbours for special goods, the diversified harbours have increased their market share, as a consequence of the good service they can offer their customers. Another cause to the increase in the market share is that the liner shipping has at many harbours ceased of the development of land transport and the establishment of container traffic .

Airports

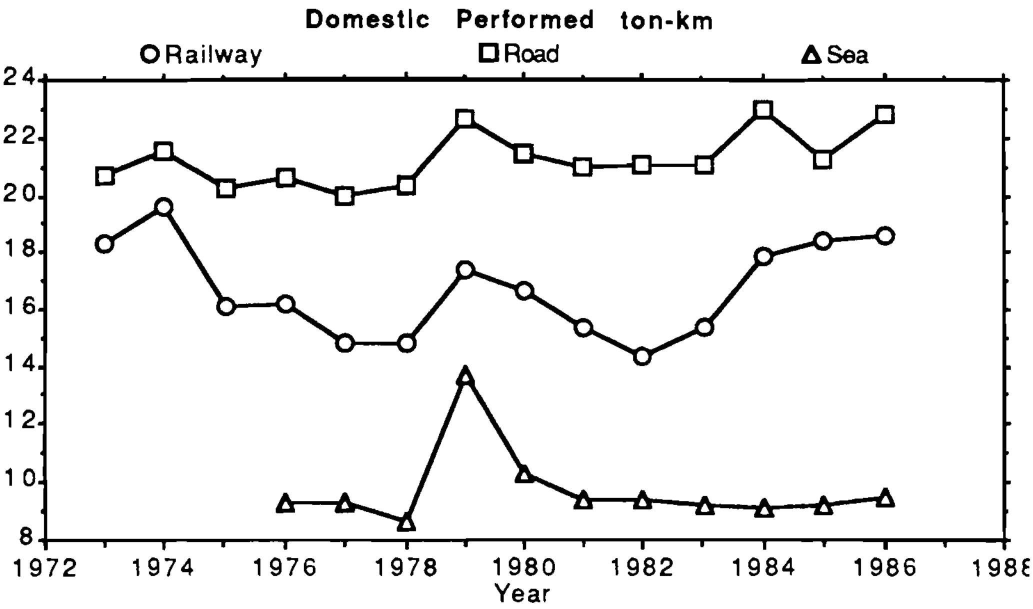
The Swedish domestic air transport is dominated by Scandinavian Airline System, SAS, Linjeflyg, LIN. However, several smaller airlines have increased their market shares due to the growth in regional air routes.

In Sweden there are governmental, municipal, military, and private airports. Most part of the airports are municipal, while the airports of most importance are governmental. 14 of the airports are run by the governmental, and 31 are under municipal concern.

A General View of Goods Freight

In 1986 the amount of the total domestic performed ton-km was 50 900 million. During most of the 1970 íes the ton-km increased and in 1979 reached 53 300 million. Between 1980 and 1983 the ton-km decreased somewhat, but in 1984 it was still 50 000 million to-km.

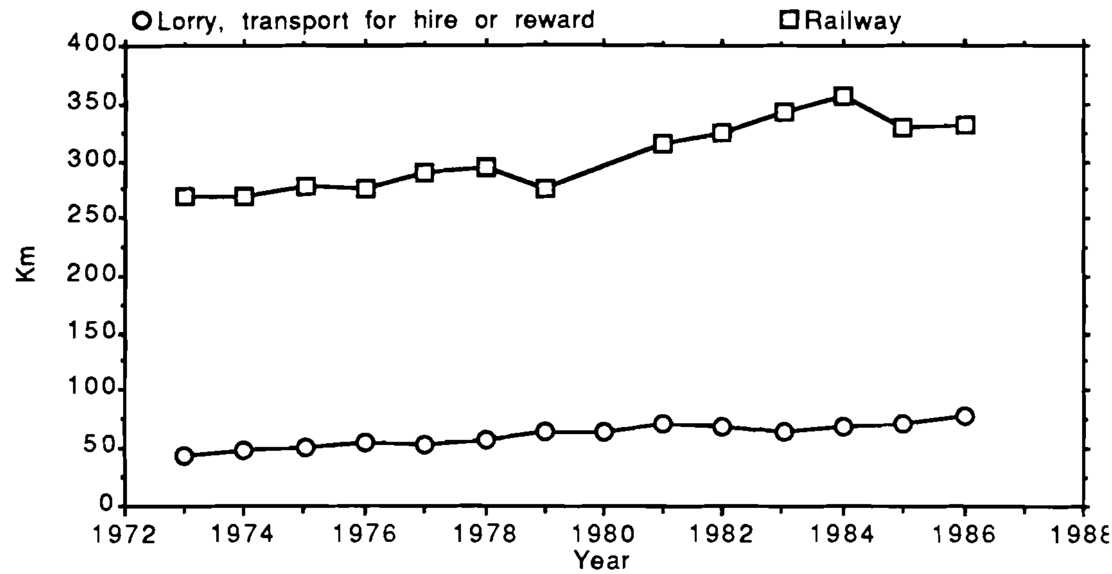
Figure 7 shows the development of the domestic performed ton-km between 1973 and 1986.



Source: Transportrådet (1982, 1983) and SCB (1985).

Figure 7 Domestic Performed Ton-km in 1973 - 1986.

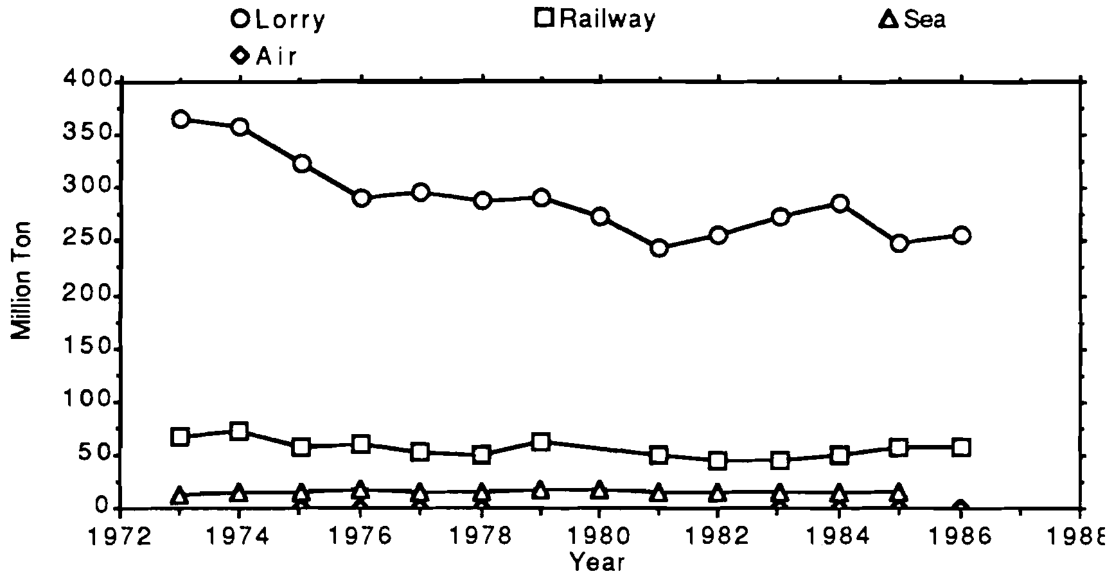
More precisely, 45 % of all performed ton-km in Sweden in 1986 were performed by lorries. In relation to transported goods in ton, it is more than 85 %, due to a large amount of short haulage. In the same year the railway transport stands for 36.3 %, and the sea transport for 18.6 % of performed ton-km. Compared to the long-distance-road transport, over the distance of 100 km, the share of performed ton-km was nearly the same as for rail transport. The ton-km in the domestic air freight is still rather insignificant, but satisfies however an important function when high speed is required. The trend for air freight is that spare parts and high-value goods dominate the volume of freight.



Source: SCB Statistical Abstract of Sweden (1980 and 1988).

Figure 8 Mean Haulage Distance, km.

Figure.8 shows the mean haulage distance for road transport and rail transport. The distance for both of the transport modes has increased. As regards road transport the mean haulage distance has increased from 44 km in 1973 to 78 km in 1986. Average increase per year has been approximately 5 %. As for rail transport it has increased from 296 km in 1973 to 331 km in 1986. Here the average increase is more moderate with only 2 % per year.



Source: SCB Statistical Abstract of Sweden (1980 and 1988).

Lorry, transports for hire or reward.
Railway, domestic traffic.
Sea, loaded to inland ports.
Air, loaded cargo in domestic traffic, average 0.006 per year.

Figure 9 Goods Carried in Million Ton.between 1972 and 1986.

Figure 9, above, shows the goods transported in ton during the same period, 1973 to 1986. For road transport as well as rail transport, the transported goods in ton have decreased. For road transport it means a decrease from 366 million ton in 1973 to 257 million ton in 1986. On the average per year it is a reduction of 4 %. For rail transport the transported volume of goods was 68 million ton in 1973 and in 1986 it was 56 million ton. It is less a than 1 % decrease each year.

Sea transport of domestic freight, loaded to inland ports, is rather constant over the fourteen years. The variation has been between 13 and 17 million ton.

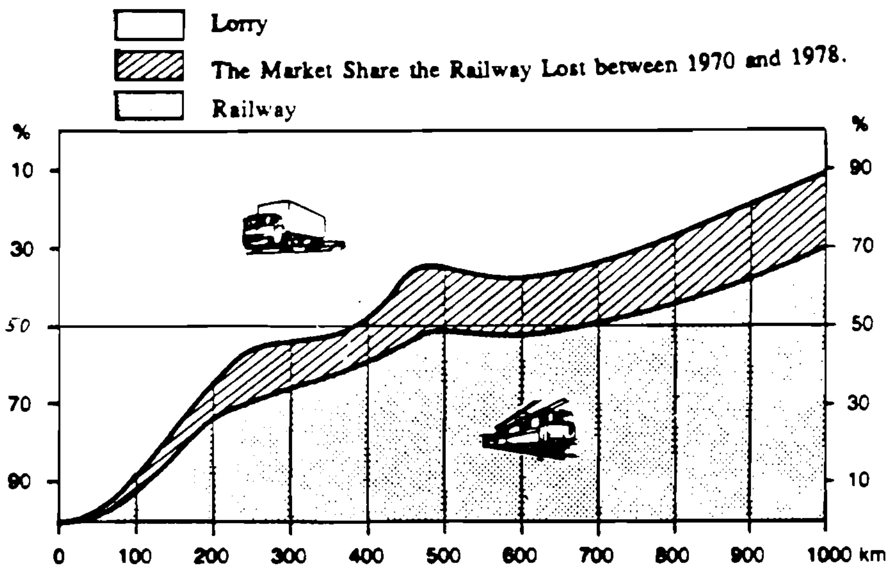
The share of air freight has, during the same period of time increased more than 65 %.

Modal Split

Regarding different means of transport, many projects clearly shows that there has been a shift in market shares.

Since the 1970'ies there has been a shift from rail transport to road transport. And there has been a shift from sea transport to rail and road transport. What we can see is that fast transports with a regional network has acquired market shares from modes with low speed and coarse network.

Figure 10 shows how railway transport lost market share to road transport also in very long distance haulage. During recent years the development has changed and railway transport now has a somewhat lower market share than road transport in distances over 100 km[1].



Source: Lumsden (1986, p 24) and Transportrådet

Figure 10 The Relative Market Share in Ton-km for Railway and Road Transport in Different Transport Distances in 1970 and 1978, excl. ore.

Noticeably the road transport also compete with very long distance transports. The fight between road and rail is not only caused by the distance, it is also caused by the weight and type of goods. The market share of the rail transport are especially high for wood

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[1] Lumsden (1986).

products and distances over 300 km. The market share are very low for food, building material, and fabricated metal products, machinery, and equipment. This is true also at long distances.

Concerning the sea transport, it is principally from the continental traffic that road and rail transport took market shares. Between 1979 and 1977 the share of sea transport in the international traffic decreased from 70 to 60 %. It was not due to a redistribution between the transport modes, but the fact that there occurred a new demand of transport which could be satisfied by high speed transport[1].

The future development depends, on one hand on the growth of the total demand, and on the other hand on the change of the supply of transport. An important factor in this context is the economical development and especially the prices of fuel. Other causes are the possibilities for the traffic companies to utilize and market the available resources in the best way.

In the international trade the modal split is very interesting and clear.
The following table, table 2, shows the mode of transport in the international trade in 1986, (excl ore and oil).

Mode of Transport	Export		Import		
	Ton	Value	Ton	Value	
Sea Transport	62	36	66	26	
Railway	14	9	11	26	
Road Transport	24	49	22	57	
Air Freight	0.1	6	0.1	8	
	100	100	100	100	%

Source: Kommunikationsdepartementet (1987) and Statistiska Meddelanden Serie T

Table 2 The Mode of Transport in the International Trade in Sweden in 1986.

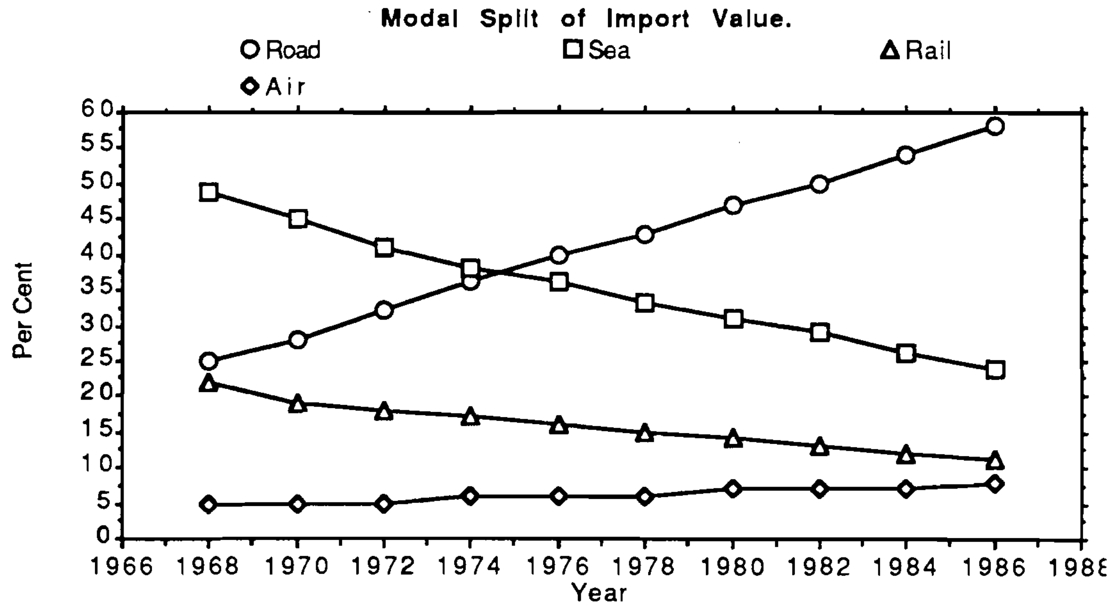
This table shows that nowadays road freight is the most important mode of transportation in terms of the value of the goods transported in the international trade while air freight constitute a transport service of the same value as the railways.

[1] Lumsden (1986).

On the basis of these facts it is possible to compare the market shares for sea transport and railway on the one hand and road freight and air freight on the other hand. The latter two modes of transport represent not only the modern system for high value goods,but also form part of the most advanced combined systems of transport in Europe[1].

Inclusive international sea transport along the Swedish coast the total transportation in Sweden runs up to more then 70 milliards of ton-km. Short way distance by road freight (less then 10 km) correspond to 10 per cent, long way distance to 50 per cent and international long way distance freight to 40 per cent of the total transportation. Of the domestic transport, the road freight transport stands for 55 per cent, railway transport for 33 per cent and sea transport for 12 per cent. The share of road freight transport stands for approximately 15-20 per cent (in ton) of the exported goods and less then 15 per cent of the import. The freight of sea transport stands for more then 65 per cent of the export, while its share of import, which depends on the procurement of oil, approximately 80 per cent.

Figure 11 shows more in detail the development of the modal split between 1968 and 1986, expressed in import value. Together with air freight the road transport has taken more and more of the market share.



Source: Wandel (1988a) and Statistiska Meddelanden Serie T

Figure 11 Modal Split of Import Value.

[1] Kommunikationsdepartimentet (1987).

I.4 Warehousing, Materials Handling and Packaging

Warehouse

In the rate of deprecation used is 4 % in order to calculate the capital cost[1] for investments in warehousing, the following trend is seen[2] in table 3. In same table calculating the area has been used, with the basis of figures about investments in warehousing, we reach the following figures per sq. meters (fixed prices 1970).

	1970	1975	1980	1986	
Current Prices	3 149	6 091	10 280	18 464	Million SEK
Fixed Prices (1970)	3 149	4 143	4 249	7 632	Million SEK
Cost per Sq. meter	159	168	149	[3]	SEK

Table 3 Investments in Warehousing, Current and Fixed Prices, and Cost per Sq. Meter.

It can be seen that during this period of ten years it has become increasingly expensive. In this figures no considerations has been taken to the fact that some warehousing have been discarded. Furthermore, there is other factors which most likely is of great importance for the estimation. During the 1970 ies rather many AS/RS where built in Sweden and their high increased successively. At the beginning of 1970 ies the warehouses were commonly of a high of 15 to 20 meters, at the end of 1970 ies some warehouses of 30 to 40 meters had been built. Consequently a capital cost per sq. meter area of 149 SEK (in 1970 years prices) most likely carries a larger volume of inventory in 1980 then in 1975 and then in 1970. Principally the capital cost the ground has been replaced by a cost for equipment, since the latter becomes considerably larger at AS/RS configurations. The efficiency in the use of warehousing has increased most considerably during 1970 ies.

[1] Interest 12.5 %.
[2] Ågren (1983, p 60).
[3] Interest 12.45 %

Materials Handling

The cost of material handling, can be divided up in physical costs that is wages direct associated with the physical handling and costs for the equipment.

In turn the physical cost can be divided in two parts. The first is personal working with the actual movement of the goods such as drivers of forklifts and cranes. The second consists of personal responsible for packaging and storing.

The number of employees registered in this professional groups (which work more than 20 h/week) shows in table 4[1].

	1970	1975	1980	1986
	119 073	127 383	116 134	126 431

Table 4 Number of Employees Responsible for Materials Handling.

Relating this figures the number of goods in ton which has been transported and handled during the same three years, the following figures in table 5 are reached[2]:

	1970	1975	1980	1986[3]	
	5 029	4 561	4 391	3 550	Ton per person

Table 5 Number of Goods in Ton Per Person.

The efficiency calculated in tons handled per employee, as above, in this professional groups has decreased successively. There are several reasons for this trend. Working hours was reduced during 1970 ies. In 1973 a reduction of number of working hours from 42.5 to 40 hours per week was done.

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[1] Ågren (1983 p 55).
[2] Excl. air freight.
[3] Statistical Abstarct of Sweden (1980).

In 1977 a fifth week of holiday was introduced. Together these two measures resulted in decrease of working hours approximately 7.9 %. Also during this period the absence caused by illness increased.

A calculation of the costs on the basis of the average of wages and the number of employees in those professional groups gives the following result in table 6.

	1970	1975	1980	1986	
Current Prices	3 072	6 193	9 247	11 720	Million SEK.
Cost per Ton (1970)	5.10	7.20	7.50	10.80	SEK per ton.

Table 6 Total Cost and Cost per Ton for Employees Working with Materials Handling.

A considerable decrease in the efficiency can be noticed during 1970 and 1975 constitute as much as 40 %. And price is more then two-times high in 1986 then in 1980.It is difficult to figure out the causes for this. Possibly one reason can be the considerable wage increases in the mid-seventies.

In the second category of costs, that is costs for equipment used primarely in handling and storing are found.This cost includes deprecations[1] as well as capital costs. The actual working expenses are considered to be very low and consequently left out. In table 7 the capital costs for these three years are the following.

	1970	1975	1980	1986[2,3]	
Capital Costs	829	1 352	2 382	3 870	Million SEK

Table 7 Capital Costs for Equipment in Materials Handling.

[1] Economical life, 8 year, interest 12.45 %.
[2] SCB, Industrial Statistic 1978 - 1986.
[3] Interest 12.5 %.

Packaging

A total cost of a package can be divided into three parts; transport packaging, consumer packaging, and printing costs. The cost of transport packaging amounts to approximately 46 %, the consumer packaging 44 %, and printing costs for 10 %[1]. Table 8 shows the following.

	1970	1975	1980	1986[1]	
Total Cost	2 125	3 300	5 600	10 800	Million SEK
Excl printing costs	2 010	3 120	5 295	10 220	Million SEK
Fixed Prices (1970)	2 010	2 120	2 190	4 224	Million SEK

[1] Trend extrapolation from previous years.

Table 8 The Total Cost of Packages, the Total Cost excl. Printing Costs in Current and Fixed Prices (1970).

Table 9 shows the distribution of the total cost of packaging in different sectors in 1980. It is difficult to distinguish a pattern in the relation between the cost of packaging and the market value. Most of the sectors had a relationship below one. Not suprisingly the food and the chemical sector, ISIC 31 and 35 respectively showed considerably higher relations due to the nature of the products as regards liability to damage, requirements of hygiene, leakage etc.

Sector		Cost Million SEK	Market Value Million SEK	Relation %
Mining	2	11	3834	0.3
Food	31	2 401	41 229	5.8
Textiles	32	72	7 896	0.9
Wood	33	127	24 961	0.5
Pulp	34	518	41 842	1.2
Chemical	35	788	47 372	1.7
Cement	36	158	7 999	2.0
Iron	37	132	26 292	0.5
Metal	381	189	20 762	0.5
Machines	382	175	31 639	0.6
Tele	383	148	19 064	0.8
Transport	384	106	36 952	0.3
Other	385/39	26	3 710	0.7
Electricity, heating	4			
Construction	5			
Trade	6	444		
Total		**5 295**		

Source: Ågren (1983)

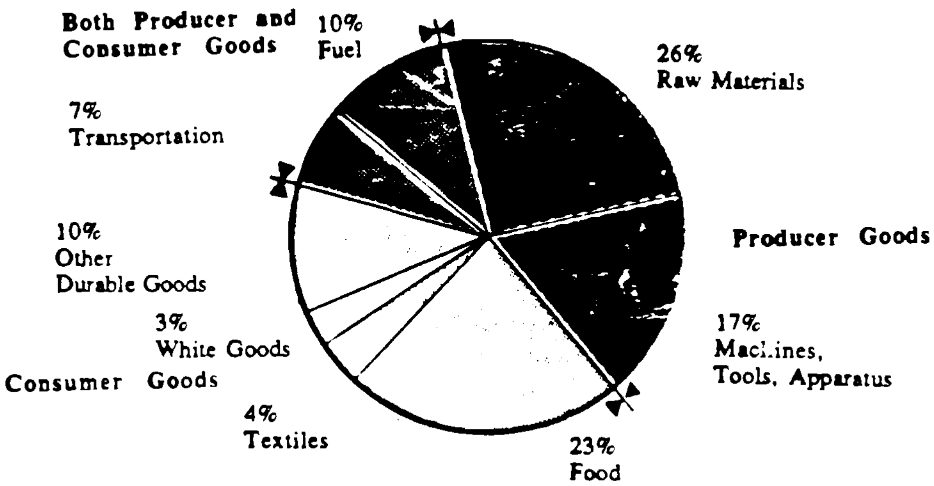
Table 9 Packaging Cost in Different Sectors in 1980, Current Prices.

[1] Esseltepac - Norrköping, Sweden, Ågren (1983, p 67)

I.5 Distribution Channels and Patterns

Wholesales Trade

Figure 12 shows Swedish wholesale in 1983 divided into groups of commodities. Consumer goods constitutes only 40 % of the total wholesale and hardly 25 % is food. The most important part is goods, 43 %, which are used as input in the industry or consumed by another end-consumer, for instance as in the case of construction sector. Furthermore, there exist a third main group, 17 %, which includes such products as transport and fuel which are used by producers as well as consumers.



Source: Larsson (1987, p 13) and SCB Partihandelsstatistiken

Figure 12 The Swedish Wholesale in 1983 Divided into Groups of Commodities.

The traditional view of the wholesaler is that he should serve as an intermediary between the producer and the retailer. This view has, however, decreased gradually during the latest 10-20 years, especially in certain sectors such as food and textile retailing. This implied that many wholesaling companies have disappeared. The main causes to this development are[1]:

1. A number of large retailing companies, after with a considerable network of shops, have developed. For many of those it is more profitable to buy directly from the producer and distribute the goods via the companies own centralized warehouses.

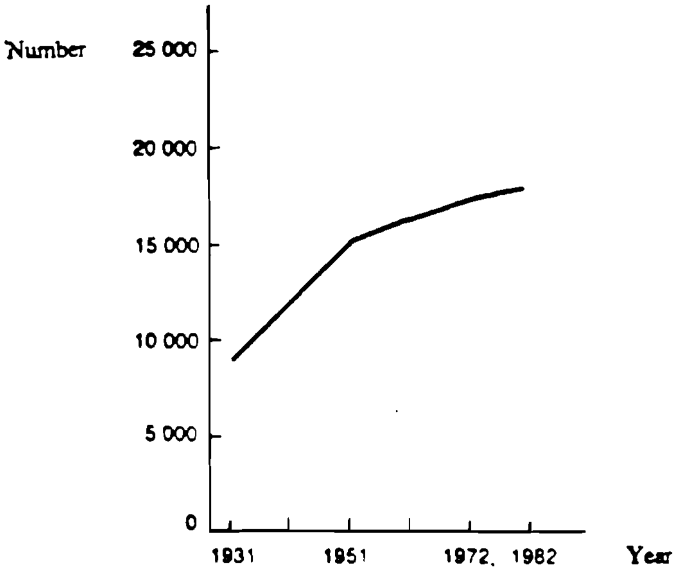
[1] Larsson (1987).

2. Small retailing companies have joined in voluntary chains. The management of the chain settles contracts with the producer on behalf of the members. The goods are delivered either straight to the retailers or via a centralized warehouse organized by the chain.

3. Some of the goods, for example, furniture, are so bulky and so unwieldy that distribution to retailers are not profitable.

4. As a consequence of the increasing use of branded goods the producer has taken over part of the work at the market which was earlier done by the wholesaler.

Figure 13 shows the change in the number of wholesales since the beginning of the 1930 íes.



Source: Larsson (1987, p 19)

Figure 13 Number of Wholesalers 1931-1982.

Between 1931 and 1951 the number of companies increased by more than 70 % as a consequence of the extensive expansion of the industry after the end of the Second World War. During the subsequent period of 20 years the increase only reached 18 % despite a relatively considerable growth of the volume. The number of mergers increased during the 1960 íes which counteracted an increase in the number of companies.The average number of employees per company rose from 7.7 to 9.1 during the same period.

During the 1950 íes and 1960 íes the large change of structures took place in retailing which caused many shops to close and caused an increase in the development of chains.

It also influenced the suppliers of the retailers. Many small wholesalers disappeared or merged and a number of small regional inventories which served shops in areas considerably larger than earlier.

Retailing

In 1984 retailing companies were allocated as in the following table, table 10:

Number of Employees	Number of Companies	%
> 200	81	0.3
50 - 199	262	1.0
20 - 49	864	3.3
10 - 19	1 981	7.5
5 - 9	4 814	18.2
2 - 4	11 321	42.6
0.1 - 1	7 166	27.1
Sum	26 489	100.0
No employees	47 056	
Total	73 545	

Source: Larsson (1987, p 25), CFR Centrala Företagsregistret.

Table 10 The Allocation of Retailing Companies.

As few as some 80 companies have more than 200 employees which is considered as the limit to large-scale enterprises in industrial contexts. This only corresponds to 3 per thousand of all companies with employees. Furthermore, the number of what can be seen as middle sized companies, with 20 - 199 employees, is relatively low, approximately 5 % of the total number. According to this classification retailing is a pronounced small-scale-enterprise sector. More than 50% of all companies have no employees. A study shows that there have been no obvious changes in the distribution of sizes since the mid-seventies[1].

[1] Larsson (1982).

Retailing can be divided into three different form of integration:

1. **Branch companies** - which include retailing companies that mainly work with one sector and that own and run, with a centralized management, at least five shops. These are not members of voluntary chains.

2. **Voluntary chains** - an economic organization between independent companies meant to improve the salesmanship of the individual companies through common measures.

3. **Independent companies** - companies which are not tied to a branch company nor to a voluntary chain.

Table 11 shows how the market shares in turnover in large retailing sectors are distributed among the the different form of integration.

Sector	Market Share % Branch Shop	Voluntary Chain	Shop Standing by Itself
Department Store	98	2	-
Food	23	56	21
Clothing	29	10	61
Furniture	26	27	47
Radio & Television	5	41	54
Tobacco & Newspaper	29	-	71
Watches, Optics & Gold	17	22	61

Source: Larsson (1987, p 32)

Table 11 The Market Shares in Turnover in Large Retailing Sectors are Distributed Among the Different Forum of Integration.

I.5 Logistics Costs and Efficiency

Logistic costs include transport, storage, handling, warehousing, equipment, packaging, and damage.

Table 12 shows the total cost of logistics for the year 1970, 1975, 1980, and 1986[1].

	1970	1975	1980	1986	
Total Costs of Logistics	26 238	47 603	85 139	144 068	Million SEK
GDP	151 929	267 416	470 705	815 414	Million SEK
TCL/GDP	17.3	17.8	18.1	17.7	%

Table 12 The Total Costs of Logistics (TCL), Gross Domestic Product (GDP), and the Relation TCL/GDP.

Nationally it is interesting to study the efficiency by looking at the total costs of logistics, TCL, related to the Swedish GDP in factor prices. The GDP and the relation TCL/GDP is indicated in the same table.

Divided in to the different kinds of costs we get following result, table 13.

	% 1970	1975	1980	1986
Transport	6.9	6.7	6.7	7.3
Inventory carrying	2.7	2.7	3.4	2.8
Handling	2.8	3.2	2.7	2.0
Equipment	3.5	3.9	4.1	4.3
Package and damages	1.4	1.3	1.2	1.3
	17.3	17.8	18.1	17.7

Source: Ågren (1983)

Table 13 The Logistic Costs Divided in to Different Kinds of Costs.

[1] Year 1970, 1975, and 1980 (Ågren 1983), and Year 1986 (Borg 1990).

Consequently it is clear that the share of costs of logistics in society has increase continually during 1970 ies. This is true despite of the fact that the sector which has grown the most in Sweden, in relation to the GDP, consists of private and public services while logistic costs mainly is found within the manufacturing sector, ISIC 3, trade, ISIC 6, and transport , ISIC 71.

Table 14 shows the relative size if logistic costs in 1980 for some sectors in the Swedish economy.

ISIC	Sector	Value Added	LOGISTIC COSTS Million SEK	% of Value Added	% of Sales
1+2	Agricultural, Mining	19 300	6 300	32.6	
3	Manufacturing	111 000	48 800	44.0	15.7
36	- Cement	4 500	2 100	47.0	26.4
37	- Iron, metals	8 600	4 900	56.3	18.5
384	- Transport, equipment	15 500	3 300	21.4	9.7
4	Electricity, gas, water	13 100	700	4.9	
5	Construction	38 700	1 000	2.5	
6	Trade, restaurants, hotel	58 300	23 900	40.1	
7	Transport, communication	31 700	2 300	7.4	
	Unspecified		3 500		
1-7	Material Sectors	272 100	86 400	31.8	
8+9	Other Service	196 000	0		

Source: Ågren (1983), Wandel (1984), UN Industrial Statistic, National Account

Table 14 Relative Size of Logistic Costs in 1980 for Some Sectors in the Swedish Economy.

Table 15 shows the components in the logistic costs in relation to market value in the different branches respectively, and the ratio value/weight, and inventory carrying cost in relation to weight.

For the goods with a high ratio of value/weight, principally the transportation costs are lower, but the relation is however inverted in the case of inventory carrying cost. Furthermore, the inventory carrying cost is lower for the more expensive transports.

Sector	Transport %	Inventory carrying cost	Inventory holding cost	Packaging %	Market value %	Value/ ton SEK	Inv. holding cost per ton
Transport 384	1,6	3,4	3,7	1,0	9,7	82200	3030
Fabricated metal, 381	1,6	3,9	4,4	0,9	10,8	18900	830
Machinery 382	2,4	6,0	4,6	0,6	13,6	57400	2660
Electrical 383	3,5	5,5	4,0	0,8	13,8	86800	3470
Food 31	4,2	1,4	4,0	5,8	15,4	9200	370
Chemical 35	11,4	1,9	2,0	1,7	17,0	2100	40
Textile 32	4,6	3,8	8,0	0,9	17,3	87800	7000
Pulp 34	6,3	1,4	8,7	1,2	17,6	8300	720
Iron and Steel 37	5,2	4,2	8,6	0,5	18,5	2800	240
Other 385/39	7,5	4,7	4,9	0,7	17,8	(205500)	
Wood 33	11,4	2,9	8,0	0,5	22,8	4800	380
Non-metallic mineral, 36	14,3	2,2	7,9	2,0	26,4	1100	90

Source: Ågren (1983)

Table 15 The Components in the Logistic Costs in Relation to Market Value in the Different Branches Respectively, and the Ratio Value/Weight and the Ratio Inventory Carrying Cost/Weight.

II. Managerial Structures and Strategies.

II.1 Organizational and Institutional Structures.

In view of the change in focus in the industrial enterprise which has taken place during the last two decades, the companies have undertaken many and drastic measures. To sum up it can be said that this change in focus has implied a shift from the actual production i.e. the products manufactured, to marketing in this case from the company to the market[1]. A triggering factor in this change of focus is the increasingly keener competition, which can be noticed in the higher supplies covering larger geographic areas and the more intensive work to influence the market[2]. By studying this change a shift in the structure can be noticed both as regards the organization of the logistic chains and the organization of the company as such.

For example, the reasons for changes in the structure of companies logistic chains have been:

* increased centralization of inventories
* customized production

Consequently, the earlier conception of decentralized storing has now developed into centralized storing. Some of the causes are[3]:

1. The increased consciousness of the capital cost at inventories.
2. Several inventories on the market makes it more difficult to survey the situation.
3. Improved systems of information and communication have made it possible to improve information connections to customers and forwarders.
4. A change to customized production has decreased the importance of inventories.
5. The traditional role of wholesalers has partly disappeared. The role has changed into that at so called information brookers which means communicate contacts and informations.

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1 Ericsson & Persson (1981).
2 Storhagen (1987).
3 Abrahamsson, Borg & Storhagen (1988).

Companies transition to an increasingly customized production has been noticed during the latest decade. To a large extent this growth in the share of customized production has been initiated by the keen competition the countries in the west experienced when Japan entered their market. The development has accelerated as the Japanese competition has started to be considered a real threat. But also factors such as growing differentiation of products, and the technological development, for instance FMS, have contributed to the development of customized production[1].

From a logistical point of view there has also been a development within the organization of the companies.

The task to organize the companies activities regards control, planning, responsibility and coordination of the physical flow of goods have change drastically. Between different departments in the company earlier there were no overall responsibilities of the control of the material flow. Companies have more and more established special departments of logistics. The change to this departments has been gradually. First it started with one department responsible for the materials management and one responsible for the physical distribution. Later there was a gradual integration of the two departments as well as the production control.

In this case the interest is not limited to the operational level. The management of the company also have an interest of these problems, and they can also see prerequisite of higher competitive advantages on strategic level.

Finally the development within the company in the future can increase the emphasis on the three kinds of bridge-constructions[2].

1. Within the internal operative process.

* integrated planning of the delivery, inventories, assembly, production of detailed parts, and material supply.
* stockless production, short exchange of die, and small batches.
* lots of influence of Japanese production philosophy.

[1] Ågren (1989).
[2] Sarv, Ericsson & Bäckman (1985).

2. Toward customers and suppliers.
The concept market orientated production is not restricted by the borders of the company but develops to a large extent

* correlated mutual planning.

* stockless systems of deliveries and transportation systems with high performance.

3. In the dimension product development - design - internal flow of goods and products

* the participation of suppliers and customers in this process.

* increased use of modules in the structure of products and increased utilization of computers in order to integrate the process.

II.2 Economic Regulation of Logistics Activity

Transport Policy

In the period between 1940 and 1963 strong regulations apply for the issue of transport licences in order to protect the state railways. After 1963 a gradual liberation of the system started which took place in three phases[1]:

Phase I starts during 1964. Several exemptions from the compulsory issue of a licence were announced. demands for the proof of the necessity for issue of a new licence or expansion of capacity became less stringent and an annual increase on lorries capacity by 15 % was allowed without being necessary to prove its necessity. Regarding tariffs every transport mode became responsible for their adjustment so that to cover it´s cost.

Phase II started in 1966. Lorries below four tonnes gross weight and special transport vehicles e.g. tanks exempted from the obligation to justify the necessity for the issue of a new licence or for the expansion of their capacity. The capacity of the rest vehicles could by 20 % per yearly.

Phase III started in 1968. During this phase all regulations regarding capacity should have been abolished and only "quality" criteria of entry should remain. In 1972 quality requirements for entry to the market became more strict. In 1978 quantity restrictions on the separation of the market ceased into regions. Also railways were not obliged to issue fixed prices and thus they had the opportunity to make discounts.

As a consequence of a political decision in 1963 regarding traffic, the existing regulations which restricted competition were removed, and neutrality of competition was to be aimed at between the different type of traffic.

In 1979 another decision was passed involving a separation of the responsibility for costs and payments. This was done in order to present that types of traffic would be come scarcely used because of scaringly high fees[2].In this decision the socioeconomic effects were considered through extendingly the responsibility of costs to include external effects

[1] Kritz (1976).
[2] TFK (1982).

as well as through the fact that the government connected transport policy to a larger extent to regional and industrial policies[1].

Inventory Taxation

From an accounting- and taxation point of view, the possibilities to record available inventories have changed over the years. During a number of years it has, from a tax law point of view, been possible to deposit a certain share of companies inventory to a so called reserve stock. The taxable allowance for a companies reserve stock fund has, in accordance with applicable tax legislation allowed a maximum limit as large as 60 % of the value of inventories after the inventories have been marked down due to obsolescence etc. Hence, 60 % of an increase in inventories is deductible from the taxable profit. The profit is about 52%.

The above mentioned legislation has of late been sharpened and implies that the reserve stock can be accounted for 50 % of the average of the two previous years´posted inventory value. However, instead of just writing down the inventory by 50 %, another possibility is now available. A company can instead use a combination of the above mentioned statute - a statute that bears reference to depositing funds to a intracompany profit adjustment fund. This possibility is especially favourable for wage-intensive companies, for example companies in the service sector. Deposits to the intracompany profit adjustment fund can at the maximum entail 20 % of the year´s total paid salary costs. In this case deposits to the reserve stock are in limited to 35 % of the inventories value[2].

This for Sweden unique inventory "subsedies" gives an investment to invest in more stocks than other companies.

[1] Ireståhl and Tarkowski (1988).
[2] Andersson et al (1989).

II.3 Information Technologies

A General view

The following examples of informatics gives initiated innovations in industry[1]:

* JIT deliveries of only immediately needed directly to the point of use. Requires on the minute, small, and frequent transport and advanced information systems for exception reporting and rerouting.
* Sell first than produce. Requires transport of many small flows across wide distances, EDI ordering and electronic markets.
* Computer integrated manufacturing. Small batch deliveries and perhaps reduced transport needs due to local production together with EDI for CAD and orders.
* Centralized storage located near transport, terminals. Requires fast transport of many small parcels to many different places, which demands consolidation terminals and EDI to prepare the transport chain downstream.

The penetration of these innovations has a large impact on the logistic cost, which accounts for some 40 % of the assets in a Swedish manufacturing company[2]. Excellence in logistics not only gives a cost advantage but also increases the revenues due to competitive delivery services, as short and reliable lead time, and the sales of logistic services and hardware.

The price to prestanda ratio for microelectronic products and thereby telecommunications and computers can be expected to continue to drop at the same rapid rate as in the past ten years. Even with current prices, many beneficial applications have not yet been invented and the invented ones not yet fully implemented. Hence, we are only in the beginning of an evolution where telematics considerable will contribute to economic growth and restructuring.

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[1] Wandel (1988b).
[2] SRF (1982).

In the transport sector there is a need to have access to the same updated information at the same time in many locations of which some are in vehicles under way. This results in specifications on communication and hardware that in the early part of the telematics evolution were difficult to fulfil.

Most data is today entered manually using keyboards and shipments are identified with the text on the address label. Major weaknesses are[1]:

* Slow; Four times slower than automatic registration.
* Expensive; Goods location can only be registered a few times along the transport chain.
* Error prone; Two to four errors of 100 key punches.

Alternative technologies are among other things in Sweden:

Bar code reading with a pen or with a laser scanner or camera for remote reading. The method is simple, fast, cheap and relatively reliable. Several standards exist, but is generally not a problem since the same equipment can print and read most of them. A rapid adoption of this technology can be expected in goods transport for identifying shipments, transport equipments, and paper documents.

There is also a need to standardize addresses. All shippers and transport operators have registers of their costumers, containing address, customer number, telephone etc. In Sweden the national data bank for Goods Address Number, GAN, has been established. A unique number is assigned to all establishments that potentially can receive goods. The data bank contains address information, industry code and number of employee. The government paid for the development of GAN, which is owned by major transport operators and wholesalers. It is open for everyone. Updating of costumer addresses is made faster and cheaper than before and the standardized identification code makes it possible to simplify registration, e.g. using bar codes, EDI. Interlinked national goods address data banks should be developed in order to facilitate further use of advanced informatics in goods transport of all modes.

[1] Tarkowski and Ireståhl (1988).

Vehicles are already coded in a standardized form. Similar standards might have to be considered for containers and other load modules when they are used in open exchange systems, e.g. container pools.

Most of the information along the logistic chains are today entered manually, transfered as mail or voice in telephone networks. One of the major problem and challenge is:

High document handling cost in trade. The Swedish Trade Procedure Council, SWEPRO, estimate the cost to 3 400 SEK for an export shipment and 2 700 SEK for an import shipment, which is on average 4 % of the goods value. Other reports have indicated double that percentage. EDI is estimated to reduce these costs with 20 %[1]. The cost savings come from:

* Reduced data entry cost.
* Reduced clerical errors since each data element is only entered once.
* Reduced copying and transmission cost, up to 50 times cheaper than mail.

The reduction of the number of documents and simplification of the procedures should be done before standardization and computerization. One study mentioned that there are 65 documents and 350 copies for one shipment. The Single Administrative Document and Simplified Procedures are steps in that direction.

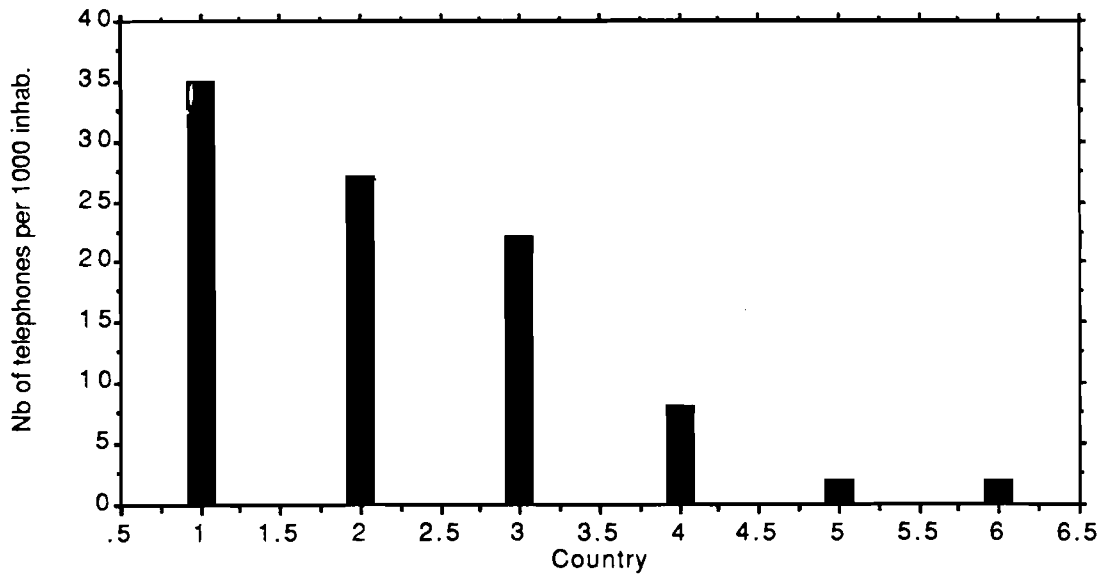
The high document cost also mean higher order cost. since the cyclic inventories, which constitutes about half of the inventory capital, is proportional to the square-root of the order cost, the estimated 20 & lower document costs means about 5,5 % less inventories.

This way the main drive to start the ODETTE project between the major car industries and their suppliers. They wanted to issue material released for all high volume-valued components for each car to be assembled, i.e. sequential Just In Time deliveries.

Telephone and Data Communication

Accordingly to the Statistical Year Book at the UN, Sweden holds, in 1983, highest position as regards intensity of telephones per 1 000 inhabitants with a number of 890. Study the Swedish development separately this is seen to have increased by 45 % during a period of ten years. In order to compare it can be mentioned that Switzerland comes second with 810 and the United States third with 760 telephones per 1 00 inhabitants. The situation in Scandinavia is that Danmark and Norway comes fourth and sixth respectively.

Regarding the number of mobil telephones per 1 000 inhabitants, figures 14 shows that there have had their largest break through in the Scandinavian countries. Norway holds the highest place with about 35 and Sweden is second with about 27 mobil telephones per 1 000 inhabitants.



Source: Ny Teknik, nr 18, 1989.

1. Norway, 2. Sweden, 3. Finland, 4. Great Britain, 5. West Germany, 6. Japan.

Figure 14 Numbers of Mobil Telephones per 1000 Inhabitants in 1989.

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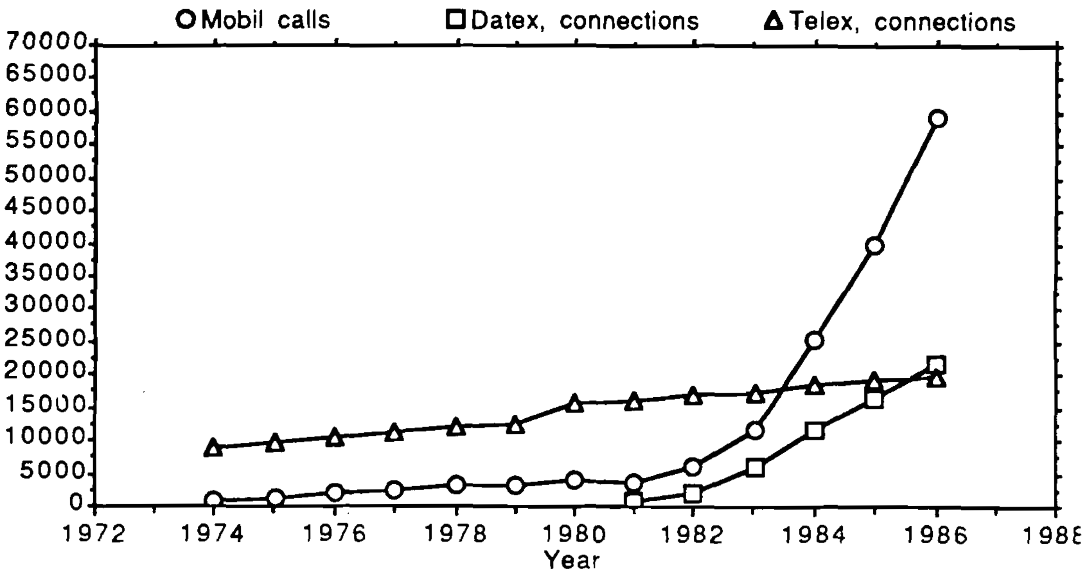
[1] SWEPRO (1985).

As for Sweden it is seen in figure 15 that the real breakthrough for mobil telephones took place around 1982, at least judging from the number of mobil telephone calls. Since 1982 the number of mobil calls has increased drastically.

The use of Telex has had a more even development accordingly to figure 15. The number of Datex connections, however, has increased steadily since the introduction at the beginning of the 1980 íes.



Source: Statistical Abstract of Sweden (1980, 1988)

Figure 15 Number of Telex and Datex Communications, and Number of Mobil Calls Between 1974 and 1986.

II.4 Human Resources and Education

Human Resources

Table 16 shows the development and the allocation of human resources within the transport sector.

	1950	1960	1975	1980
Railway	71	59	34	29
Bus and tramway	-	-	20	25
Private car	-	-	15	15
Other road transport	-	-	57	59
Sea transport and seaport	37	38	30	27
Air transport	3	7	8	10
Forwarding	-	-	16	20
Warehouse	-	-	2	3
Total	111	104	182	188

Source: Census of population and housing 1980

Table 16 The Number of Employees in the Transport Sector 1950 - 1980 (thousands of people)

The possibly most noticeable change has taken place within the railway traffic where the number of employees has decreased considerably from 71 000 in 1950 to 29 000 in 1980. Also within sea transport and seaports a marked decrease can be seen (even stronger during the years 1981 - 1984). Road transport bus- and tramway, forwarding and air transport show increased number of employees.

Education

In Sweden we have higher logistics education at the five leading technical universities, namely in Stockholm, Gothenborg, Linköping, Luleå and Lund and at the local university of Växjö. There are logistics courses or at least logistically related courses or courses that bring up the logistics subject as part of the training also in the economical education at the other big universities and the other local universities. But the six educational centers mentioned account for at least 80% of the total number of logistics teaching student-hours.

Basically, you need a high school degree to start studies at the universities in Sweden, but there are also a growing number of opportunities for people without high school degrees, but with professional experience. To be qualified to take a university degree, there are basic course requirements on the high school level, but you are entitled to take specific courses at the universities also without these basic course requirements. Växjö, for example, has several hundered students from the industry in its logistics courses, which have been awarded university credentials but no final university degrees.

All the universities mentioned, except Växjö, also have Ph.D. programs in the logistics area. So far, however, only a handful logistics doctors have been produced in Sweden in various logistics subroutines like transportation etc.

The development of the logistics courses in Sweden is primarily oriented towards internationalization, computerization and organizational development. Integration of the logistics concept like Just in Time is also important to most universities[1].

II.5 Research Projects

There are mainly two organizations which finance the logistic research in Sweden. Firstly, The Swedish Transport Research Board, TFB, is an governmental authority which purpose is to initiate plane, coordinate, support and inform concerning investigation, development and demonstration project within the field of traffic and freight transport and logistics constitute part of their activities.

Among the tasks of the organization are to draw up programs for research and development within there field of activity as well as update the same.

The research board is of the opinion that research concerning transports of goods and logistics is of great importance. In some miner areas there is a special need for great contributions in order to improve the conditions for developing knowledge and reach a

[1] From Hans Sarv's speach at the 6th European Logistics Congress in Milan 1988.

high level of quality within basic fields and applied research as well as in investigation activities.

The program treats problems and research needs under two headlines; Development and Structural Changes and Quality Requirements on Freight Transportation Systems and Services. support to universities for R&D is emphasized, especially for the development of quantitative methods and economic analysis[1].

There financial contributions a mounts to 7 million SEK in logistics and freight transport.

Secondly, there is a collaboration, The Organization of logistics research (Föreningen för MA-forskning), between the committee of technological development (Styrelsen för teknisk utveckling, STU) and a number of Swedish industrial and commercial industries.

The program is financed by the supporting companies (60%) and STU (40%). Furthermore the companies are expected to contribute to a certain extent through the participating of their experts in teams collaborating with the researchers in collecting data about and analysing their own company.

The acquisition of financial resources from the companies is effected through yearly contributions of 30 000 SEK during a period of three year. The program is set up under 3 years basis calculated to reach the extention of 5 million SEK per year. This corresponds to approximately 12 researchers per year[2].

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[1] PROMA (1988).
[2] TFB (1988).

Conclusions

Sweden is a sparsely and unevenly populated, long and narrow country, where transport is disturbed by winter conditions several month each year. It is highly dependent on foreign trade but Sweden is isolated from its main markets with water barriers. It is a member of EFTA but not yet of its main trade partner EEC.

The service sector: public service, communication, and trade, is growing, and it employees now more than 60 % of the working population. The industry sector that produces metal products, machinery, and equipment is growing and dominated by large multinational companies. However, much of the production is performed in small batches and in small plants. This sector is characterized by high inventory levels, due to the complexity of the production processes and the large number of different products and parts, and it requires reliable and relatively fast transport systems, in comparison with the traditional export sectors iron, ore, pulp, and paper.

All these characters together with a tax system that subsidies inventories and overtax truck transport have resulted in larger inventories and more transport relatively most of its competitors.

The economic policy has resulted in low unemployment, high costs for unskilled labour, low cost for skilled labour, higher inflation, and lower productivity and economic growth than most OECD countries.

Since logistics constitutes a large share of the total costs of a product, particularly on the export markets, and probably higher than for many of its competitors, large emphasis has put on increasing the logistics efficiency of industry and trade. This can be summarized in the following trends and barriers:

* increases in number of logistics professionals, courses, and conferences and logistics decisions have been moved from the loading docks to the board rooms. However, the level of education is still much lower than in most other sectors and there is still no full transport or logistics master program.

* more logistics oriented transport policy and a shift to relatively more air and road transport. However, investment and maintenance of the infrastructure is lagging and the growing environmental awareness are hampering the development.

* more money into logistics research and development. However, there is a lack of PH.D:s, researchers and research leaders, and most money goes to applied and short range R&D.

* reduction of inventory levels and number of storage places. However, companies with high inventory levels do still pay less tax than those with little inventories.

* a relative other nations, fast development and spread of new informatics and robotics technologies, due to higher cost for unskilled labour, job safety awareness, and progressive labour unions. However, the fact that Sweden is not a member of EEC causes problems for R&D collaboration and market access for the Swedish informatics producers.

References.

Abrahamsson, M., Borg, J. & Storhagen, N.G., 1988, Changing Demands on Sweden's Surface Transport and Goods Flows - The Consequences of Increased Business Logistics Practicies in Industry, Dept. of Management and Economics, Institute of Technology, Linköping, Sweden (in Swedish).

Andersson, J-O, Ekström, C., Gabrielsson, A. & Jansson, E., 1989, Redovisning och beskattning, Faktabok, försöksupplaga, Liber, Malmö.

Borg, J. & Pirttilä, T., 1988, Study of Inventory Structures and Trends in Sweden and Finland, paper presented at the Fifth International Symposium on Inventories, 22-26 august 1988, Budapest, Hungary.

Borg, J., 1990, Beräkning av de svenska MA-kostnaderna för år 1986 - en uppföljning av rapport nr 130, Tekniska högskolan i Linköping, EKI-MA/TS, Linköping (in swedish)

Ericsson, D. & Persson, G., 1981, Materialadministration - ett företagsledaransvar, Liberförlag, Malmö.

Industrial Statistics IB 10, SM 8502 and IB 10, SM 8703, Statistiska Centralbyrån, Stockholm, Sweden.

Karlöf, B., et al, 1987, Liket i balansräkningen, Liber, Stockholm, Sweden.

Kritz, L., 1976, Transport policy and the Lorries. A Study of the Effects of Regulation and Deregulation, Stockholm (in Swedish).

Kommunikationsdepartementet, 1987, Sveriges framtida transporter, Ds K 1987:16, Allmänna Förlaget, Stockholm, Sweden.

Larsson, F., 1982, Strukturella förändringar inom parti- och detaljhandeln, 1976-81, HFI meddelande M 14, Stockholm.

Larsson, F., 1987, Den nya varuhandeln, Studentlitteratur, tredje upplagan, Lund.

Lumsden, K., 1986, Transportteknik, Studentlitteratur, Lund.

PROMA, 1988, Ramprogram för MA-forskning för perioden 88/89 - 90/91, Föreningen för MA-forskning, 1988-05-17/303:RAM-89, Stockholm.

Sarv, H., Ericsson, D. & Bäckman, G., 1985, MA idag - materialadministration i utveckling, Liber, Malmö.

Sarv, H., 1988, The 6th European Logistics Congress, The Realities and Challages of European Logistics Into the 90's, Milan 9/10/11 November, 1988.

S-E Bankens Kvartalsskrift 1968-1985, Sweden.

SRF, 1982, Kapitalrationalisering, Sveriges Rationaliseringsförbund, Liber Förlag, Stockholm, Sweden.

Statistiska Centralbyrån, 1980, 1988, Statistical Abstract of Sweden, 1980 and 1988, volume 67 and 74, Official Statistics of Sweden, National Central Bureau of Statistics, Stockholm.

Statistiska Centralbyrån, 1980, Census of Population and Housing 1980, Stockholm.

Storhagen, N.G., 1987, Materialadministration - grunder och möjligheter, Liber, Malmö.

SWEPRO, 1985, Datautväxling i utrikeshandeln, publication P4, Swedish Trade Procedure Council, Gothenburg, Sweden.

Tarkowski, J. & Ireståhl, B., 1988, Transportadministration, Studentlitteratur, Lund, Sweden.

TFB, 1988, Forskningsbehov för Godstransporter och materialadministration (MA), Forskningsprogram, TFB-meddelande nr 56, september 1988, TransportForskningsBeredningen, Stockholm.

TFK, 1982, Transportköparna och transportföretagen i framtiden, del 3, Samhällets styrning av transportsektorn, TransportForskningsKommissionen, Rapport 1982:10, Stockholm.

Transportrådet, 1982, Transporter i Sverige, Transportmedlens utveckling och utnyttjande, del 1, rapport 1982:4.

United Nations, Industrial Statistics Yearbook 1983, Volume I.

United Nations, National Accounts, 1983.

Wandel, S., 1984, pages 6-24 in Strategies for Capital Reductions in Materials Management and Distribution, Swedish Transport Research Commission, report 1984:2 (in Swedish).

Wandel, S., 1988a, How Much Can Inventories Be Reduced?, working paper 1988-10-26, Dept. of Management and Economics, Institute of Technology, Linköping, Sweden.

Wandel, S., 1988b, Telematics in Goods Transport, working paper, sept 1988, Dept. of Management and Economics, Institute of Technology, Linköping, Sweden.

Ågren, B., 1983, Kostnader för transport-, hanterings-, och lagringsverksamhet i olika branscher - mätning av effektivitet och rationaliseringsmöjligheter, Report no 130, Dept. of Management and Economics, Institute of Technology, Linköping, Sweden.

Ågren, B., 1989, Ledtider och kapitalbindning vid kundorderstyrd produktion, Dept. of Management and Economics, Institute of Technology, Linköping, Sweden.

Logistical Strategies in The Netherlands From European "Gateway" to "Distribution Centre"?

by

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1 Introduction

"Ce système d'entrepôt tourne au monopole. Et si les Hollandais sont en réalité les rouliers du monde, les intermédiaires du commerce, les facteurs et les courtiers de l'Europe". (The other nations could not prevent or prohibit it.)[1]

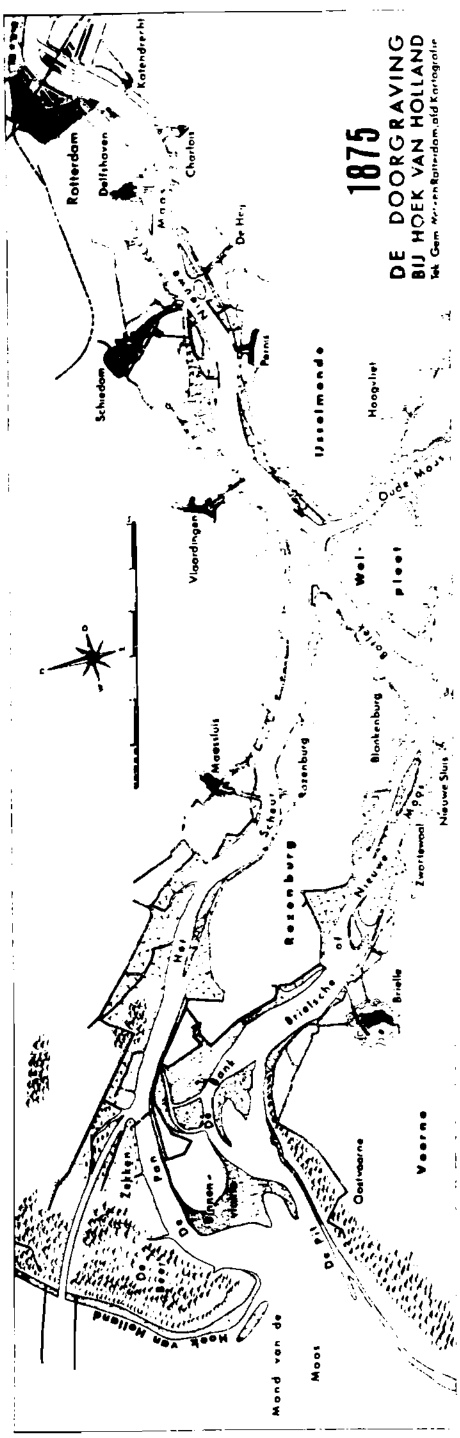
For centuries the Dutch have been one of the major traders of the world. Apart from shipping technology, several factors were important to secure the Dutch hegemonic position in world traffic during this era. Wallerstein [2] in his seminal work on the formation of the capitalist system, describes the network of inland canals, the (political) supremacy after the closing of the river Scheldt by the Dutch, and cheap freight rates (low cost ship construction). As McNeill states [3], "the rise of the west" has mainly been based upon technological and infrastructural development.

The Dutch lost this hegemony, overtaken by Great Britain, during the 18th century. This process of the rise and fall of trading nations has been described in detail by Braudel [4]. After having analysed the backwardness of the English at the end of the 15th century, Braudel shows how London was able to take over from Amsterdam and to become the "centre" of world trade due to the strong position of British companies at the dawn of the age of Enlightment, the 18th century.

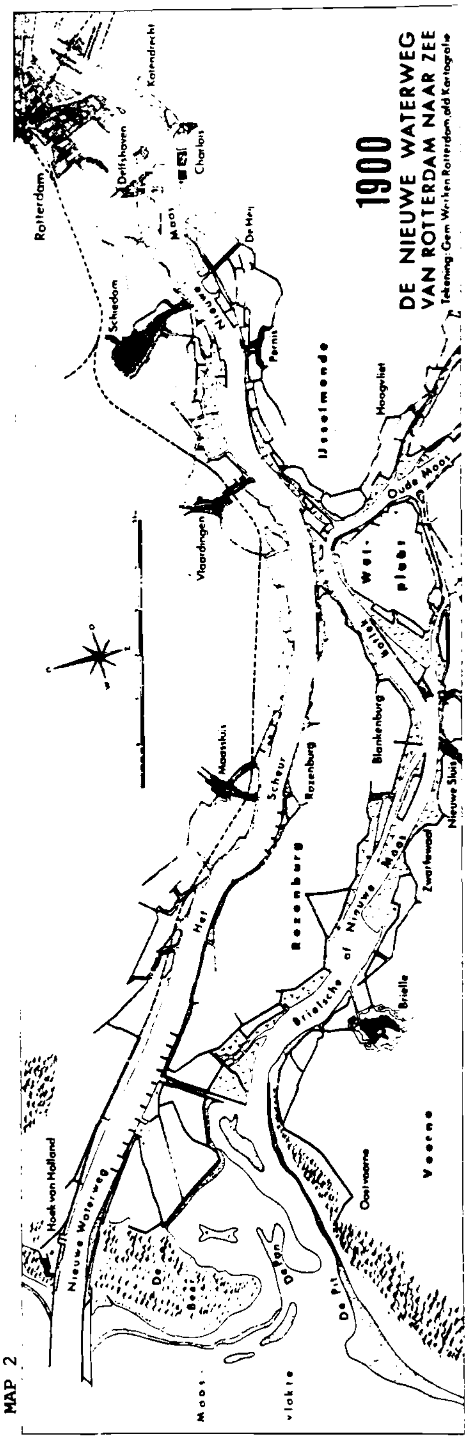
Since then there have been again several shifts in economic positions and centers of geopolitical power. "Between 1848 and the early 1870s (there has been an) extraordinarily economic transformation and expansion" [5] in the overall economy creating the basic components of modern world trade and traffic. The role of (technological) innovations in this process has been the subject of many investigations and is still a front line item in many discussions. Rothwell & Zegveld [6], for example, relate the leading position of the great western capitalistic countries to their innovative power. Others stress the economic power relationships of multinational corporations [7]. The elements of technology, infrastructure and economic power are all crucial factors in explaining the geo-economical position of a country or other socio-economic territorial unit. In this article we emphasize yet another crucial factor which will, in our opinion, gain in importance in the geo-economic positioning of cities, regions and countries during the coming decade *Channel Logistics or Integrated Logistics.*

The foregoing suggests a hypothesis: Material infrastructure is a key function in economic development of a region. This, however, is not "a priori" true. One is dealing here with the famous chicken and egg story. Since, if economic relations tend to prevail, material infrastructure - e.g. roads, bridges, tunnels and railroads- will be created to reflect this fact. Conversely one can say, that by realising material infrastructures, economies can improve or even flourish [8].

It is beyond the scope of this article tot go into this subtle theoretical discussion. Nevertheless for the presentation of this article, it must be kept in mind that there is no irrefutable (let alone causal) relation between material infrastructure and economic development. Furthermore, material infrastructure can be seen as a kind of logistic function, necessary but not sufficient, to improve the socio-economic functioning of societies. This is why so many times scholars have tried to analyse and forecast the impact of infrastructure.



MAP 1



MAP 2

An early example has been given by J. Dupuit in 1844 in his book Public Works and the Consumer [9]. And it is for this reason too that in Holland an impressive development of material infrastructure took place, from the time that Great Britain took over the world leadership in naval trade. In fact, the inland waterway that connects Rotterdam with the North Sea had thus been realised one hundred years ago (see maps 1 and 2).

Today, at the end of the 20th century, Dutch governmental attention is focused again on the economic function of material infrastructure. It is stated in various forms in different White Papers [10] that to secure the gateway function to Europe, the Netherlands

Table 1: Number of world population, 1965, 1985; projective calculation for the year 2000, world total and nine zones; urbanisation percentages.(1000inh.)

	1965		1985		2000	
	Population	urban%	Population	urban%	Population	urban%
1.World	3.323,640	35.7	4.842,048	41.6	6.127,117	48.2
2.Africa	313,615	20.5	553,210	32.1	877,439	42.2
3.N.America	214,042	72.0	263,404	74.0	297,683	78.0
4.Ctr.America	58,090	50.3	105,534	63.7	149,557	71.3
5.Sth.Amer.	146,871	56.4	268,825	72.4	359,581	80.2
6.East Asia[a]	827,449	24.9	1.183,177	26.6	1.383,339	31.5
7.S.-E.Asia	916,020	18.5	1.459,224	25.6	1.905,359	34.6
8.West Asia	64,133	38.2	112,830	56.0	168,298	65.5
9.Europe	444,956	63.4	492,009	73.3	513,110	78.9
10.Australia	11,387	83.0	15,714	86.8	18,668	89.1

[a]China plus Japan, excluding the other countries. Japan is a strongly urbanised country (76.5% in 1985, exp. 79.3%)

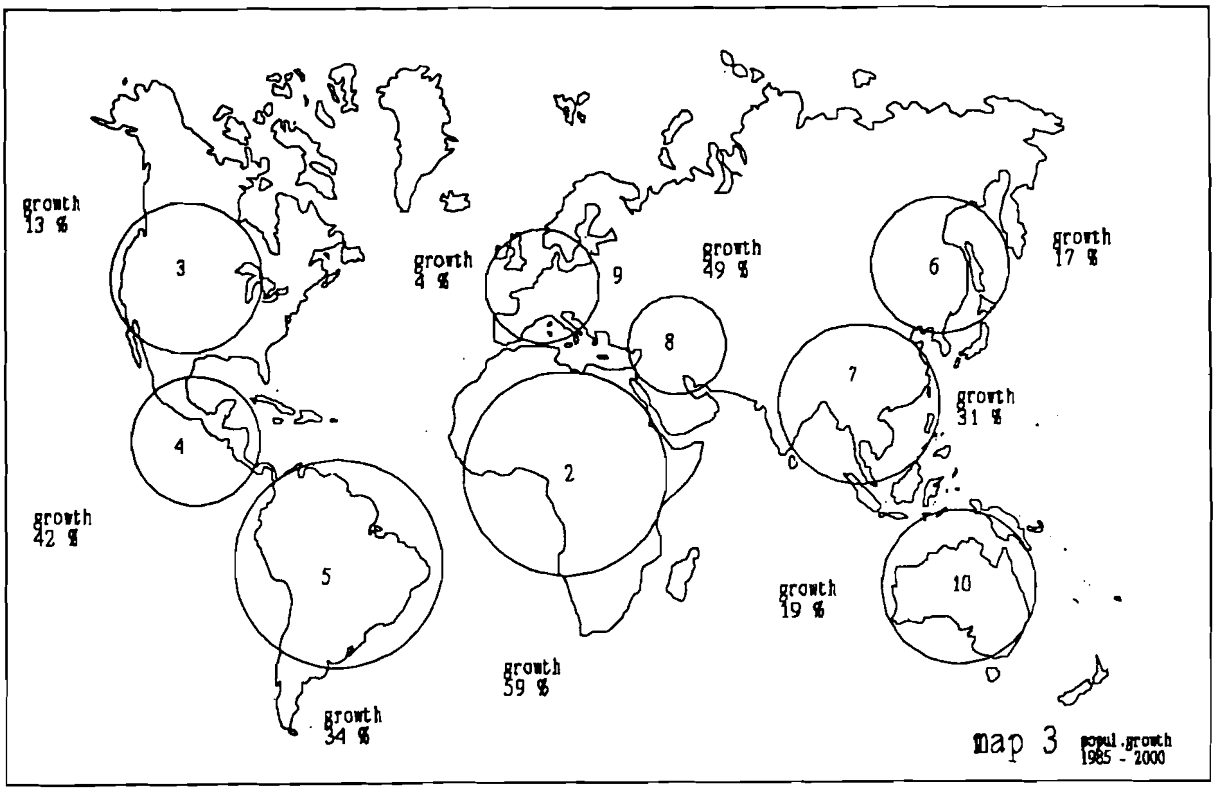
Source: United Nations, 1985

have to modernize and to expand their material infrastructural equipment. Especially the in- frastructural networks linking the ports of the Netherlands to the Hinterland have to be renewed. Although we agree with the statements that the actual infrastructure has to be adapted and improved, we query how, in which direction, and in relation to what kind of strategies ?

It is our contention that the modernization of the infrastructural factors must be seen in a broader context. The logistical position of the Netherlands in world trade patterns has to be deduced from many other factors too. These include [11]:

- the distribution of people, the demographical growth rate, etc.;
- the development of the income of people, their ways of consumption and the geographical patterns related to this;
- the development of the production structure in the hinterland (inland relations);
- the reliability of the labour functions in the port;
- the institutional inertia, customs, taxes, etc.;

For world trade an indication of potential development is rather difficult to construct. Certainly, it can be said to be dependent on the growth of consumption in the near future. Looking at Table 1 it can be deduced that the "market of the affluent" around the Atlantic Basin will grow from now until the year 2000 (see map 3). One could estimate its growth to about 12% in some 15 years. There has also been an explosive growth of mutual investment flows between Japan, the USA and Western Europe during the period 1975 - 1987 [12]. These are important factors in the development of trade to and from Europe, and hence for the position of the Netherlands.



Similarly, the development of trade to and from Europe is dependent on many other factors influencing purchasing power in this part of the world. For instance, environmental problems might become a barrier to economic growth. This can be very important as the greater part of world trade is concentrated in the affluent world, i.e., more than 70% in 1984.

For the Netherlands one has also to include the overwhelming shipping capacity that is influencing the seaborne trade. In relation to the restructuring of the world economy, the shipping companies have to solve the problem of overcapacity - some 30 to 40% - including reorganising and concentration [13].

Such restructuring includes deployment strategies of consolidating freight and containers into trunk lines and creating "main ports" all over the world for consolidation and de-consolidation of trade. So, the strategies of shipping line companies is also crucial for the competition of Western European ports, e.g. Rotterdam. It is for this reason that nowadays the very specific place the Netherlands could obtain in world trade is sometimes characterised by the words "Gateway to Europe". It is more or less a logical consequence of the situation that Rotterdam is evolving into a main port for the continent for many shipping lines.

At the same time, one can witness how in the Netherlands there has developed a broader connotation to the concepts of main port and gateway; a European distribution function for the Netherlands building upon their geographical advantageous position, but above all their historically developed capacity and potentiality of "traders to the world". To achieve this goal, intensive co-operation is being created between the Dutch state institutions, trade unions and entrepreneurs. A comprehensive policy is being formulated and worked out covering different aspects of the Dutch distribution function [14].

We can observe that at different levels and from different perspectives the concept of "logistics" becomes crucial. One can distinguish at least two sides of this logistical policy: private and public. Both sides receive our attention in the following sections. But first we examine the process of logistics development itself, in order to provide an idea about exactly what is going on.

2 Changing logistical processes: from "just transportation" to "channel logistics" and further

The ever-increasing international integration of production, services and capital are leading to new economic challenges and risks for the Netherlands. In 1992 the European Community (EC) will become one single market free of economic barriers and tariffs between member countries. This single market will create opportunities for capital. The Netherlands offer a good location for companies which want to be close both to international ports and airports and to the main consumer markets, but the single market also means that the Netherlands will probably have to compete more with other countries, as a location for companies operating on the EC market.

In this situation of competitive pressures building up in the Netherlands, companies in production and transport are beginning to reconsider the traditional approaches to logistics and transport within and between firms and companies. Logistics productivity is said to be the competitive edge for the nineties in Europe [15]. The trends towards a "global economy", "global products", "global producers" and even "global consumers" seem to be becoming realities. In several recently completed Dutch studies this has been investigated. How firms use logistics as part of their strategic operations on the different (global) markets [16].

Instead of seeing inbound and outbound traffic as "just transportation", shippers and transport firms are beginning to define their operations from a cross-functional perspective. The entire product [17] acquisition (manufacturing or buying) and distribution processes are viewed as a whole, from initial order entry through final customer delivery. This approach is called Product Channel Logistics, or Channel Logistics. The approach of Channel logistics is to evaluate cross-functional trade-offs to maximize overall (chain) profitability, rather than individually managing production or distribution activities.

The key difference between the traditional logistics and product channel logistics is the shift away from managing assets (such as warehouses, trucks, inventories) towards managing processes (such as product systems, transport systems, product flows and information flows). Herewith product channel logistics is an entirely new approach to production, transport and logistics, requiring new upgraded intra, and above all, inter company transport and information systems.

A survey of the Town Planning Institute of Rotterdam [18] has shown that many firms in the portuary branches are engaged in restructuring processes as described above. The firms interviewed can be classified as transport organising and cargo handling enterprises. Not only mass or bulk, but also general cargo and of course containerised products. All firms acknowledged the logistical developments and tried to an- ticipate the changes. Some of the firms even initiated the changes themselves.

They have to deal with a remarkable growth of diversification in bulk goods, the need for strategic stocks (buffers) and of course the overwhelming process of containerisation. New transportation strategies are needed and are in fact developed. Some firms already are underway to the "mainport concept" in transport logistics (Koninklijke Nedlloyd N.V., Seaport Terminals B.V., ECT N.V.). The main port concept entails that international sea shipping lines use only a few nodal points on each continent for their shipments. At these nodal points the shipments are consolidated and de-consolidated. Other firms in the port region of Rotterdam are in a process of becoming "Logistical Third Parties" offering to shippers new value-adding partnerships by providing not only transportation and cargo handling, but warehousing, financing, order entry and other related activities as well.

What developments are causing these strategic adaptations, and which perspectives can be discerned ? By taking a historical perspective, some answers to these questions can be offered. The relevance of logistics has very much to do with the standardization of time [19] and the integration and homogeneisation of space [20]. International trade has followed a trajectory from seaborne to overall logistics during previous centuries, with a rapid acceleration in the last century. Through the ages resources have been exploited to get basic or raw materials, from there onwards intermediate and final products have been made and sold. Transport has always played an important role in this process. However, it has got its dominant position only in industrial capitalism, in which integration and production are characteristic features of the development processes. More and more localities and regions could be integrated and unified into the capitalist development process, e.g. the formation of national and supra-national space-economies [21]. European space had not been open or accessible until the end of the 15th century when national networks of waterways and roads were constructed. Before this time there was little trade over intermediate distance. The regions were more or less selfsup- porting, and transport over land was very difficult but intensive over short distances [22].

Currently, a high degree of connectivity across distance can be discerned, due to new commuciations and transport technologies, functional linkages among economic activities are formed that would not otherwise have been possible. New technologies permit the re-arrangement of physical space in such a way that the time involved in production and distribution arrangements is drastically reduced. The, until now, existing clusters of economic activities are broken up, including the original competitive relations. Rather loose production chains, in which productive activities are linked sequentially by free market "mechanisms", change into solid, centrally managed flows with flexible cross connections. New product chains are generated with other "coordinating and regulating" mechanisms than hitherto.

This is what channel logistics at this moment is all about. It is the design and operation of the physical, managerial and informational systems needed to organize, and above all, to control flows of goods and information in time and space. Transportation and logistics are no longer simply the mastering of space, but they are aimed at the control of space and the insertion of the real time dimension into the production processes.

Some of the necessary conditions for this way of operating and controlling can be identified. Availability of key logistics information and facilities for Electronic Data Interchange (EDI) with external parties are crucial to the functioning of product channel logistics, because it improves the breadth, timeliness and quality of data. Only by means of micro-electronics and telematics, the dimension of real time can be introduced into the logistical chain processes.

Highly reliable and qualitatively outstanding infrastructural networks for the transportation of products and information along the product chains are necessary preconditions for the formation of the systems of product channel management.

The necessary conditioning of the institutional organisations and the planning of material infrastructure is an empirical fact in western (affluent) countries. The upgrading of the gateway-function of the Netherlands in this respect is exactly what is at stake at the moment in the Netherlands and it is one of the main drives behind the two Dutch White Papers recently published. It is especially one of the main reasons why companies in the Netherlands are paying so much attention to the quality of infrastructure and the "positioning" of distribution centres in the vicinity of the main ports (the port of Rotterdam and Schiphol Airport) in the EC-market. But it is not just spatial proximity anymore, it is "reductions in lead time" [23].

The foregoing discussion can be concluded by pointing out that Dutch enterprises and public institutions are trying to cope with the challenges of product channel logistics. The changes implemented at this moment, however, will not be enough in our opinion. Another shift in logistical conception will likely occur in the near future. The perspectives of the product channel logistics seem to be the formation of integrated networks with nodal points and clustered nodal points as keyfactors in positioning in world economy.

The trends in concentration, hitherto mainly visible in cross sectional relations (fusion of firms within branches, enlargement of operating scale, and the like), will more and more take place along the production flow or channel, both upstream and downstream of the flow [24].

Enterprises will occupy sequential nodal points in a more comprehensive way than before. Leaving their "original" specialisation (transport, production, distribution, financing) they tend to completely manage a material (and information) flow from raw material to final product.

This will lead to new forms of societal production system. In comparing the dominant Tayloristic production system (identified as the assembly line production and functional organizational structure) with the new, integrated channel production network or chain, one can see the following differences:

Production line (Tayloristic).	Chain (Production channel logistics).
A production line is a concept with complementary activities sequential in time and place (the assembly line);	The concept of channel logistics implies isochronic and coherent autonomous activity-clusters (autnomous production groups);
participants (labour) do not need a clear image of each others activity; optimalization of partitioned activities is the central task;	participants are aware of the totality of the compound product; optimizing the complete production process is the central task;
operations consist of splintered managerial units in broken time sequences; activities are sequential with several stocks locations;	operations form an accessory part of integrated management based on real time conception; processes can take place simultaneously and attention is focussed on the elimination of down time and reduction of stocks and work in progress;
workers have to deal with homogeneous workpieces but with different procedures;	workers have to deal with heterogeneous workpieces in a singular circulation process with homogeneous series;

In the new logistical organisation the ultimate goal is the control on a real time basis of the production process, than can be managed from the origins to the final demand. Effective demand prevails, so it is not just another rationalisation or optimisation of transport activities, but an attempt to control the overall process and to reduce the uncertainties of markets and consumer behaviour. One of the effects of this development is the strong influence of logistical standardisation in production.

Our expectation is: in the near future we will see the rise of product channel logistics. At the horizon one can imagine some futuristic worldwide network with nodal points in a hierarchical, centralised order managing the complete world production and consumption cycles through various logistical means.

However, how different developments may occur can be illustrated by the differences in strategies of firms even in a single industry: the automotive industry. This shows the uncertain outcome of the outlined processes. Two well known global companies, Ford and Toyota, practice converse strategies. Ford is concentrating on global sourcing and producing, while the other's production activities are mainly regionally concentrated. Toyota City is the name of the regionally agglomerated production complex in Japan. Both strategies are being followed by other companies. In the USA the model of regionally clustering can be discerned amongst the localisation patterns of the Japanese "transplants" [25]. A company like Volkswagen seems to follow the global car strategy, albeit in a modest form. Which one of the strategies will win, or better, which strategy will be the stronger is quite uncertain. Strategies of, on the one hand global centralised management, on the other hand regional "bottom up" production regulation might even be overruled by a so called "Triad" strategy; the development of subsidiaries and Japanese/American and Japanese/European plants in each of the three economic centres of the world [26]. This strategy implies that transnational firms have to be "true insiders" in three markets

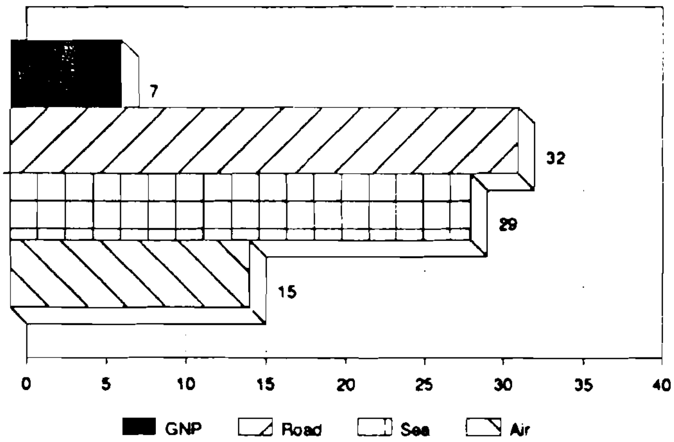


Figure 1: Dutch share in European Transport. Source: CBS

and their periphery, that is: Northern America (USA), Western Europe and Japan. This point of view corresponds roughly with the investment picture, sketched in the introductory note, above. The interpenetration between the three sides of the Triad seems already to be a fact.

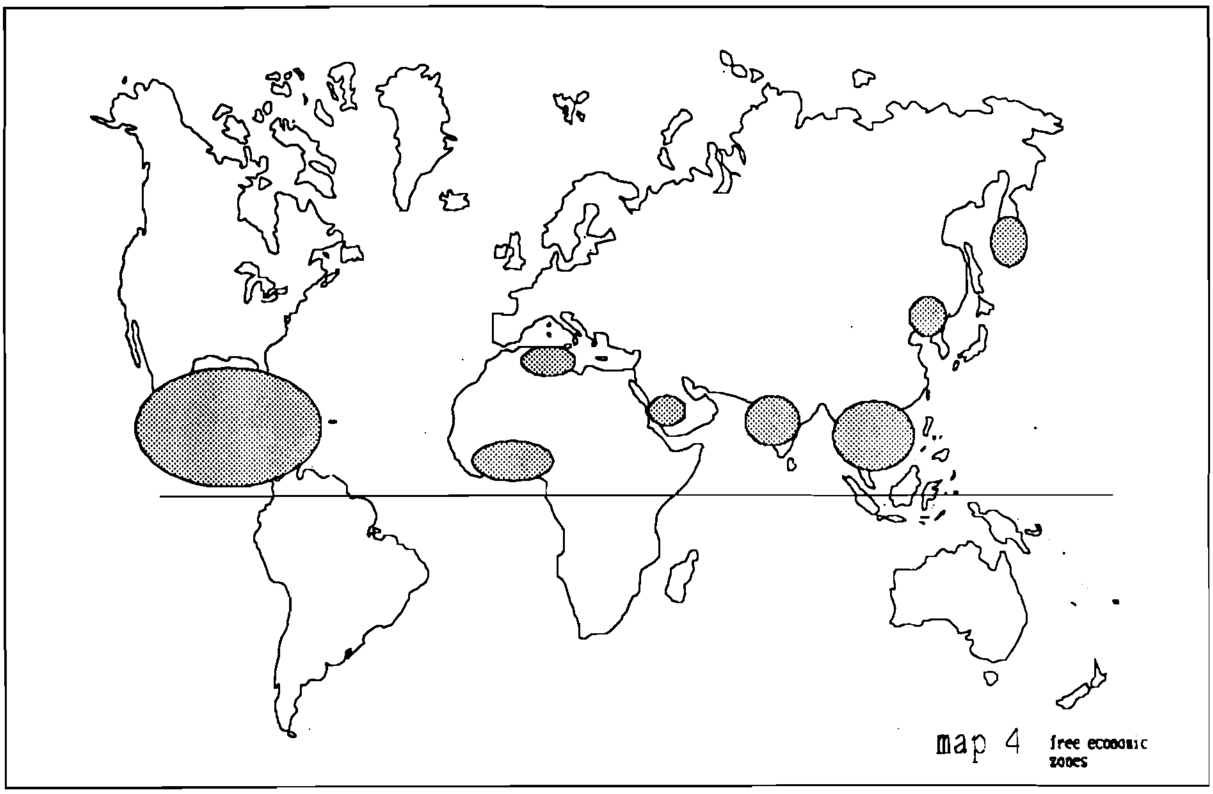
3 Economic importance of transport and governmental strategies

There are several ways of indicating the importance of transport activities in the Dutch economy. For example, comparing the contribution of activities to the national income is one, another is the number of jobs in the particular branch, and again another is the value added. Many figures give an opportunity to show the important role transport and related activities play in Dutch economy.

Looking at Gross Domestic Product one can see the following figures illustrating the position of transportactivities in Dutch economy. GDP 1987 and 1988 have been respectively 391 and 408.4 billion dutch guilders, to which Transport services have contributed respectively 31.2 and 32.5 billions. Comparing transport with industry. For industry the figures were 80.3 and 86.9 billion in 1987 and 1988. (See also Figure 1).

During the last years transport, trade and distribution ac- tivities accounted for about 20 per cent of Dutch GDP and for about 23 per cent of Dutch employment, which is higher than the share of industrial activities.

Not only transport activities as such, but also related (derived, intermediate) activities, are at stake. Activities implementated by traffic form a broader part of Dutch economy than transport itself. Historically, many Dutch economic activities are related to trade, transport and transit. Schematised, in the 1920's and 1930's a broad network of activities already existed. An inward flow of raw sugar, salt, agribulk, silicates, stonecoal, lead, linen, wool, tobacco, wood was worked into intermediate and final products [27].



A multibranch industry as a byproduct of traffic developed, exporting many delicate products like genever, beer, cigars and cigarettes. Today the kinds of products exported are very different: e.g. chemical products (petro-chemical, fertilizers) and agricultural products. However, transport has remained vital to the economic positioning of these products.

Of all goods transported to the Netherlands, more than half is directly shipped to other West European countries (transit). For this transport, the large rivers and canals are still the main arteries, especially for transport to the German "hinterland".

Dutch transport firms provide nearly one-third of European road transport. The shares for sea transport and air transport were 29 and 15 percent in 1988.

For several decades the port of Rotterdam has been the largest port for Europe (Figure 2). Schiphol Airport is an important hub in international air freight and passenger transport (Figure 3). In this respect, the Netherlands are still an important "gateway to Europe". This geographical and logistical position of the Netherlands is reflected in the structure and organisation of the main transport axes (see Map 4).

Realising the importance of transport, it is not surprising that the Dutch government has paid very much attention to distribution and trade activities during the recent years. However, these policies and especially the implementation of strategies are not without contradictions. The way Dutch government tries to deal with the changing logistical processes can be seen as being mainly a financial restrictive policy in combination with a strategy of stimulating private investment in the collective infrastructure. Dutch government tries to put project responsibility to (larger clusters of) private companies and joint ventures, where cost-benefit analysis leads to the idea of tollways, turnpike bridges, tunnels under the main rivers.

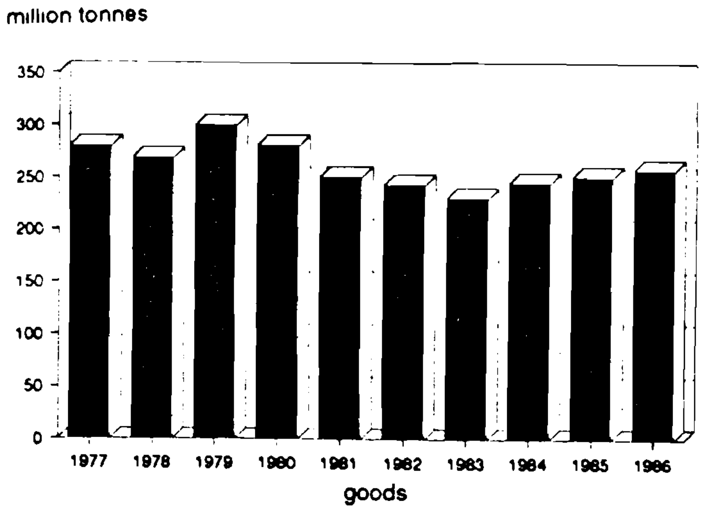


Figure 2: Goods by sea to and from Rotterdam. Source: Port of Rotterdam.

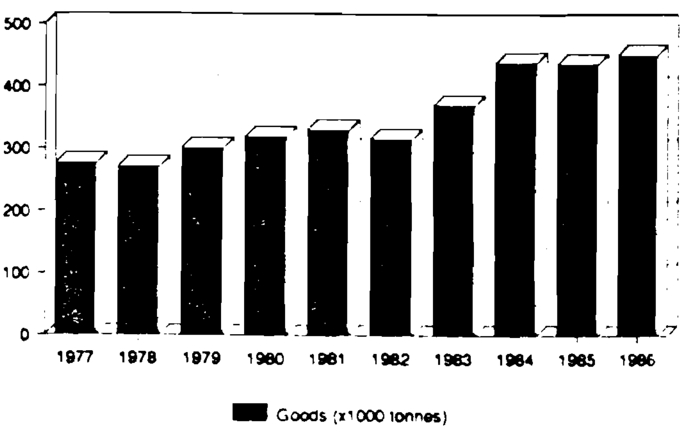


Figure 3: Goods transported at Schiphol Airport. Source: N.V. Luchthaven Schiphol.

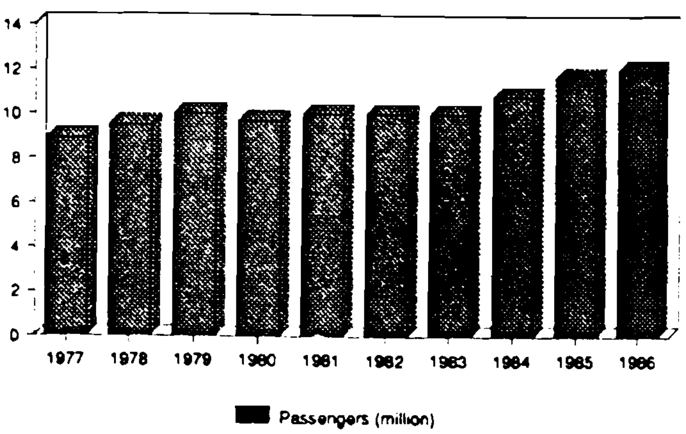


Figure 4: Passengers (incl in transit) at Schiphol. Source: N.V. Luchthaven Schiphol.

On the other hand, in the White Papers on Physical Planning, and Transport and Traffic strategic goals are formulated which can only be implemented by direct state involvement and strict regulatory policies; for instance the stimulation of combined rail-road transport at first to Austria and Northern Italy and later also to Scandinavia, France and Spain. For this several actions are needed, not only in terms of publicity, but also by means of investments in technical improvements and the like. The same argument applies to the strategies of reducing the growth rate of private car usage and reduction of pollution of the environment. For a reduction of total automobile passenger kilometers, more is needed than a policy of stimulating the so called social partners. At the same time, the material infrastructure is being renewed in order to tackle the congestion on the main transport axes.

The general picture, though, is that renewal of many parts of the infrastructural and economic structure of the Netherlands can be expected, one way or another. The networks of transport will be modernised and its usage intensified, which will have important spatial effects on the Dutch situation. So to speak, a "third wave" in the 20th century economic geography of the Netherlands is under way. The first wave was that of the flourishing of the forementioned industry (agribulk, anorganic chemical raw material, wood). Secondly, organic chemistry developed, or perhaps formulated in a better way, a petrochemical boom took place, roughly speaking in the sixties and seventies.

Thirdly, there is reason to believe that for the nineties there will be a reconstruction of Dutch infrastructure and space by the intensifying and expanding international logistical chains and networks, the ongoing containerisation, the changing raw materials base of production and the insertion of telematics into the different branches of the Dutch economy. Spatial development will follow, and on the other hand will act as an enabling feature. The "urban fields" of Randstad and Northern Brabant will expand to the adjacent regions and the relations of Rotterdam with its (near) hinterland, its region and, for some people surprisingly Antwerp, will be intensified. Looking at logistics development some kind of conversion is taking place. The region was fed by the harbour functions during past centuries, while in the near future the ports will be dependent on the regions.

Of course, this statement has to be corroborated or refuted in the coming period of economic development. In the meantime it is of interest to observe what is going on in the world of corporations and government.

4 The development of logistics in the Netherlands

Surveys by McKinsey show that Europe is lagging the U.S. and Japan in key measures of logistics performance (see Figure 5). In order to keep up with the competitiveness in the world marketplace, European manufacturers are forced to use logis- tics. Many of them are at a cost disadvantage, because they are high-cost suppliers in markets that are increasingly drawn to low-cost suppliers. Others are in cut-throat competition for high service and quality.

What we see is that since the 1970's European firms have been modifying their structures of operations: from mass standardised products towards more customer-specified products; from vertical integration towards outsourcing, putting out and co-makership contracts: all attempts to gain economies, flexibility and control (over the operations).

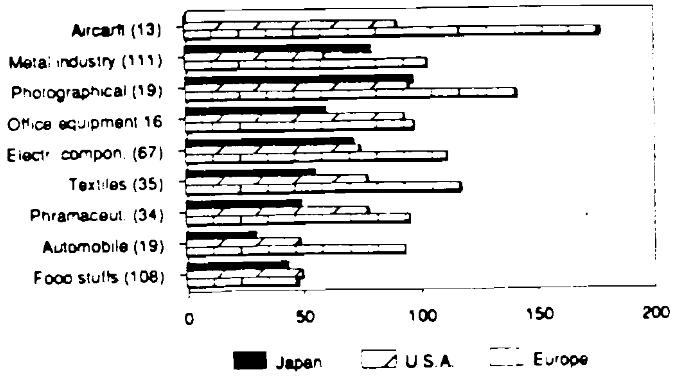


Figure 5: Inventory Turnover in Days. Source: McKinsey. ()number of companies in survey.

For the Netherlands, the general picture seems to be the same. However, what is missing is a good intra-sectoral and intersectoral comparative study of the logistical performance of Dutch companies. There are some attempts to estimate the economic relevance of logistics for Dutch economy [28]. These studies suggest that economic benefits are to be made, using logistics approaches up to 100 billion Dfl. Still, the pitfalls and boobytraps of these kinds of macro-economic logistics surveys are manyfold, especially as long as there are no good methods to estimate inter-companies "logistic chain-economies". Up till that time we will have to do with micro-economic and meso-economic approaches.

A McKinsey analysis of twelve typical Dutch SME-companies has shown that they have higher inventory levels than similar Japanese companies (see Figure 6) [29]. In general, inventory reductions can make a disproportionately high contribution to improvements in logistics costs: see the examples of inventory costs for chemical industry and capital goods in the Netherlands (see Figures 7 (a) and (b)). The ATKearney survey of 1986 even suggests that Dutch companies are lagging European competitors. The indicator used is the availability of integrated logistical plans (see Figure 7 (c)) [30].

Improvements in logistics can frequently offer greater leverages than reductions in direct labour. Take the example of a Dutch manufacturer of consumer durables. The cost breakdown shows that direct labour accounts for 5.1logistics cost for 6.2% (see Figure 8). The same example for a more integrated manufacturer of consumer durables shows the same point (see Figure 9).

In the period 1984 - 1987 the Dutch Organisation for Logistical Management (NEHEM) has conducted 11 pilot projects in three major sectors of the Dutch economy in order to find out what the situation of logistics really was, and above all to identify strategic options to raise the competitiveness of Dutch SMEs (>10 and <200 employees) using integrated logis- tics. For the relevance of SME for the Dutch economy, see Figure 10 [31].

The pilots were located in industry, trade and construction. Figure 11 shows the potential benefits from logistics improvements for the pilot projects. And if 50% of Dutch SME companies in the three selected sectors of the economy could achieve improvements

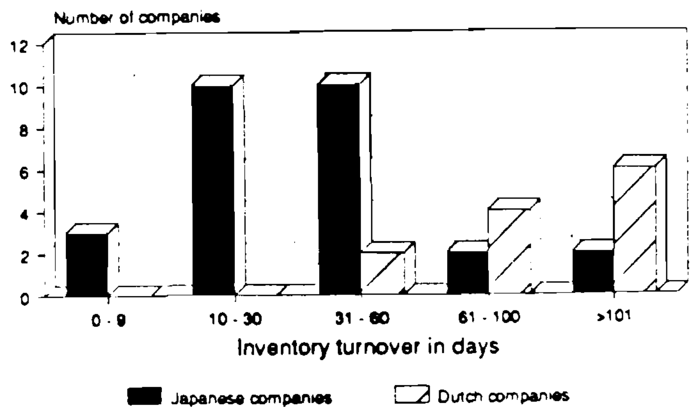


Figure 6: Inventory Turnover. Japanese and Dutch SME. Source: McKinsey.

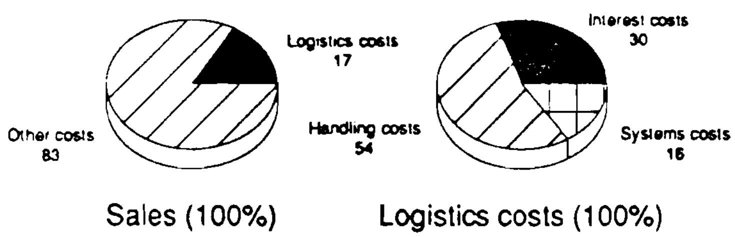


Figure 7: Share of logistics costs. Dutch chemical industry. Source: McKinsey.

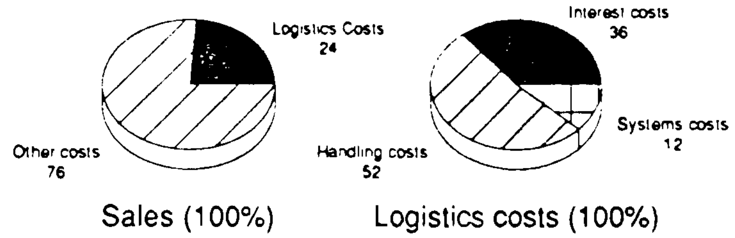


Figure 8: Share of logistics costs. Dutch capital goods industry. Source: McKinsey.

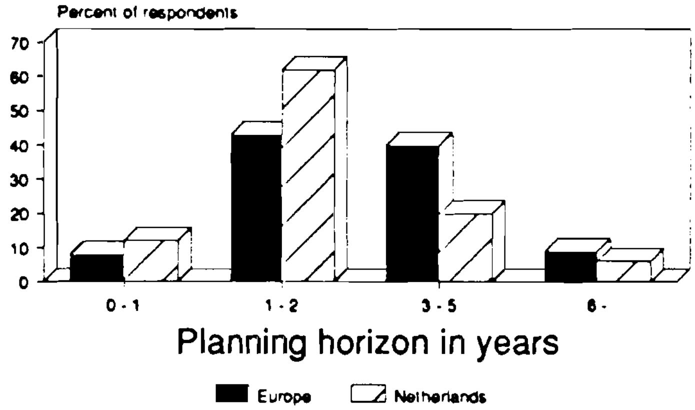


Figure 9: European and Dutch Companies. Logistical planning horizons. Source: McKinsey.

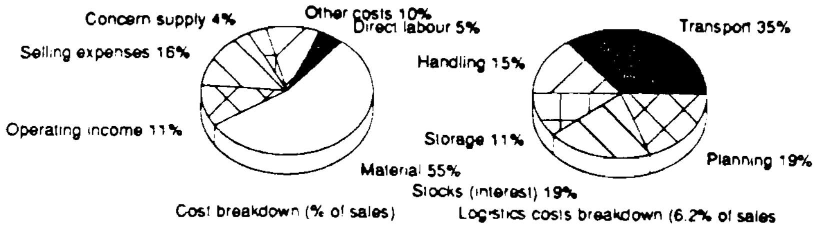


Figure 10: Share of labour costs and logistics. Source: McKinsey.

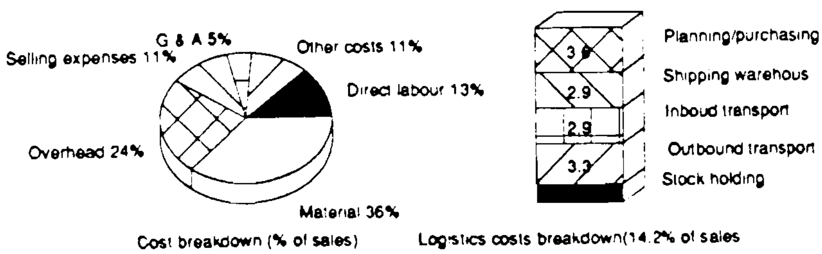


Figure 11: Share of labour and logistics costs. The example of an integrated producer. Source: McKinsey.

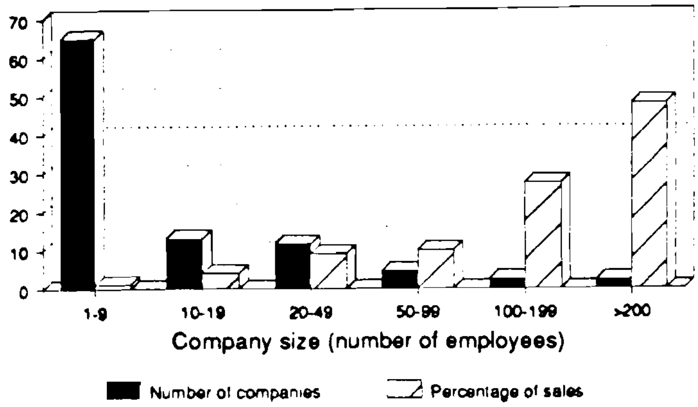


Figure 12: NL 1984 Breakdown of Industrial Sales. Source: CBS.

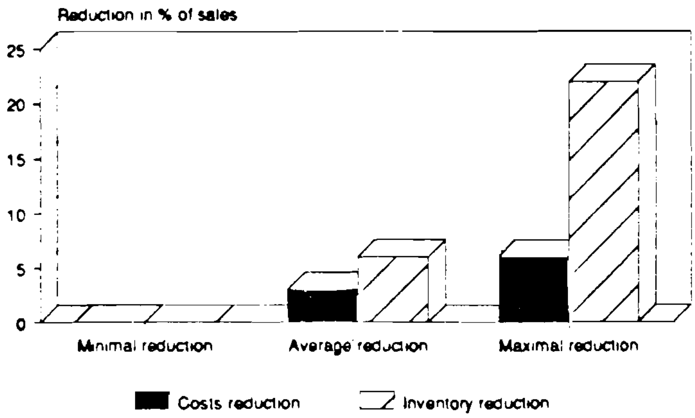


Figure 13: NEHEM SME Pilot Results (11 companies). Cost and inventory reduction through the use of integrated logistics. Source: NEHEM/ McKinsey.

approximating 50% of the pilot results, the possible benefits for the Dutch economy would be between Dfl 600 and 900 million.

Recent INRO-TNO research has shown that of all Dutch firms in industry, trade, construction and retailing, up to 70% (in terms of employment) is susceptible to logistics improvements in terms of better inventory management, integrating inbound and outbound transportation with inventory management and the use of contract of third party logistics [32]. However, most Dutch firms are just discovering the "hidden treasures" of logistics. The actual diffusion of integrated logistics is very slow.

The "awareness" on the other hand is fairly large. It is recognized that quality will become an important factor in global competition. A survey conducted by NE-

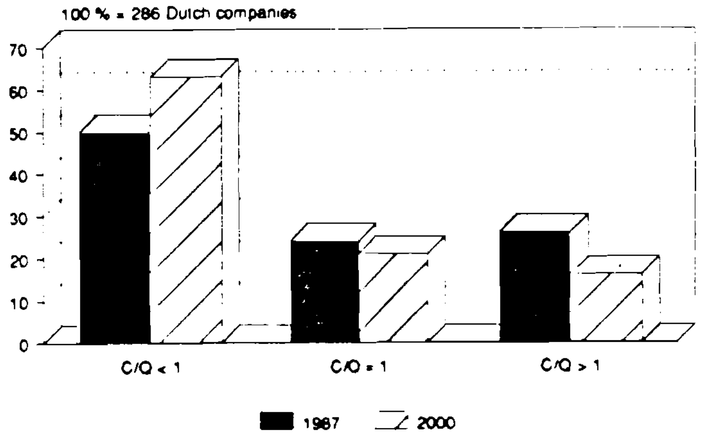


Figure 14: Growing Importance of Quality. Source: NEHEM/McKinsey.

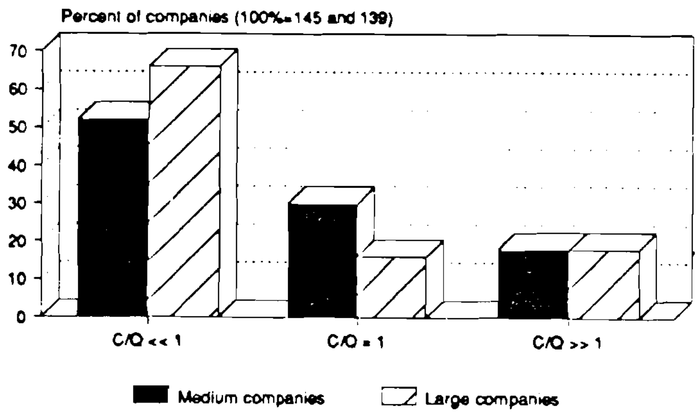


Figure 15: Importance of Quality in Competition. Source: McKinsey.

HEM/McKinsey in 1987 amongst 1000 companies in the Netherlands shows that companies expect quality to become more important in competition than costs: from 50% in 1987 to 63 in 2000 (see Figure 12) [33]. Especially large companies (>200 employees) expect to have to compete more on quality than on costs in the future (see Figure 13).

Companies asked how they would achieve a better competitive quality position in the markets, put forward the following strategies [34]:

(a) better marketing strategies:
These include: better promotion activities (68%), either alone (36%) or with co-makers (26%); a better response to the customers needs by means of more customer specified products (61%), broadening the product range (54%). Controlling and lowering the costs of marketing was mentioned by only 19%;

(b) better purchasing strategies:
These include: choosing highly reliable suppliers (73%) for example in the form of

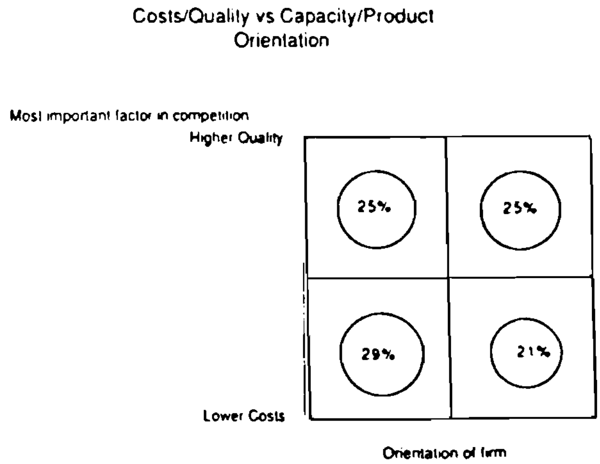


Figure 16: Orientation of Dutch firms 1987. Source: NEHEM/McKinsey.

vertical integration (54%); establishing forms of co-makershipments (55%); lowering the costs of inventory and inbound transportation (54%);

(c) using logistics strategies:
The following elements were mentioned: offering better logistics services (68%) to achieve by firms individually (42%) or by means of vertical integration (43%); introducing better planning techniques (65%); controlling and lowering the logistics costs (52%) and standardisation of products and services (18%).

The message becomes very clear, companies are expecting growing competition in markets that will become more and more global. In this steadily growing competition, logistics can be used as a weapon to gain competitive advantages; either in producing higher quality of products and/or services, or in producing more customer specified products. Strategies are clearly thought through.

In this reflection and reconstruction of strategies in the Netherlands two distinct directions seem to come to the forc; the first direction is that companies are striving to gain advantages by going from just using the installed capacity to producing products/services with higher standards of quality; the second direction is that from just using the capacity to the production of specific products. If we put the results of the NEHEM/McKinsey in a matrix with on the Y-axis, from capacity to quality; and on the X-axis, from capacity to product, the result is as follows (see Figure 14). For 1987 the companies are fairly evenly distributed over the matrix. In the year 2000, 41% of them want to be in the upper right position (Figure 15).

The situation differs for the various economic sectors of the Dutch economy. Construction and trade are heavily focused on utilising the installed capacity, while industry in general is very much oriented towards products. Nevertheless, 40% of industrial companies are mainly involved in economising capacities. The orientation of the services sector is, of course, towards producing a customers' specified product with high quality standards.

Dutch transport is still a sector with the emphasis on cost-competition. It remains, up till now a sector dominated by small and medium sized enterprises. The processes of

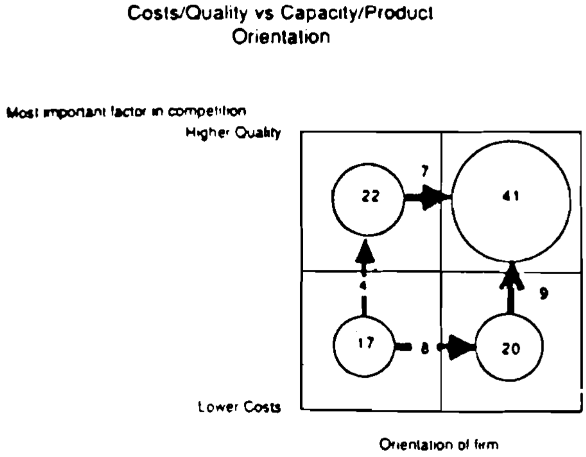


Figure 17: Orientation of Dutch firms 2000. Source: NEHEM/McKinsey.

centralisation are, however, speeded up, partly because of the need of logistics by industrial companies, partly because of the formation of the Common market. Besides the many small firms, the Dutch transport sector is also characterised by highly advanced logistical companies which are amongst the fore-runners in the logistics of transportation and in channel logistics (Dutch companies like Frans Maas N.V., Intexo-Van Ommeren N.V., Koninklijke Nedlloyd N.V., Pakhoed N.V.). These companies have already prepared for the nineties and the need for new logistical services. And that is because major changes are underway in international transportation.

It is not unlikely, that the introduction of the channel logistics approach in Dutch firms can be evaluated with the help of a model of phased development. One can distinguish three phases (or stages) of logistical development: we have called these elsewhere the phase of optimisation, the phase of connection and transformation, and last but not least, the phase of integration. The reason for this categorisation is as follows: the first steps in the logistical modernisation process are often the upgrading in importance of the logistics operations (e.g. by appointing someone in charge of logistics). The second step is re-organisation of the main logistics functions into corporate logistics. The recognition that logistics costs are vital in global competition is surely one of the main reasons for this logistics awareness. A third step, then, is to take a broader view, the approach of product channel logistics.

Hence, the first phase is characterised by the firms putting emphasis on separate logistical activities; techniques of materials management and physical distribution are being improved. In the second phase intrinsic logistical features are the most important points of action. For example Just-in-Time delivery and the like. The third stage includes the genesis of logistical chains systems, based on an integral logistics concept. It is oriented to complete control of integrated chains [35].

Looking at the Dutch situation one can say, that most firms just reached the beginning of the first phase of development. During the last five years some Dutch enterprises have started the second phase of logistical concepts, mentioned above. The third phase is just over the horizon with perhaps a few firms just gathering a glimpse of it.

Logistics are best developed in automobile production, electronic business and products that can not be kept or stored too long, like flowers, fruits, and the like. If enterprises will proceed following somehow the logistics development according to the stages we have described, at least two important effects must be analysed in the next years.

In the first place it is reasonable to expect fundamental changes in the type of transported products, or, to put it another way, product definition will change in a direction with more logistical features. A brand new classification of economic activities has to be made and accepted, with logistical characteristics [36]. For the Netherlands such a new grouping of firms or better units of production has been elaborated in the context of the introduction of advanced logistics concepts in manufacturing [37]. This grouping is based on notions regarding the substitution of economies of scale by economies of scope in manufacturing. The extent to which this may occur is given by two dimensions: the degree of standardisation of the production processes and the variety in manufactured products (see Figure 16). In this way four separate groups of manufacturing firms can be distinguished:

- firms with continuous processes;
- firms with discontinuous processes;
- firms producing on the level of product groups;
- firms producing in multi- or single project situations.

This grouping reflects an increasing degree of flexibility in the production processes as well as an increasing sensitiveness to the changing demands of customers. Of special interest in this case are the firms of the product group type, because they will very often use group technologies and programmable automated machinery, either for low-flow or large-flow volume batch production of semi standardized products. At the level of product groups one can find the examples of modern automotive industry, consumer electronics and micro-electronics. The next level of flexibilization, the project situations, contains "more traditional" examples such as the aerospace industry and ship-building.

Within the context of overall processes of technical change, we expect that the presence of producers at the level of product groups, together with the occurrence of producer services, would be the principle keys for assessing the competitive position of Dutch regions.

Secondly, it has to be expected, that the third phase of logistics development will cause rather large spatial shifts in economic activities. One of the reasons could be the urge for new product/market combinations [38].

5 The changing function of the port of Rotterdam: the "hub approach" in international transport

In measuring the importance of a port, the yardstick of "tonne" is normally used [39]. In itself, this indicator is not meaningless. From it we can get an impression of the physical

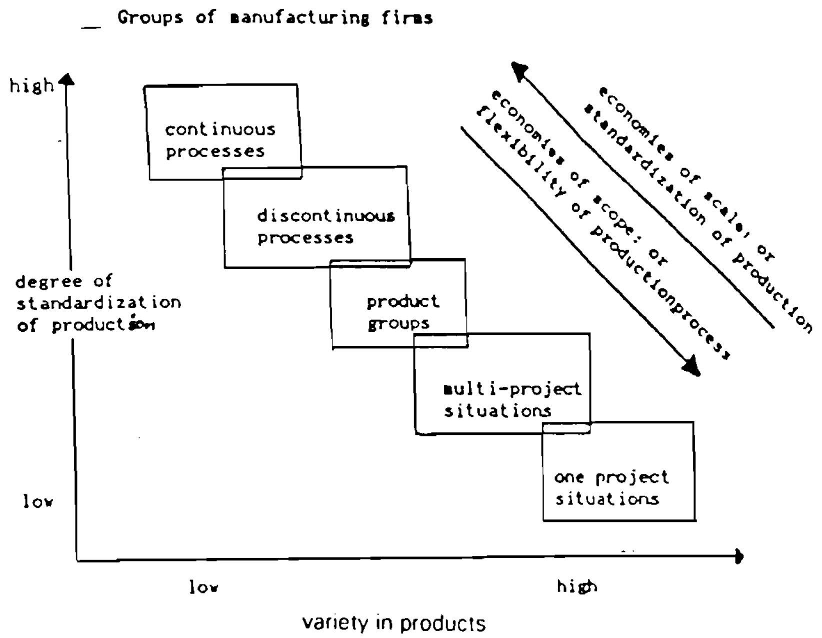


Figure 18: Standardization and flexibility of types of production processes. Source: Janssen (1987) [36].

Table 2: Imports by sea in Rotterdam (By weight and value in 1984)

Goods	Weight(mil.ton)	Value (mi.DG)
I Industrial products	9.97	17.80
Refinery/chemicals	7.98	8.02
Metal industry	0.60	5.05
Agricultural indus	0.81	1.97
Other industry	0.58	2.76
II Agriculture	9.58	6.69
Animal feed	6.55	5.05
Grains	0.54	0.33
Fresh Fruit etc	2.49	1.32
III Extraction Ind.	5.62	1.20
Coal	4.12	0.74
Iron Ore	0.39	0.02
Non-ferrous	0.13	0.27
Fertilisers	0.98	0.17
IV Oil production		
Crude oil	43.56	29.62
Total I-III	25.17	25.70
Total I-IV	68.73	55.32

Source: Gemeentelijk Havenbedrijf Rotterdam

performance of people and/or equipment, which must occur to accomplish the handling of cargo in a port. The "value" of goods is another extremely important factor. It indicates the possible contribution of transhipment of goods to the national income.

First of all, the total figures for transportation of goods through the port of Rotterdam. In 1986 526.0 million tons were shipped through the port of Rotterdam. From it 69% (362.0 million tonnes) were imported from or exported to the European continent. So, Rotterdam is an important transport hub for European sea transport.

Intra-European sea transport plays an important role (25% or 92 million tonnes). In this intra-European sea transport, the relations with FRG., Benelux, France and the U.K. however account for 40% of import and 62% of export. The relevance of Rotterdam for these countries is accentuated by the figures for inland transport to and from Rotterdam: 270.0 million tonnes. Of this total 110.0 million tonnes were domestic inland transport. In 1984 this figure was 92.1 million tonnes.

In the Tables 2 and 3 import and export by sea according to weight and value are given for the year 1984. The statistics here are restricted to Dutch imports and exports.

Table 3: Exports by sea in Rotterdam (By weight and value in 1984)

Goods	Weight(ml.ton)	Value (ml.DG)
I Industrial products	18.53	34.15
Refinery/chemicals	13.35	15.84
Metal industry	1.00	7.62
Agricultural indus	2.50	6.60
Other industry	1.68	4.09
II Agriculture	1.59	2.11
Animal feed	1.27	1.64
Grains	0.07	0.09
Fresh Fruit etc	0.25	0.38
III Extraction Indust		
Coal	0.37	0.07
Total I-III	20.49	36.33

Source: Gemeentelijk Havenbedrijf Rotterdam

Imports by sea into Rotterdam amounted to 27.47 million tonnes with a value of 26.63 thousand million guilders. This equals Dfl. 0.97 per kg. For exports these figures were 21 million tonnes, 37.17 thousand million guilders and Dfl. 1.77 per kg.

In Rotterdam crude oil dominates in terms of tonnage. This oil, however, has a low specific value (Dfl. 0.66 per kg). If crude oil is included the value of imports reaches 55 thousand million guilders. The value of the goods flow through Rotterdam destined or originating in the Netherlands is therefore certainly impressive. And this is before transit cargo (transhipments) is taken into account. To put the value in its context: it is about 1.5 times the production value of the whole Dutch transport sector and three times the contribution of this sector to the national income.

The average value per kg seems low. However we must bear in mind that the Netherlands are the importer of large quantities of raw materials for industry, agriculture and energy (inclu- ding coal). These are bulk goods with a relatively low value. Low value products (less than Dfl. 1.0) account for 21.68 million tonnes, giving a value of 12.39 thousand million guilders. The value shows how important general cargo is to the port of Rotterdam.

Exports on the other hand include far more semimanufactured and end products. Low value products account for only one-fifth of the total export flow.

In imports refinery products and chemicals are extremely important, both in terms of weight and value. There is an important difference between the imported and exported products. After refinery products and chemicals the products of the metal industry come in second place (see Figure 17).

What shows clearly from the overall Tables 2 and 3, is that in terms of value Rotterdam can certainly be called a port for industrial products. In exports, this is true in terms of

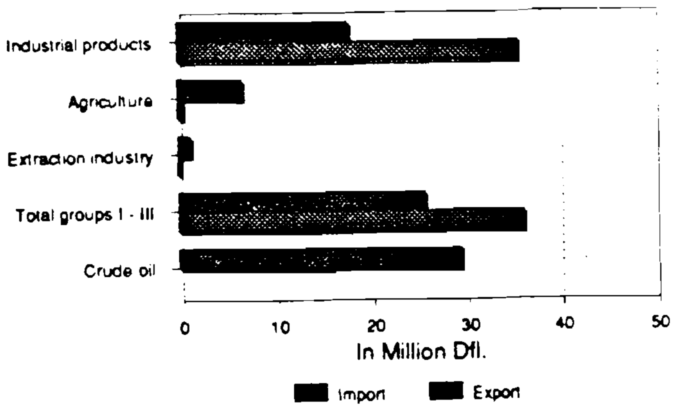


Figure 19: Value of imports and exports by sea 1984. Source: Germeentelijk Havenbednjt R'dam.

weights as well as value. But for imports the tonnage share is still only 30% for industrial products (excl. crude oil).

On the global transportation routes, however, important changes are occurring. Older economic centres decline and new ones emerge, especially in the Pacific Basin (Japan and the NICs). This will have an effect on the global freight flow patterns. The most important freight flows, those between U.S.A/Canada and Western Europe, show considerably smaller rates of growth than the ones between the Far East, South East Asia and the Rest of the World. Especially the freight flow between the USA and South East Asia has had remarkable rates of growth (above 10% a year). The flows from South East Asia and Europe and between Far East and Europe are growing at 5 per cent per annum.

In the long run, these developments will have an effect on the goods shipped to Rotterdam; less raw materials , more semi-manufactured and industrial end products. Taken together with the containerisation of freight, the tendency of increasing numbers of containers will continue. The growth rates for containers all over the world is impressive, in the period 1970 - 1980 a growth of 11.5 % a year. In the 1980s it was 9% a year. Most of the container flows for Europe have been directed to the port of Rotterdam.

The port of Rotterdam is in fact the European main port for companies, such as Sealand, USL and Nedlloyd. Rotterdam's specialty is the transhipment of Full Container Loads (FCLs) for Western Europe. Nevertheless, in line with the growth of international logistics, LCL-containers (Less than Container Loads) are gaining in importance. These are con- tainers which will be stuffed and stripped in the vicinity of the main port. In fact it is an activity with a much higher value added. Antwerp is a port internationally known for handling these LCL-containers. Two recent surveys, conducted by McKinsey and HDIC (Holland International Distribution Center) have revealed that especially Japanese and other Asian manufacturers, which plan to construct a foothold in the Common Market, are giving high priority to the vicinity of a reliable LCL-port. It is in the region adjacent to such a port, that they want to build their distribution centres (<200 km).

Another very important change is the rapid growth of overseas/continental intermodal shipments in the international distribution operations of many companies. Large reductions in logistics costs and substantial improvements in service times can be gained by utilizing intermodal services. International intermodal shipments are currently the fastest growing area of overseas trade. As an example, intermodal flows on the trans-Pacific routes increased by 100 percent over the years 1976 to 1982, compared to 30 percent for total trade on the same routes. Companies like USL, APL from the U.S.A. and Nedlloyd from the Netherlands are heavily involved in intermodal transport. Perhaps the creation of these intermodal transportation companies is one of the most influential factors behind the growth of intermodalism.

Besides the concept of "door to door transport", one of the main principles behind intermodalism is consolidation of freight flows. On the basis of this principle, transport chains and transport systems are developed in which at specific nodes, freight is consolidated geographically and/or in time, thus enabling the use of larger vehicles, trains, boats or planes that offer economies of scale within the larger chain perspective of economies of scope; resulting in lower transportation costs per tonne/km.

Centralized storage points and transport terminals located along large routes, have the effect that geographic closeness is replaced by closeness in real time. In extremis, the way a good is being produced, is altered radically. A product must be kept moving - from its initial stage of raw material to its final consumer - in a logistical coherent network of transportation, production and distribution activities. Storage has to be minimized and activities for trans-shipment, production and distribution are to be located where this is optimal for the Value Added Network (VAN).

This means that in the process of rationalisation and optimisation of goods flows, logistical performance along the chain becomes the key factor. Paperless transactions are becoming possible and necessary where most documents are replaced with computer-to-computer communication. Buffer-stocks between processes are being reduced radically in order to improve productivity and quality. With the help of computer-integrated-manufacturing technology, tele-ordering and rapid transport facilities, production and deliveries can be made to customer requirements much earlier in the logistics chain. The major Hubs or Gateways are becoming both the "material nodes" for the consolidation and de-consolidation of the flows of goods and the "immaterial nodes" of the dataflow networks in the geographical Hub-and-Spoke-networks.

In this perspective, competitive advantages are sought by the Gateway or Hub Rotterdam in a combination of the following elements:

- its advantageous geographical position: a good harbour for large sea-going vessels combined with a network of inland waterways;

- an internationally competitive location for distribution activities, through the presence of all kinds of logistical companies (shipping and forwarding, stevedoring, cargo services, dockage and storage, shipping agents, specialised inland transport modes , etc.), performing against competing costs and performances, the port can function as a multi-functional and intermodal hub;

- a high quality of logistical services as a result of the presence of good and varied "infrastructural" and above all matching "suprastructural" equipments (EDI-facilities and networks).

Table 4: Index of Centrality for European ports

Port	Centrality Index	Road/Rail Access
Antwerp	284.90	172.19
Rotterdam	264.69	147.10
Amsterdam	263.19	145.45
Zeebrugge	225.50	124.20
Dunkirk	223.57	124.20
Rouen	204.30	122.49
Bremerhaven	195.81	108.51
Eemshaven/Delfzijl	186.23	95.19
Brunstbuttel	185.03	108.22
Emden	183.44	97.63
Le Havre	157.56	91.74
Hamburg	138.40	90.32
Wilhemshaven	119.71	93.22

Source: Port Authority Bremen

Good access to the Hinterland has become a conditio sine qua non. A survey conducted by the Authorities of the Port of Bremen showed that the infrastructural access of Rotterdam to its hinterland by railway, inland waterway and road is second best of all ports in the Range Hamburg - Le Havre [40]. For this survey a centrality index was constructed ("binnenwartige Zentralität") for 13 ports in this range (Table 4).

The construction of this index is as follows: it is taken that trans-shipments are the most important shipments for every one of these ports. So, access by rail, road and inland waterway to the markets, in casu the urban agglomerations in the Benelux, West-Germany and France (with more than 400,000 inhabitants) can be taken as principal criteria. Table 4 shows that Antwerp is the port with the best access to its hinterland, Rotterdam is the second best and Amsterdam the third. Hamburg, another major port in Western Europe ranks 12 of 13.

In geographical terms, a port with good access to its hinter- land by means of all modes of transport, is clearly in a much better position for becoming a hub in intercontinental intermodalism, than one which is more peripheral or has lesser access. Geography remains one of Rotterdam's strongest selling points. Since the costs of intercontinental sea transport are only up to 12.5 to 15 per cent of total "door-to-door-transportation"-costs, it is obvious that the competitive positioning of the port of Rotterdam is very heavily dependant on the costs and performance of the adjacent (land)transportation trajectories.

However, it is not only the port itself, its geographical position and its facilities that make Rotterdam strong, it is also the competitive power of the region of which the port is part and the fact that a good international airport is located in its vicinity. These factors too, make a good positioning of Rotterdam internationally possible.

Major physical distribution operators in Europe are re-defining their localisation of networks. This is being done by redefining the ratio of accessibility of a particular region in Europe in terms of quantities divided by times. Accessibility is no longer only considered in terms of distance but more and more in terms of the reliability of time, in relation to quantities. This allows a mixture of traffic (intermodalism) even if it concerns inland waterway shipping or combined rail/road transport.

The localisation of the "hubs" strongly depends therefore upon the logistical capacity of operators to re-organize the flows, in terms of storing of different goods (express, cold, just- in-time), of mixing over different transport modes, and dealing with the necessary informations.

The Netherlands has been chosen by many international companies as their distribution centre for Europe. Point-to-point transportation is being replaced by logistical co-ordination and integration in the form of logistical supply and distribution networks. Distribution activities are located wherever best overall logistical performances and the most economical trade-offs in logistical activities can be made. The dual presence of an international port and an international freight-airport has turned out to be a very important factor.

For example, in 1984 the U.S. company Alcatel (ex ITT) decided to re-organise their international distribution activities, based on the principles of intermodalism and consolidation of freight on trunklines. The Netherlands has been chosen as the European hub. Factors taken into consideration were: the geographical position of locations for the hub, especially the presence of both port and airport in order to make use of sea/air transport; the quality of logistical service organisations; and the presence of producer services. The conclusion of Alcatel has been that the Netherlands, in case the port of Rotterdam and Schiphol airport, are for Alcatel's operations the best gateways to Europe, and that the Netherlands are the best Hub.

In Table 5 (for seven internationally operating companies which use the Netherlands as their distribution centre) the supply and distribution relations are given. Four companies originate from the USA (Honeywell, Bell Helicopter, Rank Xerox and Merck, Sharpe & Dohme), two are from Japan (Sony and Canon) and Sanstrade is a Swedish owned company.

From this table three basic forms of intermodal sea-air transport can be discerned:

1. Rotterdam and Schiphol are gateways to Europe. Distribution centres are located in the Netherlands for the supply of the consolidated intercontinental freight flows. The distribution for the European market is mainly done by road transport.

2. Rotterdam and Schiphol function as international logistical nodes. The ports operate as both world and continental nodes for supply and distribution.

3. Rotterdam and Schiphol are complementary and perform as links in the international logistical chains. Goods are brought in, either by air (Bell Helicopter) or by sea (Canon) and distributed by sea and air/road. The difference with the former two types is the warehousing function (sometimes in the form of free-tax-zones).

Questionnaires answered by the logistical executives of these and other internationally operating companies have revealed that it is not the factor of distance, as such, to the economic centres of the EC that has been decisive in the choice of location in the Netherlands. Three factors were listed as more important: the first was the "main port"

Table 5: Supply and distribution relations of 7 international companies, using the Netherlands as Distribution Center.

supply mode		origin		company	distrib. destination		mode	
Raw Materials								
R	100%	Europe	45%	RANK XEROX				
S	95%	USA	45%					
A	5%	Japan	10%		Europe	67%	R	100%
Semi-manufactured Products					Rest W.	33%	S	?
R	100%	Europe	70%				A	?
S	95%	USA	25%					
A	5%	Japan	5%					
End-Products								
S	95%	USA	?					
A	5%	Japan	?					
S	100%	USA			Netherlands			
		Far East	70%	SONY	Belgium	80%		?
					Italy			
A	100%	Japan	10%		Scandinavia			
R	100%	Europe	20%		Eastern Europe	20%		?
Metalworking					Metalworking			
R	100%	Europe	96%	SANSTRADE	Europe	90%	R	60%
A	100%	Rest W.	4%				A	40%
					Rest W.	10%	A	100%
Special Steels					Special Steels			
R	100%	Japan	80%		Europe	80%	R	100%
R	100%	Europe	20%		Rest W.	20%	S	100%
Saws and Tools					Saws and Tools			
R	100%	Europe	90%		Europe	90%	R	100%
S	100%	Far East	5%					
		USA	5%	Rest W.	10%		?	
S	?				E.C.	38%	R	100%
A	?	USA	25%	MERCK, SHARP	Rest E.	50%	R	100%
R	90%	Europe	75%	& DOHME				
?	10%	Middle E.			Rest W.	12%	A	100%
S	80%	Japan	80%		Europe	90%	R	100%
A	20%	Rest W.	20%		Africa			
					Middle E.	10%	S	?
							A	?
R	39%	Europe	100%		Europe	75%	R	90%
Rail	11%			HONEYWELL			A	10%
S	80%	USA			Middle E.	15%	S	20%
A	20%	Japan					A	70%
		Canada					R	10%
					Far East	4%	A	50%
					Latin Am.	3%	S	50%
					USA	3%	A	100%
A	100%	USA	100%		EC	50%	R	15%
				BELL			A	85%
				HELICOPTER	Rest E.	10%	A	100%
					Africa		A	75%
					Middle East		S	25%

R = road transport Rest W. = rest of the world
S = sea transport Rest E. = rest of Europe
A = air transport Middle E. = Middle East

Source: Ministry of Economic Affairs of the Netherlands, Commission for Foreign Investment in the Netherlands: *The Netherlands—Europe's Distribution Centre. Twelve Case Studies*. Adaptions made by Van der Loos & Harleman (1988).

character of Rotterdam and Schiphol. These nodes are in fact nodal points of nodal points in international transportation networks.

The port of Rotterdam is in fact the European main port for companies such as Sealand, USL and Nedlloyd.

It is in the region adjacent to such a port that they normally want to build their distribution centres.

The second factor was the presence of highly specialized and reliable internationally operating intermodal companies. This offers the possibility to use highly qualified and specialised outside distribution companies (carriers, warehouses or third parties) to perform all or part of a company's distribution function (including transportation, storage, inventory control, customer service and logistics information networks.

Thirdly, over and above that, the financial and fiscal conditions: the Netherlands have always had a liberal trading policy and Rotterdam and Schiphol are located within one and the same fiscal policy region, and for non-domestic freight flows there exists an excellent bonded warehousing system.

So, the old function of the port of Rotterdam is gradually changing into new ones: main port for intercontinental container lines, European distribution centre, port for LCL-container handling and even a "productive port". For its older functions, the material infrastructural networking was decisive. With new functions, the port has to become integrated into the international Logistical and Value Added Networks.

For this, EDI systems and networks are pre-requisites. Information systems are used ever more to acquire a competitive edge on other ports, with respect to effiency (costs and speed) and reliability, and play a much more important role in the control of freight flows nowadays than was the case in conventional transport. In today's transportation the provision of an internationally linked network for the flows of communication is as important as the provision of physical networks for the flows of cargo.

Networking and integration of the port of Rotterdam mean also "systems commitment" of Rotterdam with logistical nodes in its hinterland. The competitive edge of Rotterdam is closely linked to the ability to tranship as quick and as reliable as possible the goods into and from the hinterland. Reliable transport axes for all modes of transport are necessary, penetrating into the urban agglomerations of Europe. It is for this reason that, apart from the battle over the different Port Information Systems, we can see strong competition in Europe amongst the different ports over the structure of the road networks towards the Channel Tunnel (the "Chunnel") and the European High Speed Trains (HST of TGV) networks. For ports seem to be applying the same rule as manufacturers, get into the chains or go out of business.

6 Perspectives, paradoxes and politics; the Rotterdam strategies

For Rotterdam, getting into the logistical chains seems to be the strategy of becoming a very well equipped port for the flows of (containerised) goods from and into Europe. The competition between ports is then mainly about the levels of technological and economic equipments, and therefore the required logistical activites and services. It often seems that it is this goal that is being pursued, both by municipal and regional authorities, and national authorities not only in the Netherlands but in Belgium, Germany and France as well.

Considering the amount of capital investment needed to equip a port region and its related infrastructural hinterland networks along the latest standards, one can see that this is a very expensive competitive strategy. Certainly in respect of the fact that only one or two ports in the Hamburg - Le Havre range will become main ports. Therefore a second, in and in our view more preferable logistical strategy is also possible and in fact already discernable. This is the strategy of becoming a node in the various logistical product channels. It is a strategy of building strong positions in several logistical product chains or Value Added Networks. This strategy does not necessarily coincide with the geographical strategy of becoming the European Gateway or even Distribution Centre.

At this moment Dutch national, regional and local strategies in infrastructure and physical planning seem to be pretty much in line with each other. The crucial weight of the distribution functions and producer services is generally acknowledged in the Netherlands. For the City of Rotterdam this means that its strategy has the fullest support of all Dutch planning levels and sectors. Up to a certain extent, this strategy is a break with the strategy of the seventies in urban policy. From the mid-seventies until the mid-eighties urban renewal dominated the scene, with its emphasis on the housing question. The net outcome is that decay has been stopped, and that nowadays "living in the city" has become again a central issue; Rotterdam as a "compact city" as the architectural and planners' concept goes.

The strategy of today and tomorrow is aimed at the construction of the so called "New Rotterdam"; the revitalisation of the city in accordance with becoming a European and global urban node. As Knight has formulated it:

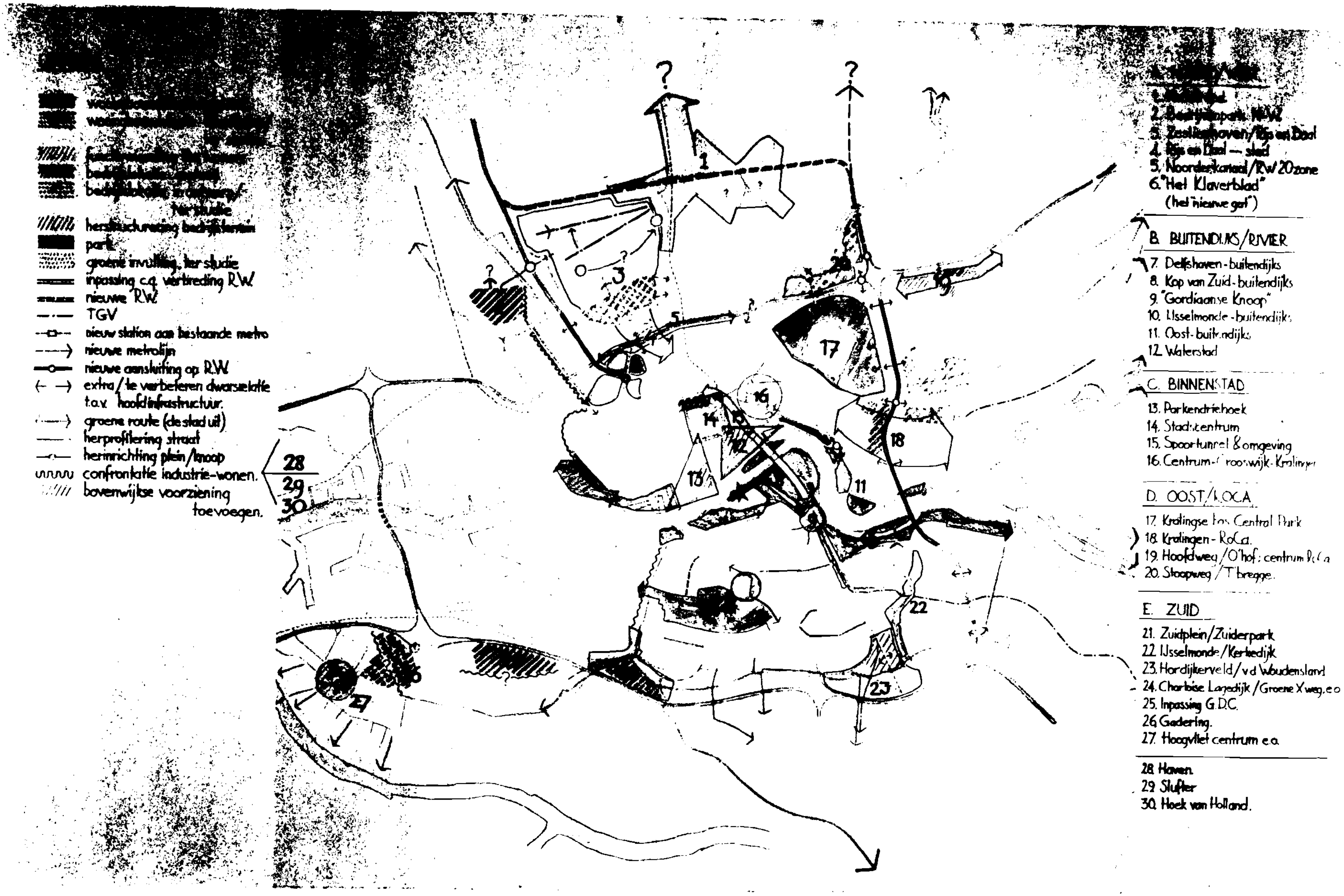
> "the primary role that a global city plays in global society is the governance of technology, i.e. the advancement and management of industrial and cultural know how. In order to do this, the city must assimilate technological culture and build a society that is learning based and multi- cultural" [41].

Several spearhead actions have been formulated to achieve such goals (see Map 9).

Of particularr interest to us are the port-related and port oriented plans. In order to fulfill adequately the international logistics functions, it is con- sidered essential that the city of Rotterdam should create a high standard of both physical appearance (a skyline which will fit a global city) and of urban daily life (from loft living to high quality of social housing). It is recognised that to build an international competitive urban environment, it is not just a matter of infrastructure but also a matter of amenities. This strategy goes along with the findings of Andersson & Batten, that

> the centres of higher education and their surrounding regions will become favoured locations and these C-regions (C for Competence, Culture, Communication and Creativity) are already forming a new network. C-regions tend to be the locations where R & D oriented units operate in corporations possessing the new systems architecture [42].

MAP 9



herstructurering bedrijfsterrein
park
groene invulling, ter studie
inpassing c.q. verbreding R.W.
nieuwe R.W.
TGV
nieuw station aan bestaande metro
nieuwe metrolijn
nieuwe aansluiting op R.W.
extra/te verbeteren dwarsrelatie t.a.v. hoofdinfrastructuur.
groene route (de stad uit)
herprofilering straat
herinrichting plein/knoop
confrontatie industrie-wonen.
bovenwijkse voorziening toevoegen.
2. Bedrijvenpark N-W
3. Zestienhoven/Rijs en Baal
4. Rijs en Baal — stad
5. Noordeskanaal/R.W. 20 zone
6. "Het Klaverblad" (het nieuwe gat)
B. BUITENDIJKS/RIVIER
7. Delfshaven-buitendijks
8. Kop van Zuid-buitendijks
9. "Gordiaanse Knoop"
10. IJsselmonde-buitendijks
11. Oost-buitendijks
12. Waterstad
C. BINNENSTAD
13. Parkendriehoek
14. Stadscentrum
15. Spoortunnel & omgeving
D. OOST/KOCA
17. Kralingse bos Central Park
18. Kralingen - KoCa.
19. Hoofdweg/O'hof: centrum KoCa
20. Stoopweg/'T bregge.
E. ZUID
21. Zuidplein/Zuiderpark
22. IJsselmonde/Kerkedijk
23. Hordijkerveld/v.d. Woudenstand
24. Charloise Lagedijk/Groene X weg. e.o
25. Inpassing G.D.C.
26. Gadering.
27. Hoogvliet centrum e.o.
28. Haven.
29. Slufter
30. Hoek van Holland.

Generally speaking, the city of Rotterdam is working on an integrated vision and strategy on issues as there are urban development, the recent boom of the service industries, and the logistical and infrastructural positioning of the port of Rotterdam. The city development plan "Logistructuur" reflects this integrated approach and in fact constitutes the first step towards a new integrated system of planning logistics and infrastructure in a city and region. Special attention is drawn to the performance of the Dutch national railway system, which at this moment can be classified as inadequate to perform the newly emerging internationally transportation tasks from and to the port. In the near future a fun- damental update and upgrade of the (self-contained) freight train system will be unavoidable. Moreover, combined transport possibilities have to be fully used. A cooperation between parties involved in necessary (piggyback companies, rail container companies, railway companies) [43].

C-regions and Global Cities, however, are not only locations of renewal of the infrastructural and logistical organizational structures. They are at the same time the regions with huge masses of unemployed, with high interracial tensions and other social contradictions. Technological innovation and modernisation is not only an economic-technological process. It is also a societal renewal process. Not only the material conditions matter, but also the social spheres. It goes beyond the scope of this paper to elaborate this point. Suffice it to say that it is necessary that the planning strategy of Rotterdam entails a socio-economic policy, in which problems are addressed as the compartementalization of social and urban life in relation to the formation of global logistical nodes. It has been argued that only when these factors are taken into account too are they interacting regionally in a synergetic form, and actual innovation will take place [44].

To summarize; as we have indicated logistics are on the move. From main port concept via hub & spoke approaches to integrated control and management of goods and information networks.

Dutch firms and enterprises are just beginning to acknowledge the strategic importance of Channel Logistics. Dutch national and local government is pursuing strategies aimed at developing urban nodal pints by strengthening infrastructural networks and constructing EDI-networks and facilities.

Last but not least, we have discussed how Rotterdam is trying to improve its functioning as a gateway to Europe on the one hand and to become a European distribution centre on the other. It is striving to improve its economic and social basis by stimulating infrastructure, i.e. railroad and highways, by creating social amenities, green belts etc. Special attention is also being given to the containerisation and EDI networks.

Confronting these strategies with the perspectives of logistical developments, one can, however, arrive at the following problems, which will only be formulated here but not be elaborated upon:

1. By concentrating so hard in trying to become the gateway to Europe by improving and facilitating container and goods flows into and from Europe, is Rotterdam "digging its own grave" in the longer run? Is there a contradiction between the function of a port in the "logistics" of the container flows and that in the "product chain logistics"?
2. Will Central Europe be the dominant area influencing Rotterdam negatively by "waking up" the (former) Mediterranean sleeping powers?

Strategic logistics research in the Netherlands will surely have to deal with these questions in the near future.

References and Notes

1. Braudel, F. (1979). Civilisation matérielle, économie et capitalisme XVe - XVIIIe siècle; tome III, pp. 202. Paris. Armand Colin.
2. Wallerstein, I. The modern world system II, pp. 53 a.f.
3. McNeill. The rise of the west, pp. 727 a.f.
4. Braudel, F. o.c. tome II, pp. 398 a.f.
5. Hobsbaum E. The age of capital, ch. 2, pp. 27 a.f.
6. Rothwell R., Zegveld, W. (1985). Reindustrialisation and technology. Longman.
7. Tulder van, R., Junne, G. (1989). European Multinationals in Core Technologies. Wiley, Sussex.
8. See the "classical work" of Hirschman, A.O. (1958). The strategy of economic development. New Haven.
   Janssen, B. and van Hoogstraten, P. (1989). The "New Infrastructure" and regional development. In: L. Albrechts, F. Moulaert, P. Roberts and E. Swyngedouw (eds.): Regional policy at the crossroads: European Perspectives. Jessica Kingsley Publishers, London.
9. Dupuit, J. (1968). Public Works and the Consumer. Reprint from Annales des Ponts et Chaussées 1844, in Transport, edited by Denys Munby; Penguin.
10. De Vierde Nota over de Ruimtelijke Ordening van Nederland (The Fourth Memorandum on Physical Planning in the Netherlands), Staatsuitgeverij, Den Haag, 1988.
    Structuurschema Verkeer en Vervoer (Structure Scheme on Traffic and Transport), Staatsuitgeverij, Den Haag, 1989.
11. Wang, W. (1987). Delft: De nieuwe kleren van de keizer. In: Planologische Discussiedagen.
12. Junne, G., Ruigrok, W.M. (1988). Een wereld van handelsblokken? In: Economisch Statistische Berichten, no. 21, 28-12-1988.
13. Laing, E.T. (1984). Containers, Conferences and Competition; special report no. 170, Economist Intelligence Unit.
14. Holland International Distribution Council (HIDC) (1988). The Gateway to Europe. The Hague'.
    The Fourth Memorandum on Physical Planning, o.c.
15. Kearney, A.T. (1986). European Logistics Productivity Survey. Brussels, Belgium.
16. NEHEM/McKinsey Company (1987). Resultaatsverbetering in het Midden-en
    Kleinbedrijf door integrale goederenstroombeheersing. 's Hertogenbosch.
    NEHEM/McKinsey Company (1988). Kiezen voor de jaren negentig. terug naar de kernactiviteiten en andere antwoorden van ondernemend Nederland op de uitdagingen van de jaren negentig. 's Hertogenbosch.
17. A "product" may be a broad group of similar products managed separately or collectively (a man's rain coat, or men's wear).

18. Town Planning Institute of the Municipality of Rotterdam (1984): Ontwikkelingen in logistiek en transport, DROS, Rotterdam.

19. Zebrubavel, E. (1982). The Standardization of Time. A sociohistorical perspective. American Journal of Sociology, 88, pp. 1-23.

20. Beniger, J. (1986). The Control revolution. Technological and Economic Origins of the Information Society. Harvard University Press.

21. For the Netherlands: Griffiths, R.T. (1982). The Creation of a National Dutch Economy. Tijdschrift voor Geschiedenis, 95, pp. 513-537.

22. Knippenberg, H., and de Pater, B. (1988). De eenwording van Nederland (The Unification of the Netherlands). SUN Nijmegen.

23. Wandel, S., and Hellberg, R. (1987). Transport consequences of new logistics technologies. Paper read at the Second world congress of production and inventory control, Geneva.

24. Wang, W. (1986/87). Rotterdam in het krachtenveld van de veranderende wereldruimte. DROS Rotterdam.

25. Mair, A., Florida, R., and Kenney, M. (1989). The New Geography of Automobile Production: Japanese Transplants in North America. In: Economic Geography (October issue).

26. Ohmae, K. (1985). Traid Power: the coming shape of global coompetition. Free Press.

27. Wang, W. (1982). Trafieken en bootwerkers. In: Stedebouw in Rotterdam, plannen en opstellen 1940 - 1981; Van Gennep Amterdam, 1981.

28. Netherlands Economic Institute (1987): De betekenis van transportkosten. Rotterdam.
de Wit, R. (1987): Transport services, logistic services and information technologies; an input-output analysis of the Dutch economy. Draft Report, IIASA, Laxenburg.

29. NEHEM/McKinsey Company (1987). Resultaatsverbetering in het Midden-en Kleinbedrijf door integrale goederenstroombeheersing. 's Hertogenbosch.

30. Kearney, A.T. (1986). European Logistics Productivity Survey. Brussels, Belgium.

31. NEHEM/McKinsey Company (1987). Resultaatsverbetering in het Midden-en Kleinbedrijf door integrale goederenstroombeheersing. 's Hertogenbosch.

32. Janssen, B., and Machielse, K. (1988): Logistiek, Ruimtelijke Organisatie en Infrastructuur. INRO-TNO, Delft.

33. NEHEM/McKinsey Company (1988). Kiezen voor de jaren negentig. terug naar de kernactiviteiten en andere antwoorden van ondernemend Nederland op de uitdagingen van de jaren negentig. 's Hertogenbosch.

34. NEHEM/McKinsey Company (1988). Kiezen voor de jaren negentig. terug naar de kernactiviteiten en andere antwoorden van ondernemend Nederland op de uitdagingen van de jaren negentig. 's Hertogenbosch.

35. Machielse, K., and Janssen, B. (1987). Logistics in production and transport; infrastructural requirements. Paper prepared for the First International Meeting on Freight, Logistics and Information Technologies, The Hague, December 17-18.

36. Janssen, B. (1987). Production, Transport, Logistics and Infrastructural Requirements: The Case of the Netherlands. Paper presented at the IIASA Workshop on Logistics Technologies, Bük, Hungary.
See also: B. Janssen and K. Machielse (1988).

37. See: B. Janssen (1987) o.c.
Janssen, B., Machielse, K. and De Ruijter, P. (1989). Logistics, Flexibility and the Control of the Production Processes. The rise of a new industrial landscape in the Netherlands? To be published in Futures.

38. See K. Machielse and B. Janssen (1987) o.c.

39. Data for this paragraph have been obtained from various issues of the journal Rotterdam Europoort Delta, published by the Port of Rotterdam.

40. Bremer Ausschuß für Wirtschaftsforschung (1980).

41. Knight, R. (1987). Governing the Post-Industrial City; Building the Global City. Conference Draft, Yellow Springs, OHio Antioch College.

42. Andersson, A. and Batten, D. (1988). Creative Nodes, Logistical Networks, and the Future of the Metropolis. In: Transportation 14, 281-293.

43. Ruijgrok, C. (1989). Possibilities for combined transport to and from the Netherlands. In: H.G. Smit (ed): European Transport Planning Colloquium; European Transport in 1992 and beyond. Proceedings of the European colloquium Brussels, April, 27 & 28.

44. Drewe, P. (1989). Adviescommissie Sociaal Economische vernieuwing Rotterdam (1987); Nieuw Rotterdam; een opdracht voor alle Rotterdammers. Rotterdam.

Logistics in Japan to Meet Market Demand on Time

by

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1. INTRODUCTION

In the current mature economic climate, market demand is highly variable. From the manufacturing viewpoint, this climate generates three unfavourable conditions ; diversified demand, greater difficulty of forecasting demand and shorter product life cycles. Thus, the competitive power of the manufacturing company increasingly depends on the speed of obtaining market information, manufacturing lead times and the speed of distribution. In Japan logistics is expected to play a key role in these processes - from market investigation to customer delivery to pursue competitive manufacture strategically. This report first reviews economic environments surrounding "manufacture". Then the following section deals with the role of logistics to meet market demand on time after giving the true meaning of JIT manufacturing and distribution. The fourth section discusses requirements for establishing the logistic system which integrates sales, production and distribution functions as a first step towards the total logistic system. The last section sees logistics from a broader viewpoint and stresses the necessity of putting brilliant human resources into the logistic function for implementing an efficient logistic system in order to gain a competitive edge.

2. ECONOMIC ENVIRONMENTS SURROUNDING "MANUFACTURE"

2.1 Trend of Supply and Demand Relation

Fig. 1 shows a conceptual relationship between demand and supply from the time before the first oil crisis to the present time. During the high growth period before the first oil crisis, there was ample demand in the market and various products were developed, produced and sold mainly on the initiative of the manufacturer. However, all markets eventually become saturated, and evidence of market saturation began to appear after the first oil crisis as shown in Fig. 2.

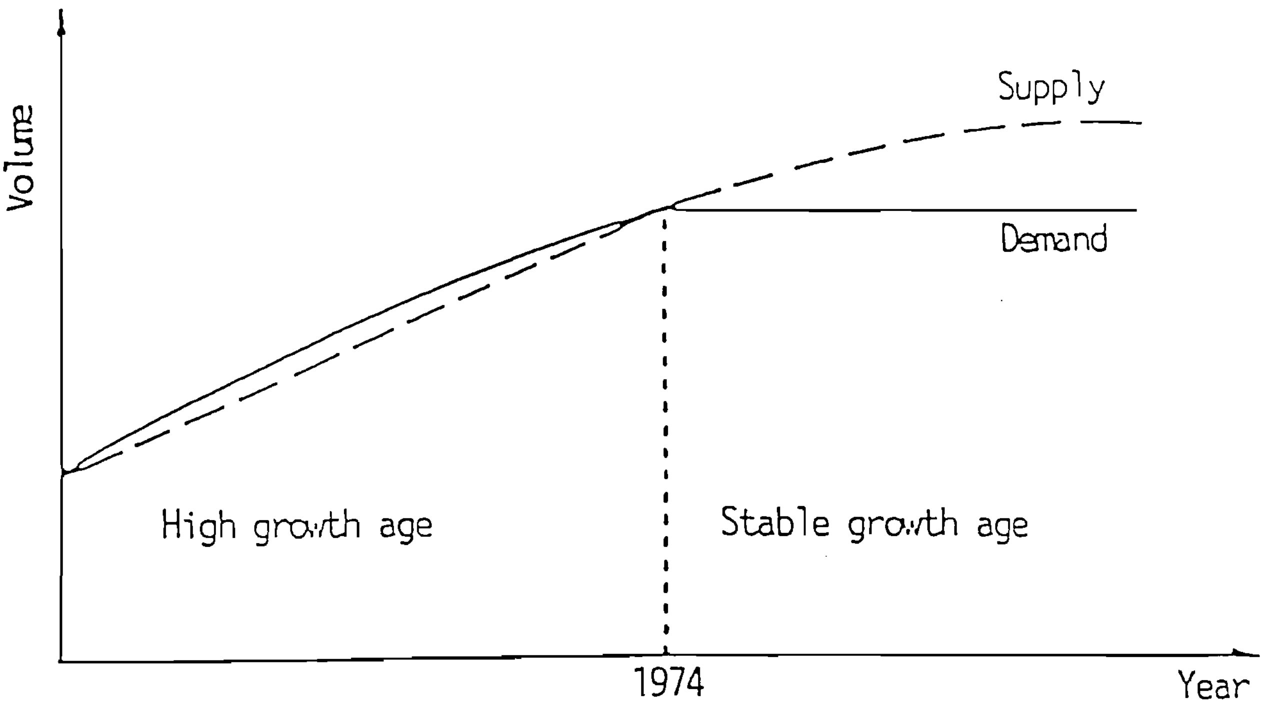


Fig. 1 : Trend of supply and demand relation.

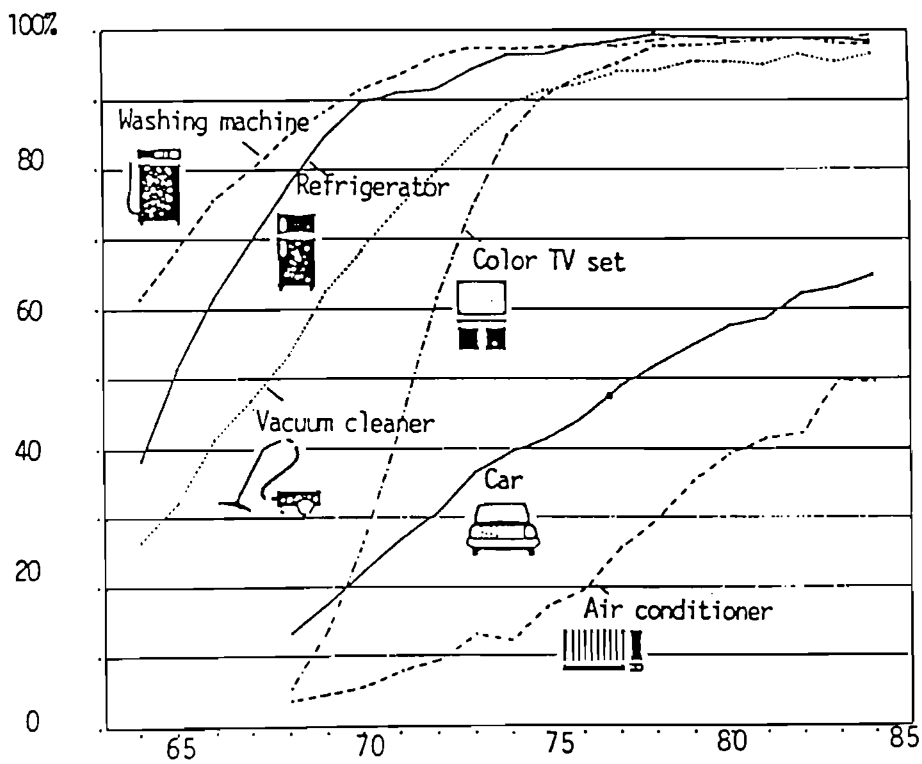
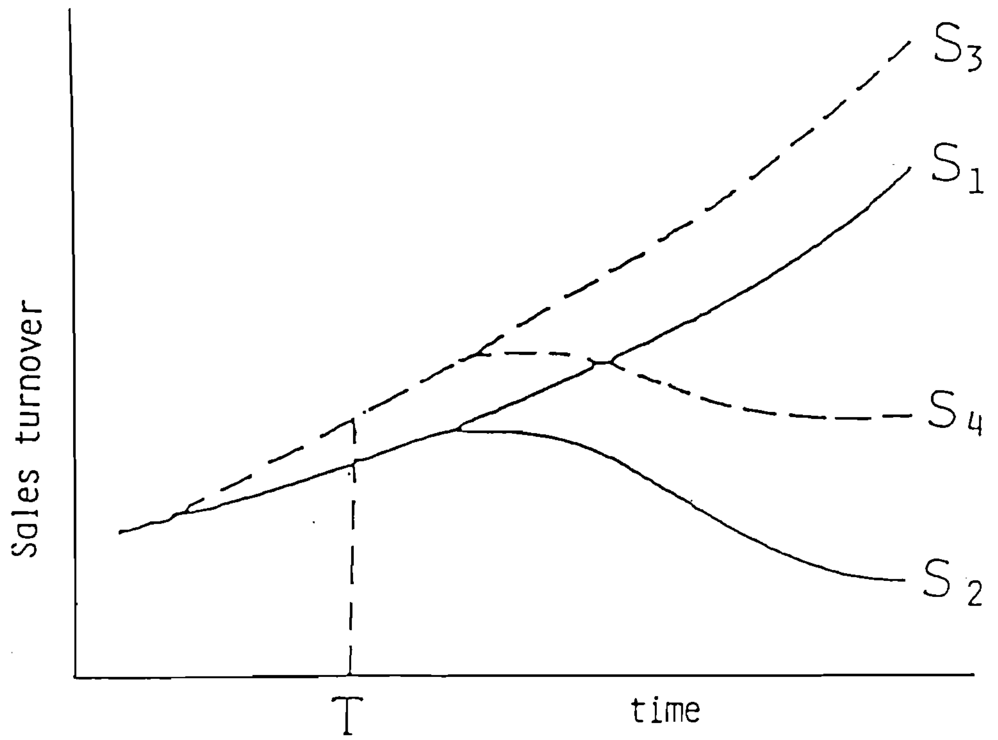


Fig. 2 : Transition of ownership ratio of consumer durables in Japan.

2.2 Diversification Theory

There is a theory in economics about the effect of diversification on sales. Fig. 3 illustrates this theory. In this graph, curve S_1 shows the sales volume over time of a given product. If this product could be produced with many variations in such a way as to meet every kind of need, then sales could possibly be increased to level S_3. Likewise, if there is a product that sells at level S_2, sales could be increased to level S_4 with increased variations.



——— estimated sales curve without diversification

– – – estimated sales curve with diversification

Fig. 3 : Diversification theory.

2.3 Growing Need for Products Matching the Individual Person's Circumstances, Personality and Tastes

In the saturated market, manufacturing companies were forced to face intensified competition. In order to maintain and hopefully to increase sales, they tried to create a new market. For instance, in the case of consumer durables, once it was a "must" to have, say, one air conditioner at each house, but now the manufacturers succeeded in creating the feeling that each room needed an air conditioner.

However, every room has a different capacity, space and color on the walls. To put an air conditioner on the wall, on the ceiling or on the floor depending on the condition of the room, different kinds of units must be provided to fit the different needs. As the standard of living has improved, consumers who have become more affluent have willingly accepted such manufacturer's endeavors. As a matter of course, there has been a growing need for products matching individual persons'circumstances, personality and tastes.

If manufacturers sell only their main products, they are liable to lose their market share. In order to meet the diversity of customers' needs, various types of products must be produced. This tendency will become more intensified in the future. Thus, after the first oil crisis, products have come to be developed in consideration of the needs of the consumer. Therefore, the period before the oil crisis is called the "Era of Product Out" and after the oil crisis, the "Era of Market In", as shown in Fig. 4.

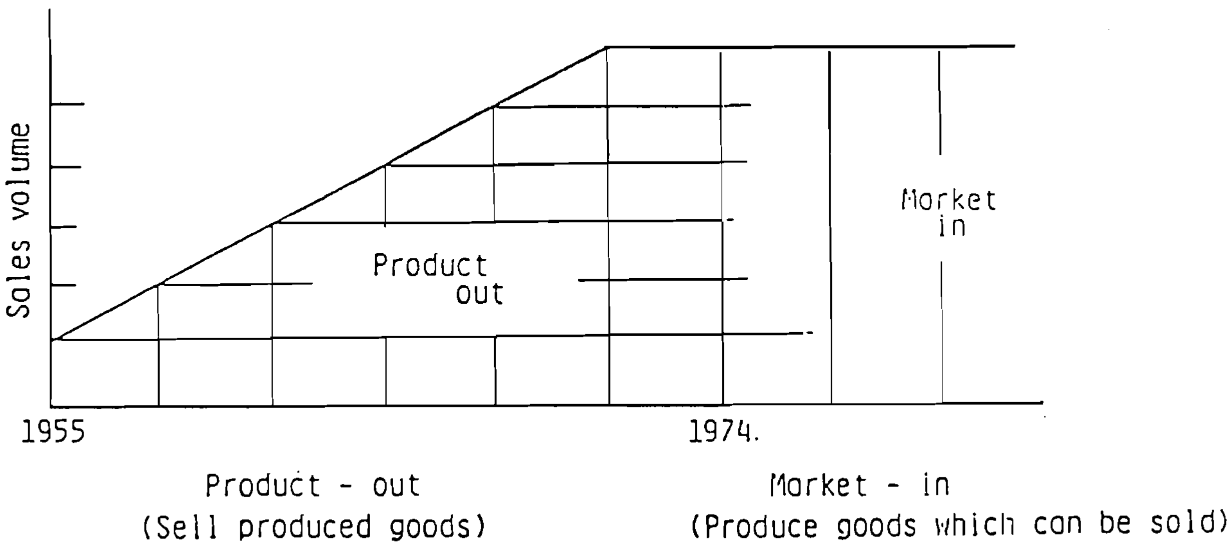


Fig. 4 : Economic environments.

2.4 Number of Variations and Market Share

Fig. 5 is a famous curve showing the relationship between the number of variations and the market share in the case of color TV sets in the Japanese mnarket. Matsushita, here indicated by an M, produces the highest number of variations in the case of color TV sets and secures the highest market share in this market. Other producers with lesser number of variations follow, such as H, T and S. There is some relationship between the number of variations and the market share.

2.5 Product Life Cycle

Fig. 6 illustrates graphically product life cycles during the 70's and 80's. In the 70's, product life cycles were relatively longer. But product life cycles have become increasingly shorter with multiple variations, because of new demand creating activities based on the policy of built-in obsolescence by manufacturers. In part, these activities have been supported by recent technical innovation. This trend is expected to increase markedly. Accordingly, when formulating a new production system, we must think of: first, the production volume, second, the number of variations and third, the product life cycle. Depending on those figures, we then have to develop a suitable production system.

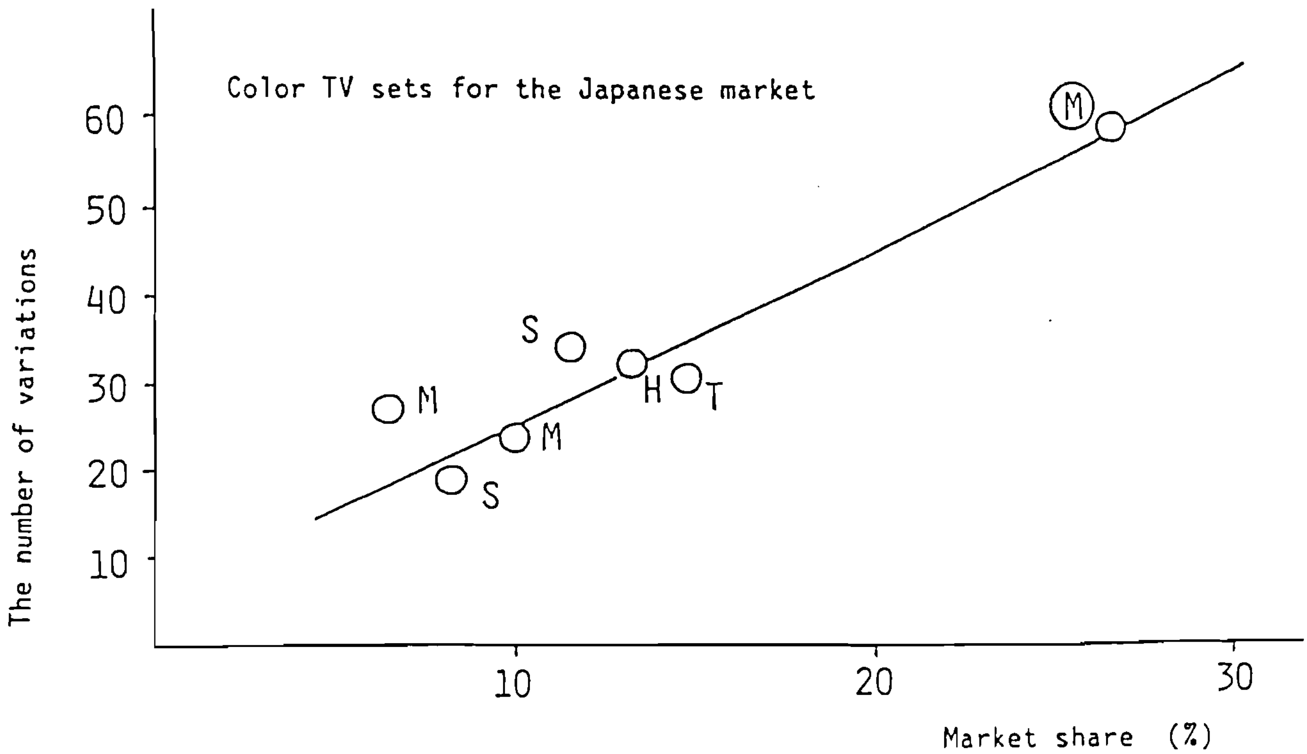


Fig. 5 : Relationship between the market share and the number of variations for matured products.

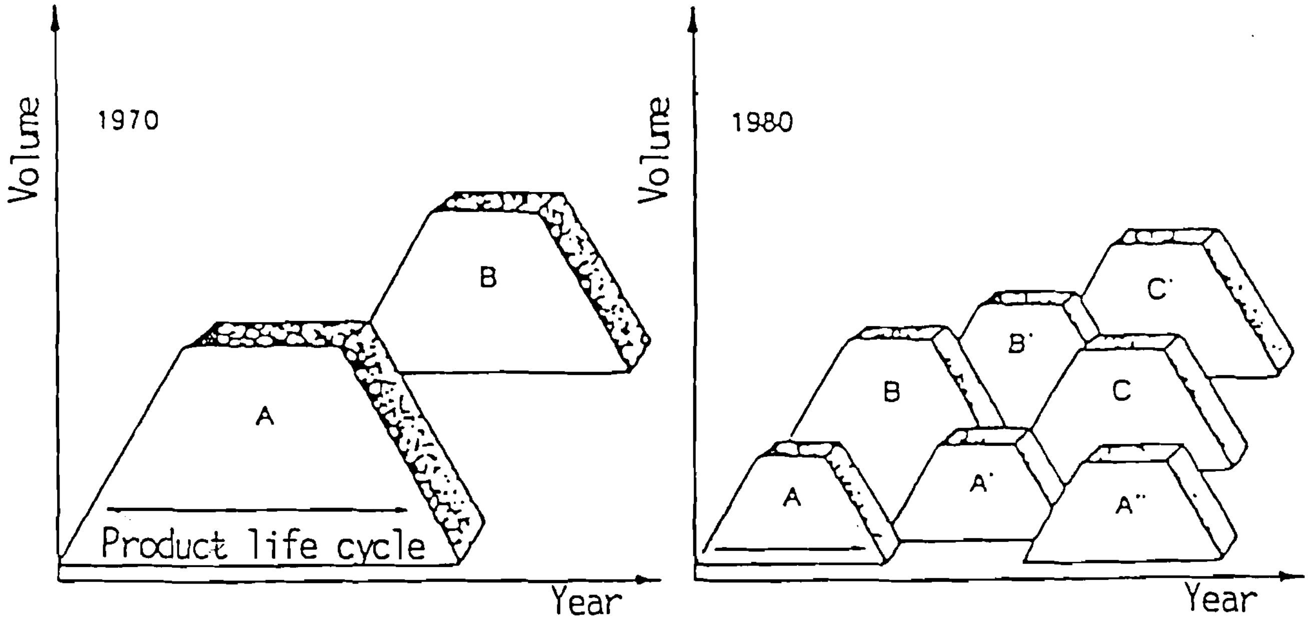


Fig. 6 : Product life cycles durng the 70's and 80's.

2.6 Three Most Unfavorable Conditions Influencing Production

In summary, we have to face the three most unfavorable conditions to manufacturing, which are : diversified demands, great difficulty of forecasting demands, and shorter product life cycles as shown in Fig. 7.

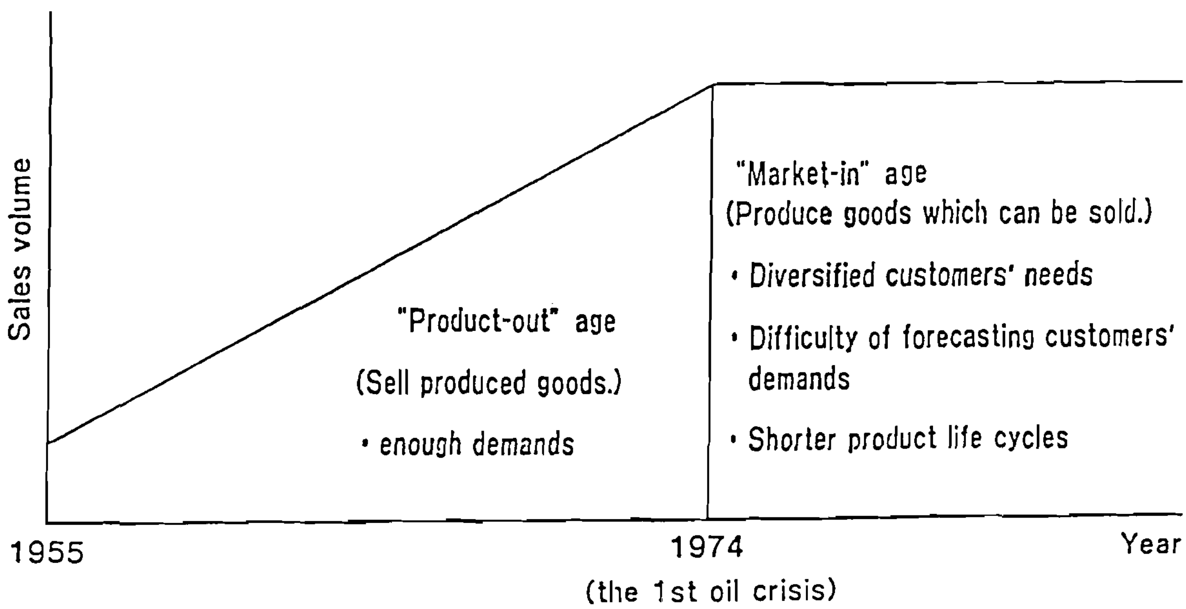


Fig.7 : Market situations before and after the 1st oil crisis.

3. ROLE OF LOGISTICS TO MEET MARKET DEMAND ON TIME

3.1 Competitive Factors in the Market

With the conventional manufacturing system and production control method, it is becoming almost impossible for the manufacturer to cope with the three most unfavorable conditions to manufacturing.

What mainly count as competitive factors in the market for manufacturing companies are :

* price,
* quality including services
* delivery date

In what order these items count heavily depends on the product. It is normally the case that when a customer wants to buy a certain product from a company, he wants to place his order with specifications at the latest possible day and that once he has made a decision, he wants to have it delivered immediately or on a certain fixed date. If he has to wait for a long time until he gets it, most probably he will lose his desire to buy it. If he finds a similar product made by another company, if the price and quality of it are almost the same, and if that product can be delivered to him much faster than that company, he may buy it. Therefore, delivery dates are surely a very important factor for the company to be competitive.

3.2 Two Solutions Flexible Enough to Meet Customers' Demand

To meet such a customers' demand, the company can take the following two solutions:

(1) To keep a very high stock of finished goods.

Then, whatever demand comes, there is no danger of losing the customer since the company can meet the demand immediately. This solution has a very attractive characteristic for the company since it enables the company to have stable production.

In fact, in the West there are many companies which employed or are still employing this solution. But, in such companies it is often the case that they don't have the very items customers want although they have a high stock of finished goods, and that the customers have to wait for a long time until they get them.

The drawbacks of this solution are:

(i) Tied up capital in the finished stock can be dangerously high.

(ii) Some of the finished stock may become dead stock because the total demands are limited and because the product life cycles are getting shorter and shorter.

(iii)Retailers, wholesalers and manufacturers have in many cases only limited space for keeping inventory. Thus, it is very difficult for them to store all the stock.

Because of these reasons, this doesn't seem to be the right solution.

(2) To have very short lead times to replenish the stock of finished goods. Then, whatever demand comes, it can easily be met. This is surely the right solution.

One function of inventory is to act as a buffer between sales and production and between production and purchasing. In other words, it separates the sales function and the purchasing function from the production function and enables them to function independently. The mass production and mass distribution system was made possible thanks to this buffering function of inventory, as shown in Fig. 8(a). But the present mature and diversified market has made this solution unfeasible. Diversification is liable to involve waste caused by the unbalance between production and sales activities. In more precise words, waste caused by excessive production of undemanded products and waste caused by losing sales opportunities because of the shortage of demanded products. Thus, if the production system cannot cope with the market needs quickly enough, obviously shortage of products and excessive inventory take place. This will be followed by the decrease of sales and the loss of the company's reputation.

Thus, it has become very important to be able to provide customers with the products meeting their demands at the right time with reasonable prices, in other words, to implement "just in time" production and "just in time" distribution. To meet the demand of just in time production and distribution, the Japanese have found as a solution the shortening of lead times. If lead times are short enough, any demand can be met whatever it is and redundant stock can be eliminated. Few stock can be accepted between sales and production and between production and purchasing. In principle, with few stock, production must confront directly the diversified and unforeseen market, as shown in Fig. 8(b). This means that only minimizing production cost is not a sufficient criterion to operate the production system. A new element, flexibility, has become a crucial concern for operating the production system.

3.3 Vital Elements to Meet Market Demand on Time

The following are the major elements required to meet market demand right on time.:

(1) Investigation of market demand

(2) Flexible production

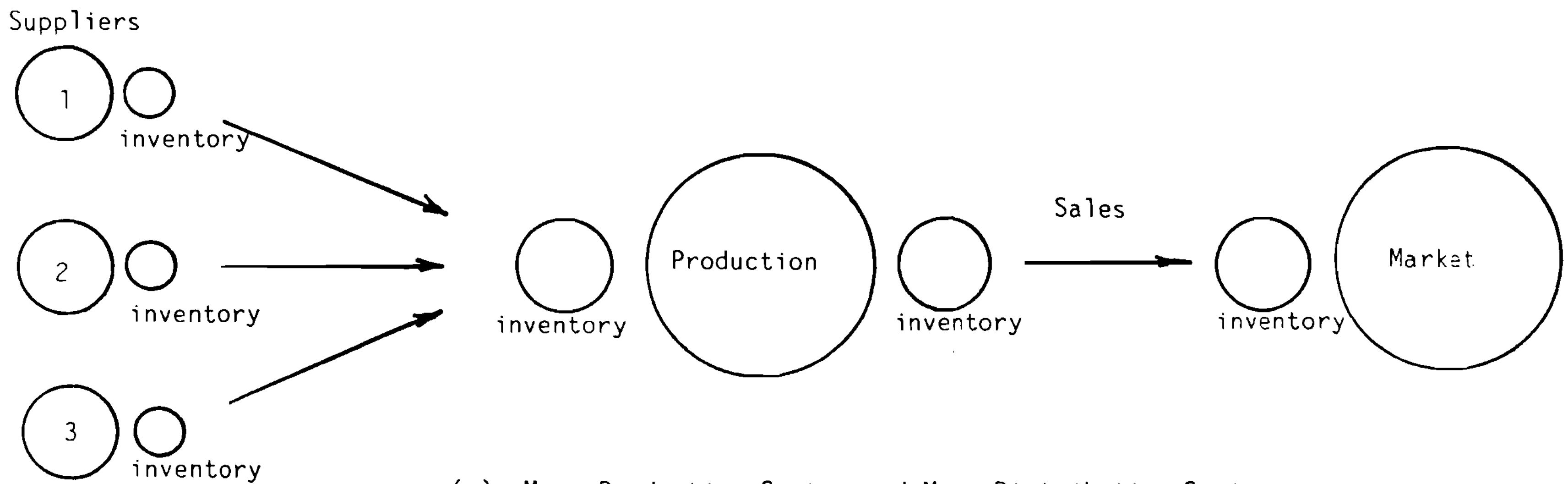
(3) Purchasing of the necessary materials just in time

(4) Integration of sales, production, purchasing and distribution functions by an efficient logistic system

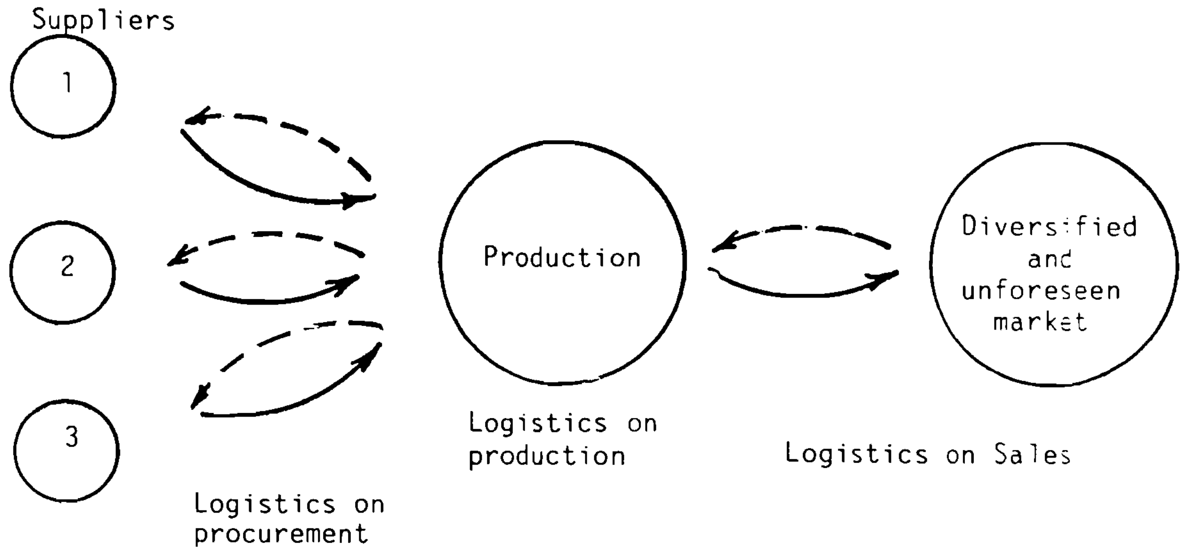
In other words, the competitive power of the manufacturing company increasingly depends on the speed of obtaining market information. The loger the time required for obtaining the information on the market demand, the higher the stock level and the bigger the risk of manufacturing undemanded products leading to lost sales due to shortage of demanded products. Competitive power also depends on the speed of procuring the necessary materials, of manufacturing the right products in the right quantity and of distributing them to the right place at the right time and at the right cost. In Japan logistics is expected to play a key role in these processes - from market investigation to customer delivery.

3.4 Logistics to Meet Market Demand on Time

Logistics is the subject for rationalizing the total



(a) Mass Production System and Mass Distribution System



(b) JIT Production System and JIT Distribution System

Fig. 8 : Production must confront directly the diversified and unforeseen market.

material flow. Before the first oil crisis, manufacturing companies regarded logistic systems as connecting pipes to support mass production and mass consumption. But, the present economic circumstances need new logistics to cope with the customers' demands on many variations, small or medium volume delivery and short delivery time from the point of receiving an order to delivery, i.e., JIT logistics. But, JIT distribution is normally associated with a substantial increase in the distribution costs. Many Japanese companies are now trying to introduce JIT logistics by reforming the conventional logistic system, together with the help of the progress of micro electronics.

Logistics is concerned with the information flow and the material flow. Its rationalization needs to be pursued by shortening the lead time of each phase from market investigation to customer delivery, trying to synchronize information flow and material flow. From the viewpoint of the different processes from market investigation to customer delivery, logistics can, for convenience sake, be classified into logistics on sales, logistics on production and logistics on procurement as shown in Fig. 8(b).

JIT logistics on sa'es involves :

(1) Placinng distribution centers
(2) Installation of direct links between distribution centers and large retail outlets
(3) Selecting routes for transportation
(4) Using transportation vehicles efficiently
(5) Establishment of sales plans with high accuracy
(6) Investigation of market demand daily or at least weekly
(7) Control of supply from operation to distribution centers
(8) Controlling inventory

JIT logistics on production is concerned with such items as:

(1) Flow oriented layout (Various machines are placed in such a way that materials are transformed into products sequentially.)
(2) Short setup times
(3) Mixed production in a small lot (ideally one piece)
(4) Build in quality at each process
(5) High machine availability with TPM (Total Productive Maintenance)

(6) Low absenteeism rate (motivation)

JIT logistics on procurement deals with items such as :

(1) Establishment of information networks with supplier to procure the necessary materials for manufacturing
(2) Selecting routes for transportation
(3) Using transportaion vehicles efficiently
(4) Controlling inventory

With regard to the physical distribution and storage tools, the following are just a few points for consideration:

(1) Developing containers in an optimal way
(2) Developing pallets in an optimal way
(3) Choosing suitable means for transportation
(4) Employing modular packing
(5) Choosing packing, loading and unloading machines
(6) Automation of distribution centers

Many of the above items are not independent; They interact with each other. Eventually sales, procurement, manufacturing and distribution must be integrated as the total logistic system.

Some Japanese companies already have implemented advanced logistics systems, using them to establish sales plans with high accuracy, automatically control supply by computers, and control manufacturing quantity. The following section discusses such systems.

4 REQUIREMENTS FOR ESTABLISHING LOGISTIC SYSTEM TO INTEGRATE PRODUCTION, SALES AND DISTRIBUTION

4.1 Necessity of Investigating Market Demand

Based on the forecast of demand, a sales plan can be established. The sales plan is the starting point for making all the other plans such as production plan, distribution plan, inventory plan, material procurement plan, etc. There will be a mountain of goods if demands are lower than estimated and there will be a shortage of goods if demands are higher than estimated. Thus, it is very important to establish a good and firm sales plan. In other words,

(1) The accuracy of the forecast of demands is very important.

(2) The gap between the sales plan and the actual sales results must be checked as early as possible (hopefully daily, if this is not possible, then weekly).

Since makers cannot control the market, estimation errors are liable to take place. Distribution information can play an adjustment role between production and sales. Its major roles are to catch the sales situations of the company's products in the market as early as possible and to clarify the gap between the sales plan and the actual sales results and feed back the information to the production and the sales divisions.

4.2 Two Requirements for the Distribution System to Investigate Market Needs As Early As Possible

In order for the distribution system to play this role, it is required to satisfy the following two requirements:

(1) To have an organization which grasps the delivery information, the inventory information and the shortage information in order to see the market movement.

(2) To grasp such pieces of information on each product.

Based on those pieces of information,

(1) The production of the articles in poor demand must be stopped and new articles must be developed.

(2) The production of the articles which sell better than estimated must be increased. The cause of good selling must be pursued and new products based on this investigation of the causes must be developed and launched into the market as early as possible.

(3) If some article sells well in certain areas and not in the other areas, its reason must be pursued. It may be the case that the sales activity in the poor demand area must be strengthened. Or it may be necessary to limit the sales areas of the article.

4.3 Integrated Production, Sales and Distribution System

When the distribution system can play such a role, it becomes possible to integrate production, sales and distribution into a system. In order for the system to function properly, the following three items are vital:

(1) To be able to grasp the delivery information, the inventory information and the shortage information daily or weekly.

(2) To have firm sales and production plans as the base.

(3) To have the system to be able to take proper measures immediately.

If any of these is missing, the integrated system will not function.

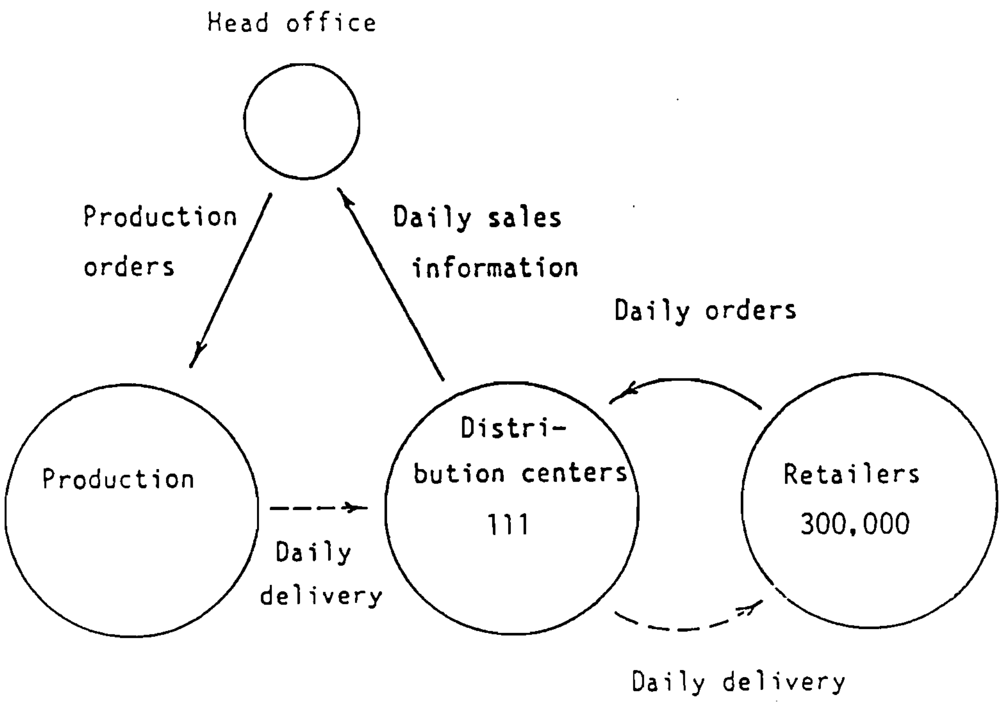
4.4 Case Study -- Kao

To see an example of an integrated production, sales and distribution system, let us see a case from the biggest sanitary goods maker in Japan, called Kao.

Kao has a head office in Tokyo, 8 operation centers and 111 distribution centers in various places in Japan as shown in Fig. 9. There are about 300,000 retailers which sell Kao products all over Japan. Between the retailers and the distribution centers, there are daily orders and daily deliveries. Kao says that with this system a customer can get any Kao product within 12 hours.

The delivery quantity and receiving quantity of each article are input to the computer terminal of each distribution center. The host computer at the head office collects the data on these pieces of information and checks for major items the difference between the planned sales quantity and the actual sales quantity regarding every article at every distribution center.

If the difference of some article exceeds more than 30%, the computer gives a warning. Concerning this article, a meeting among the concerned production, sales and distribution people takes place. When they see the possibility that the gap will still increase, they will change the predetermined



The delivery quantity and receiving quantity of each article are input to the computer terminal of each distribution center.

Fig. 9 : Kao's logistic system.

production plan and also the material procurement plan. The distribution plan will also be adjusted. As for those items whose gaps stay within their limits, production and delivery are made based on the predetermined schedules. The host computer calculates for other articles the stock levels of those items and compares them with the predetermined stock levels. If the stock level of a certain item becomes lower than the predetermined stock level, then its stock will be replenished with a certain fixed quantity.

In this way, the plan and actual result are daily compared for every article at every distribution center.

Based on this investigation, the host computer gives orders daily to production in the following way:
.....X pallets of detergent to A distribution center

.....Y pallets of shampoo to B distribution center.

Kao produces about 5,000 different items (as of 1988) and says that a customer can get any Kao products within 12 hours.

Kao, by having this kind of integrated production, sales and distribution system, has succeeded in meeting the market needs on time and at the same time minimizing the finished stock between production and sales. Kao increased its sales by 1.4 times over the last 5 years and its profit by 1.7 times. This Kao system is said to be one of the most successful implementations of an efficient logistic system in Japan.

5 CONCLUSIONS

Implementation of an efficient logistic system will require the following :

(1) Putting good human resources to the logistic function and education and training of them

(2) Establishing a logistic system and its logistic information network system

(3) Ensuring good logistic service to satisfy customers

(4) Establishing an organization to assure quality in the logistic system

(5) Pursuing logistic cost reduction

The necessity of item (1) cannot be overstressed. Japan has put many good human resources to manufacturing after World War II and obtained world class manufacturing capability. It is now the time to spare some of the good human resources to the logistic area in order to gain another competitive edge.

On Inventory and Transportation Trends in Finland

by

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1. GENERAL ECONOMIC BACKGROUND

The purpose of this paper is to describe the main characteristics of the logistic trends in Finland. This paper examines briefly the use of different transportation modes and behavior of inventories in the Finnish economy considering some general macroeconomic factors. In addition it will describe distribution of inventories among branches of industry and distribution of inventories by stage of manufacturing.

First a very brief presentation of the general state and dynamics of the Finnish economy during the period 1975-85.

The economic growth calculated by using the yearly change of GDP has been on the average 3.3 %. By and large the growth has been rather stable. The remarkable exception although is the forceful recovery and the peak of GDP at 1979 and 1980. The development has been exceptionnally steady since 1982, the growht varying between 2.7 % - 3.4 % (see Fig. 1.).

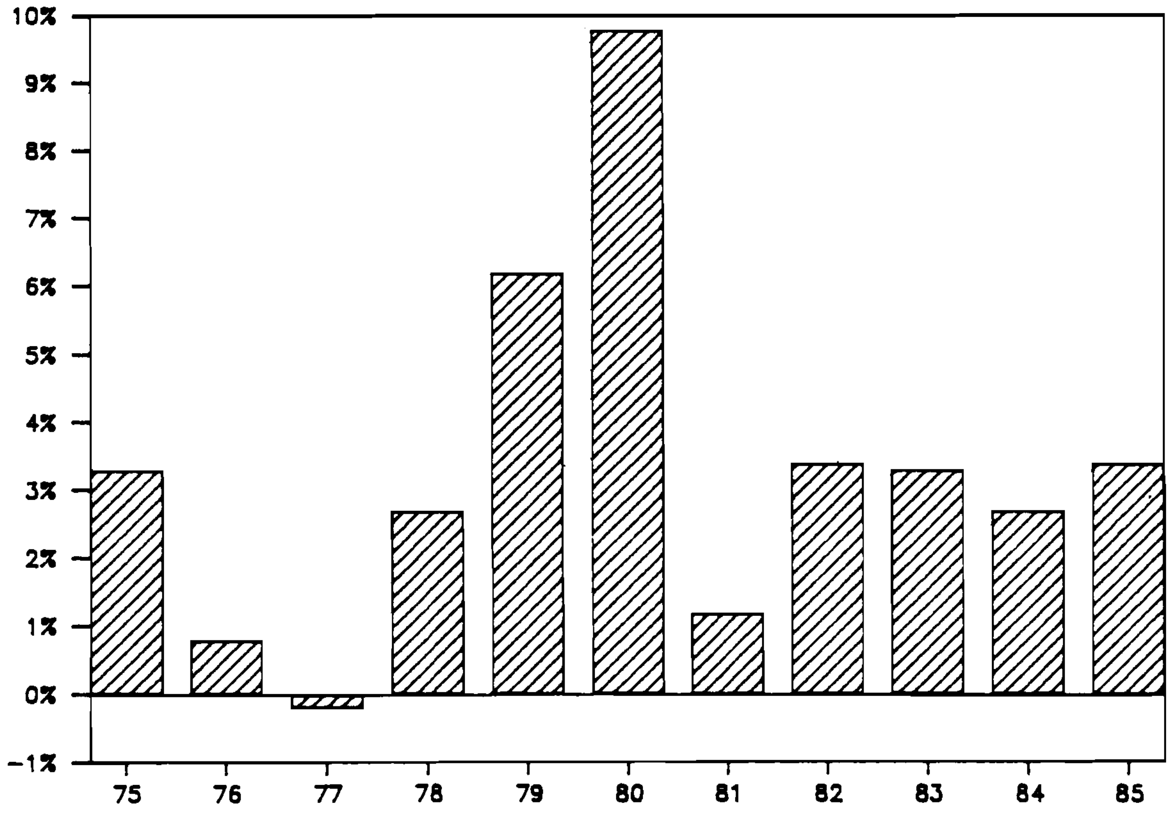

Figure 1: The yearly growth of GDP.

AN important characteristic of Finland is the openess of the economy. Compared to GDP the value of exported goods was 19.8 % in 1975 and 25.0 % in 1985. Generally the foreing trade balance has been negative.

Clearly the most remarkable shift in the Finnish economy during the period in question has been the development in capital markets. With the reduction of the inflation rate at the end of the 1970's, real rates of interest began to rise and capital costs gradually began to be a more important factor in business decissions. The events of recent years have meant, then, a real breakthrough. With the increasing role of market forces in determining the interest rates and also inflation having fallen almost to the average of the OECD countries, Finland has come to a situation where the short-term interest rates paid by Finnish companies have begun to reach the peak level of Western Europe (see Fig. 2). Then when the Finnish mark, invested as market money, brings back a real rate of interest os about 10 % and the marginal capital cost can exceed even 15 %, how much capital is tied up in inventories is no matter of irrelevance.

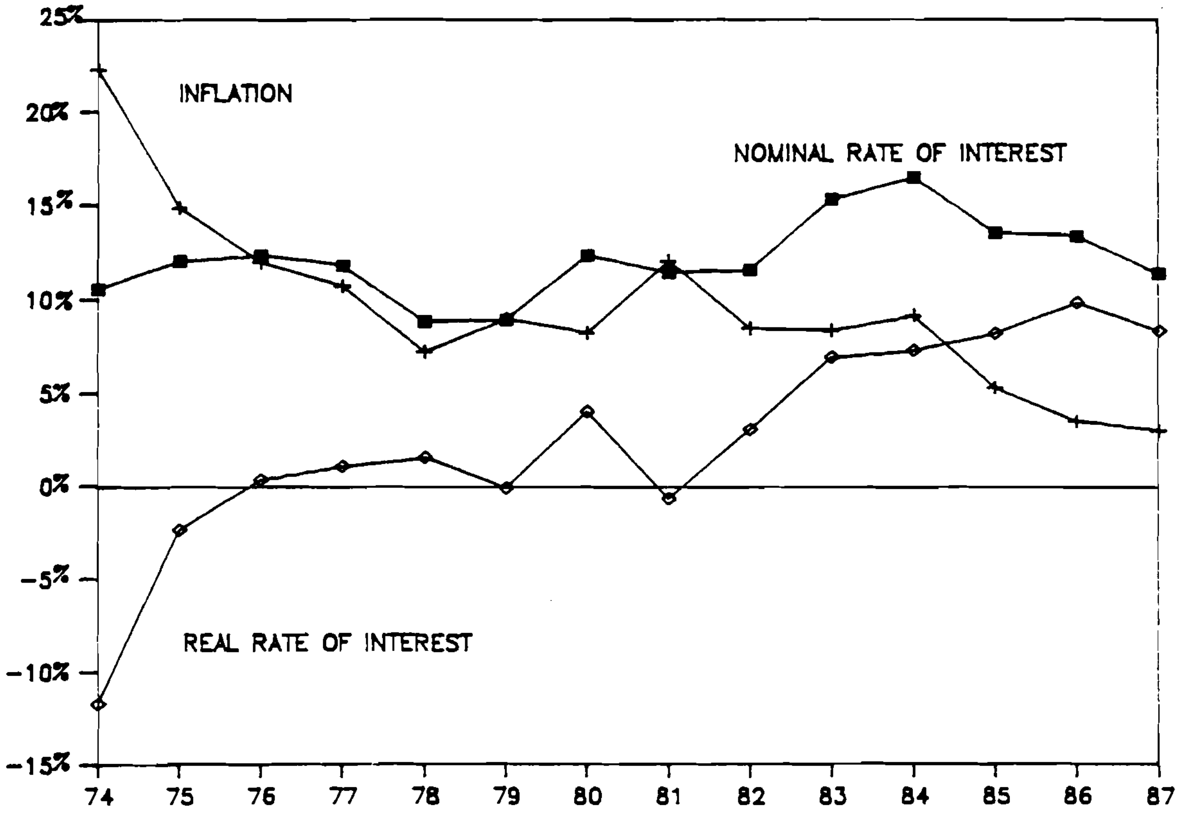

Figure 2: The development of inflation, and also nominal and real rates of interest.

2. USE OF TRANSPORTATION MODES

Domestic transport per capita in Finland is very high compared to many other countries (83,8 ton/capita or 6 475 ton km/capita in 1985). The transport intensity of the economy is due to the large area of the country and its small number of inhabitants. In the international transports the weight per capita is much less than in the domestic transport (4,1 ton/capita in exports and 7,2 ton/capita in imports).

The domestic transports have been growing until 1983 (measured in ton km they have doubled in 20 years) and after that a slight decrease has taken place. The most important mode of domestic transport has been roadtransports (90 % of transported volume and 66 % of ton km, see also Table 1.) This is mainly due to the flexibility of the mode.

In international transports the role of ships is overwhelming. 87% of export volume was transported by ships (71 % of total value) and 83% of import volume was transported by ships (84 % of total value) in 1985. This is due to the long coastal border of Finland. (See Table 2. and 3.)

In international transports the connection to Central Europe is essential. The conventional route runs over the Baltic sea, but during the last year much work has been done to develop a faster route through Sweden and Denmark, the so called "Scandinavian Link". Another alternative route has become possible in the beginning of 1988, this runs through Soviet Baltic countries. The competitiveness of these alternative routes lies mainly on the development of new transport technology and on the fact that the unit size of transports has become smaller.

Nowadays a typical transport unit in such products as paper is one container, a trailer, a truckload or a railwagon load ten years earlier the typical unit weighed thousands of tons.In the international trade of Finlandwith these "big units" the share of trailers and containers is increasing, as illustrated in figures 3(Imports) and 4(Exports). This development demands new flexibility from shiptransports, because more new alternative possibilities for transportation are available (Balt Link and Scan Link). These new alternatives raise the problem, that the volume of the Finnish foreign trade is scattered between many different routes and it is not always easy to make all these routes economical. This is one threat to the Finnish ships sailing on the Baltic.

Another problem is araising from the development of the EC-market, the harmonisation of transport regulations, especially of the road transports. As a result of this development it will be possible to see in foreign trucks carrying domestic cargo in Finland. In addition the regulation of driving periods of truckdrivers will bring new costs of transportation affecting also the time of transportation. Even now the restrictions in driving during the weekends in Germany have brought problems which have affected the Finnish international transports.

	Road transport	Railway	Ship transport	Total
	billions of tonkilometres			
1960	6,20	4,86	0,22	11,28
%	55,0	43,1	2,0	100
1965	8,10	5,18	0,96	14,24
%	56,9	36,4	6,7	100
1970	11,40	6,27	2,38	20,05
%	56,9	31,3	11,9	100
1975	15,40	6,44	2,63	24,47
%	62,9	26,3	10,7	100
1980	18,40	8,34	3,40	30,14
%	61,0	27,7	11,3	100
1985	21,00	8,10	2,69	31,79
%	66,1	25,5	8,5	100

Table 1. Domestic cargo transport

		Sea transport	Road	Railway	Air	Other	Total
1975	milj.t	23,858	0,627	4,650	0,008	0,354	29,498
	%	80,9	2,1	15,8	0,0	1,2	100
1980	milj.t	30,363	1,098	3,683	0,011	0,827	35,982
	%	84,4	3,1	10,2	0,0	2,3	100
1985	milj.t	29,382	1,151	4,167	0,014	0,728	35,442
	%	82,9	3,2	11,8	0,0	2,1	100

Table 2. Import transports by mode in years 1975, 1980 and 1985

		Sea transport	Road	Railway	Air	Other	Total
1975	milj.t	7,836	0,186	1,186	0,002	0,005	9,216
	%	85,0	2,0	12,9	0,0	0,1	100
1980	milj.t	16,070	0,847	2,347	0,005	0,048	19,317
	%	83,2	4,4	12,2	0,0	0,2	100
1985	milj.t	17,424	0,568	2,087	0,006	0,021	20,105
	%	86,7	2,8	10,4	0,0	0,1	100

Table 3. Export transports by mode of transport in years 1975, 1980 and 1985

These developments have their effects on the competitiveness of the Finnish industry on European markets.

In domestic networks there has been no remarkable change in the recent decade. The railway network has a decreasing tendency and the road and waterway networks are slightly increasing. The length of railroad network was about 9000 km and road network 76 000 km in 1986. The increase in waterway network is due to the continuing building of some new channels in the Saimaa Lake system connected to the Baltic Sea. The transportation of bulkmaterial on inland waterways is slightly increasing as investments in new vesselshave been made for this kind of operation.

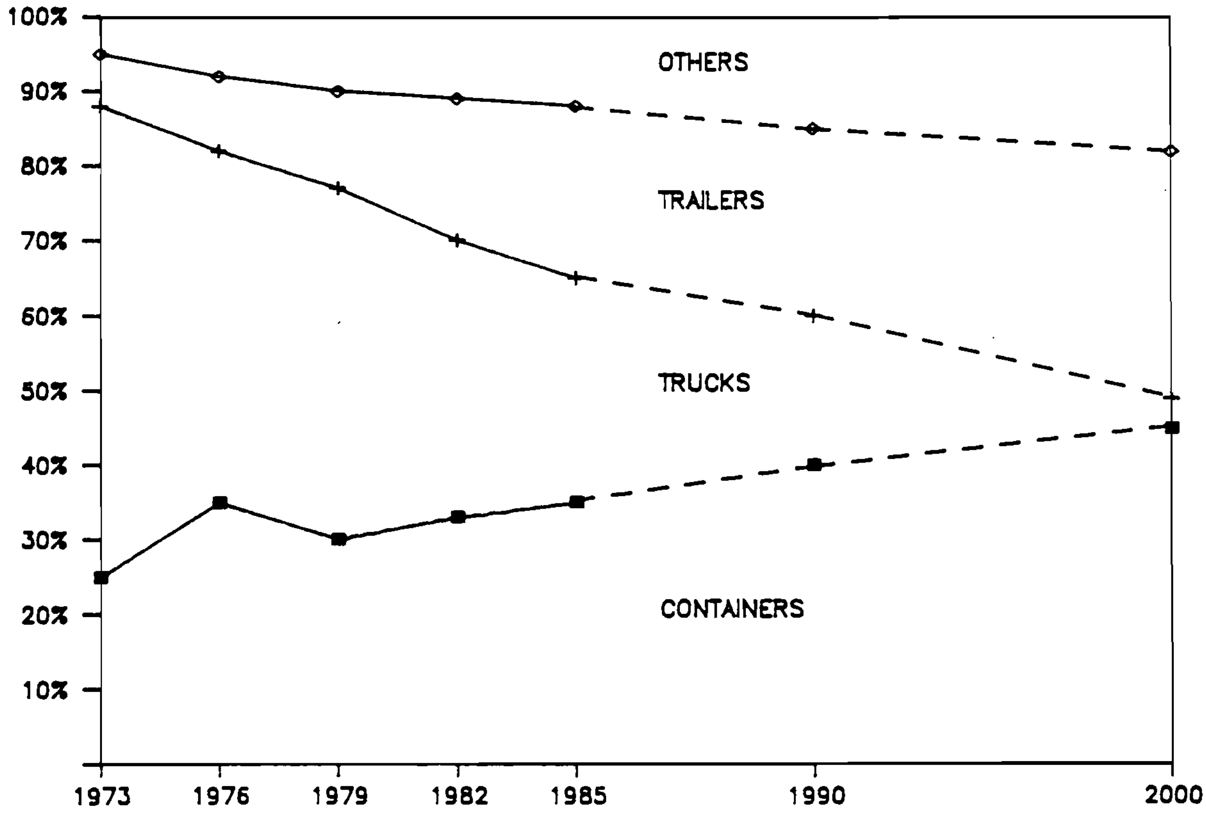

Figure 3: The Finnish import wiht "big units".

The decrease of railway network and increase of road network is due to the growing demand for flexibility in transports of unitized cargo. The Finnish railway has developed new wagons and their service in order to be able to compete with roadtransports.

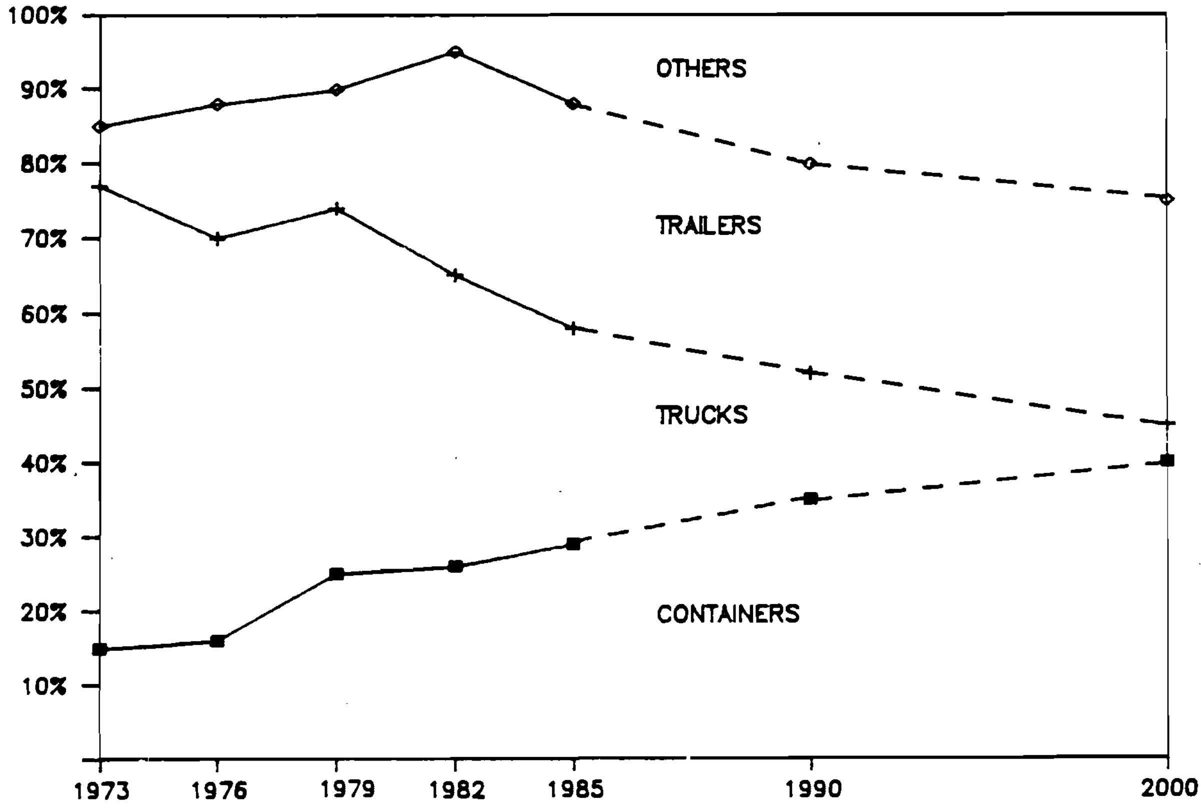

Figure 4: The Finnish export wiht "big units".

As a matter of fact, the railway is using trucs in short distance transports and selling transport services as so called door-to-door transport, so that the customer doesn't always know on what mode the cargo is carried.

From a logistics point of view the average length of transport in different modes is interesting. The average length of railway freight transport has been rather steady between 1975 and 1980, from 283 to 292 km and since 1980 the average length has been declining to 262 km in 1985. The average length of railway freight transport is rather high in Finland compared to other European countries. The same figure for road transport is 38 km in 1985.

It should also be noted, that while the freight transport on roads has grown to almost a fourfold in 25 years (1960 - 1985), the number of trucks has only grown by 15 %. This is, not only due to the rationalization of road traffic but also due to the

growing of the maximum allowable weight of trucks from 24 tons to 48 tons during this same period.
It can be assumed that this trend will continue, since the dimensions of trucks have been changed since the beginning of 1988. For instance the maximum allowable breadth of trucks has been changed from 250 cm to 260 cm, which has been an important development specially for freezed cargo transportation, since sufficient isolation can be used and still have the optimal inner space for pallets. The maximum allowable weight is also to be increased to 56 tons, but at the same time the exceeding of this limit is no more allowable, which has been possible with some goods, such as timber and sawdust, so far.

The trend has been towards larger trucks with trailers and their share of the total domestic road transportation units has been increasing. Whereas the amount of semitrailers has been increasing in international transports, where the driver does not follow with the cargo.

3. CHARACTERIZATION OF MACROECONOMIC INVENTORY BEHAVIOR

To explore the aggregate inventory behavior in Finnish economy, there are two possible ways to obtain the necessarry data. The fairly accessible option is to use the statistics of the National Accounting Systems (NAS). In the NAS is a variable, which describes the increase of inventories of the whole economy in FIM's. The values of the level of inventories are unfortunately missing. To avoid the problems due this short-comming we have built up new variable by adding up the total inventories of following sectors: mining and quarrying (ISIC 2), manufacturing (ISIC 3), electricity, gas and water supply (ISIC 4), construction industry (ISIC 5) and wholesale and retail rate (ISIC 6). From now on the concept "aggregate inventories" refers the result of this addition. For examble the sectors like agriculture (ISIC 1) and transportation (ISIC 7) are thus not included.

The Figure 5 presents the absolute value of yearly change of both the NAS inventories and the aggregate inventories.

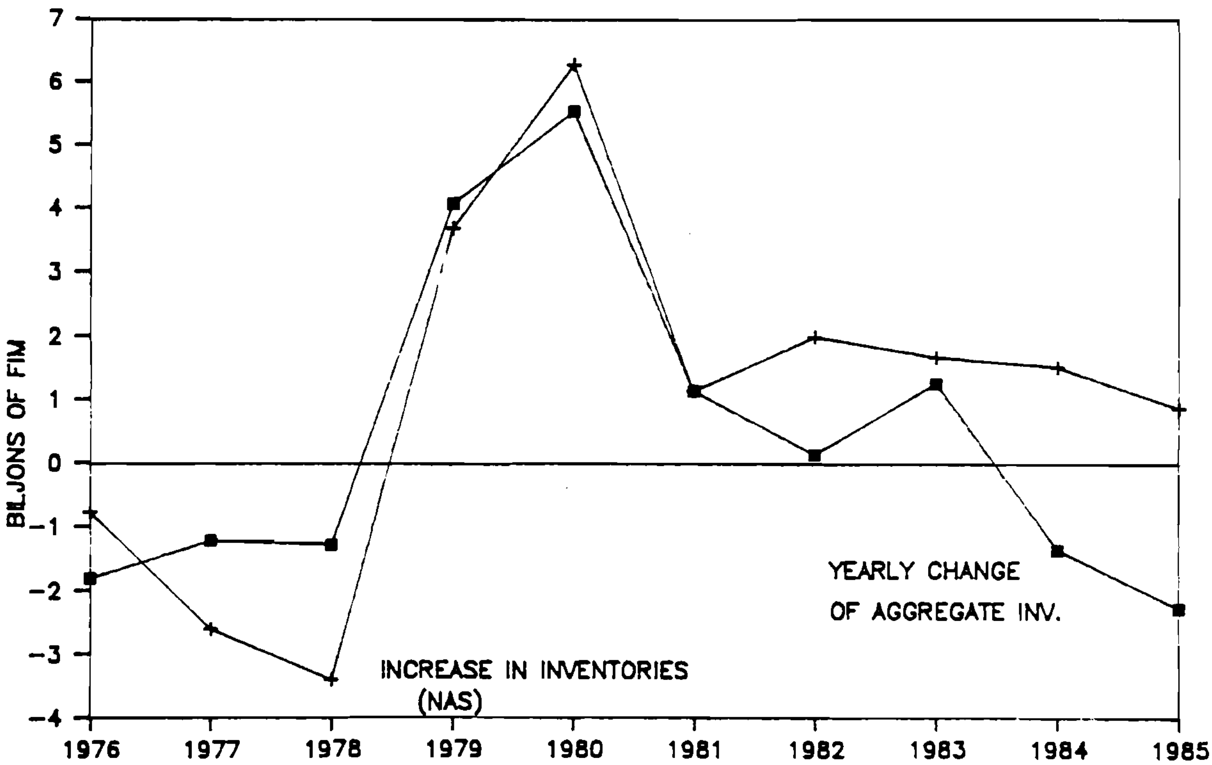

Figure 5: The increase of inventories according to the NAS and the aggregate inventories.

Despite of those sectoral differencies these two time-series are matching rather well. The correlation coefficient between them is 0.80.

In the Figure 6 the fluctuation of GDP and the aggregate inventories can be seen. It seems to be clear, that at least in several of the years studied, the inventories have behaved procyclically, intensifying the amplitude of business cycles (The correlation coefficient between the variables is 0.67).

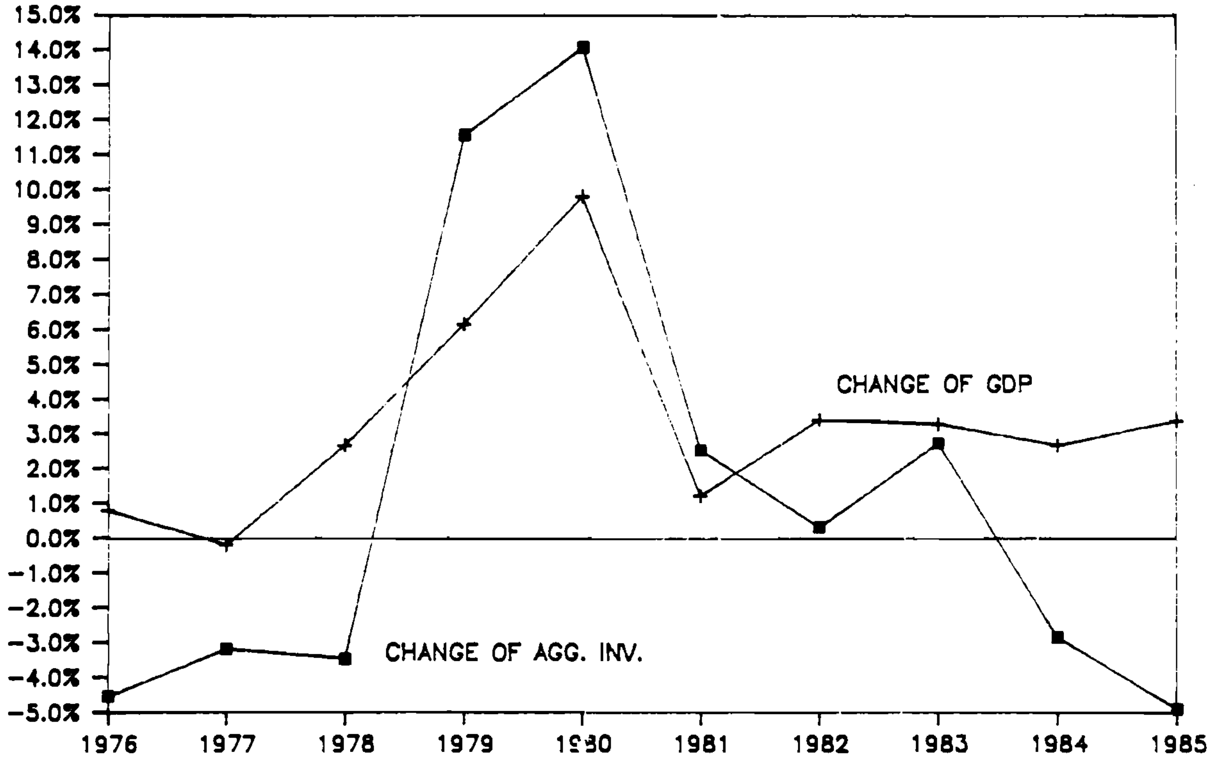

Figure 6: The fluctuation of GDP and the aggregate inventories.

When considering reasons for this behavior one obvious explanation is so called transaction motive (roughly speaking; bigger business needs larger stocks). Another explanation connected to this is the variation of cash-flow of companies. The income financing situation affect the inventory investment decisions of the entrepreneurs procyclically, by postponing investments during a recession and accelerating them in a recovery.

Another reason might be the Finnish business tax system, in which the taxation rate is high, but the companies are permitted to undervalue their stock in order to adjust their taxable income (the maximum proportional undervaluation is between 35-50 % of the original purchase or production costs of goods). When the proportional limit is reached the profitable companies could find it reasonable to increase their stocks in order to minimize their tax burden. It has been claimed that this undervaluation system, by favouring inventory investments in late stages of booms and by discouraging them in recessions, will lead to inventory cycles, which will sharpen economic fluctuations and maintain perhaps also "excess" inventories. Quite recently the elimination of the system has been proposed for discussion.

The Finnish capital market can be classified "newly developed". This means that opportunity cost of holding inventories did not earlier get concretized in the same manner as in the more efficient capital markets. The nominal interest rate were strictly administrated by the Bank of Finland and were held, compared internationally, at a very low level. Even negative real rate of interest used to be typical at early 70's. These reasons generated chronic excess demand for money and resulted in the situation, where companies were forced to stress the availability and liqui-dity aspects of money instead of the opportunity cost of money. This again led to a situation where inventories fluctuated in time to the rhytm of the business cycles and income financing.

The Figure 7 is a presentation of the fluctuation of the aggregate inventories and the total inventories of manufacturing industry (ISIC 3) together with the development of real rate of interest. It is obvious that neither of those inventory varaiables are negatively correlated with the real rate of interest. Only during the years 1983-85 the stock levels seem to be lightly diminishing due to increasing short-run inventory carrying cost.[1]

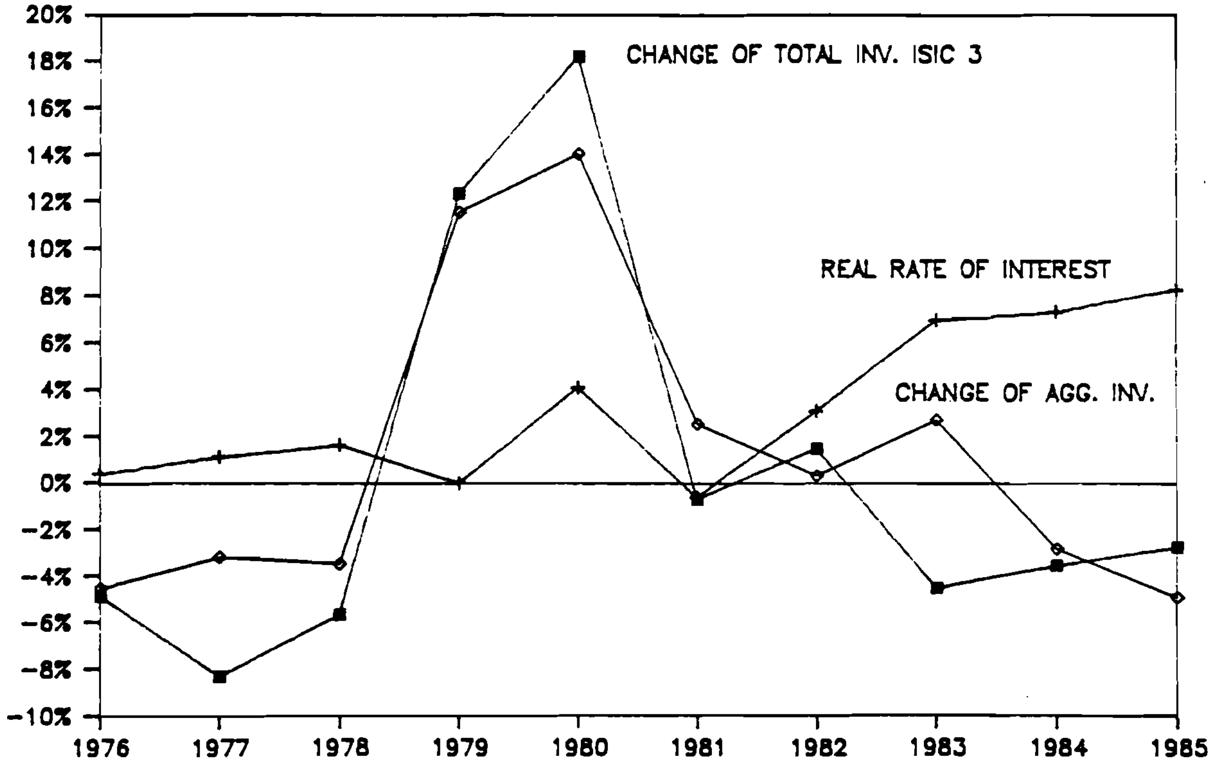

Figure 7: The fluctuation of the aggregate inventories and the inventories of manufacturing, and the real rate of interest.

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[1] Concerning the econometric analysis of inventory dynamics, business cycles and capital markets in Finland, see Kyläheiko-Pirttilä (1985a), (1985b), (1985c), (1985d), (1986) and (1987).

4. STRUCTURAL ANALYSIS OF INVENTORIES

In the following chapter we shall examine the structure of inventories in Finland. Distribution of inventories among main sectors is described in Table 4. The manufacturing sector (ISIC 3) has the major share, in 1985 nearly 50 % of all aggregate inventories. Since 1975 the share of manufacturing has decreased by 6 %, however. During the same period both wholesale and retail trade inventories have increased by about 2 %.

		1975	1985
ISIC 2	Mining & quarrying	0.8%	1.4%
ISIC 3	Manufacturing	55.6%	49.5%
ISIC 4	Elect., gas & water	2.4%	4.0%
ISIC 5	Construction	11.0%	10.7%
ISIC 61	Wholesale trade	17.8%	20.0%
ISIC 62	Retail trade	12.4%	14.4%
		100.0%	100.0%

Table 4: Distribution of inventories among the main sectors.

Considering the reasons for these changes one could assume that the so called JIT-movement has decreased manufacturing inventories the period in question. Strict competition has forced the trade sector to maintain rather high levels of inventories. While both wholesale and retail trade has low value added, the competitiveness is based on high service level, which probably explains high inventory levels.

In Table 5, distribution of inventories among branches of manufacturing in 1985 has been compared with the corresponding value in 1975. In both these years the metal products and machinery industry (ISIC 38) has the highest values. Its share has however reduced by over 2 % during those ten years.

In the studied period the biggest change has happened in the chemical industry (ISIC 35). Its share has increased even by 10 % . One explanation for this remarkable increase is the general expand of the chemical industry. On the other hand it might be only statistical illusion. Classification basis between two branches, ISIC 35 and ISIC 30, has probably changed.

		1975	1985
ISIC 31	Food, bev. & tobacco	8.8%	12.6%
ISIC 32	Textile, clothes, e.g.	7.3%	6.4%
ISIC 33	Wood products	6.7%	7.8%
ISIC 34	Paper & pulp	15.2%	12.0%
ISIC 35	Chemicals	11.5%	21.6%
ISIC 36	Mineral building materials	2.0%	1.5%
ISIC 37	Basic metal	3.9%	4.5%
ISIC 38	Metal products & machinery	26.7%	24.2%
ISIC 39	Other manufacturing	0.7%	0.7%
ISIC 30	Multibranch companies	17.1%	8.7%
		100.0%	100.0%

Table 5: Distribution of inventories among the branches of manufacturing.

In Table 6 the distribution of different types of inventories in manufacturing industry is desgribed.. Almost in every branch the biggest inventory type is input inventory and it is roughly half of the total inventories. The only exceptions are the basic metal (ISIC 37) and the other manufacturing (ISIC 39), where the biggest type is output inventories. Remarkable work-in-process stocks can be found in the metal product and machinery (ISIC 38), the basic metal (ISIC 37), the mineral building material (ISIC 36), and in the textile and clothes (ISIC 32) sectors and in multi-branch companies (ISIC 30).

In Figure 8 the indicator "inventory ratio" has been used in the sector comparison as a reverse measure of inventory turnover rate. This is defined as the ratio of total inventories and the value added of production of the sector in question , and thus the smaller the inventory ratio of the sector, the faster its inventory turnover rate. The value added of production was used in this case because it is statistically one of the most comprehensive variables for describing the size of the different sectors.

YEAR 1985	ISIC 3	ISIC 31	ISIC 32	ISIC 33	ISIC 34	ISIC 35	ISIC 36	ISIC 37	ISIC 38	ISIC 39	ISIC 30
TOTAL INVENTORIES (Milj. FIM)	51718	6491	3311	4058	6216	11165	788	2318	12510	365	4497
INPUT INVENTORIES	51.6%	50.9%	45.1%	51.2%	67.9%	64.7%	44.4%	37.7%	38.8%	41.4%	47.9%
WORK IN PROCESS	14.2%	4.4%	12.0%	4.9%	3.4%	1.0%	13.5%	22.9%	36.5%	9.9%	20.1%
OUTPUT INVENTORIES	34.2%	44.7%	42.9%	43.9%	28.8%	34.3%	42.1%	39.4%	24.7%	48.8%	32.0%
YEAR 1975											
INPUT INVENTORIES	48.5%	56.8%	38.3%	47.4%	65.6%	61.5%	37.3%	43.7%	35.0%	38.3%	48.8%
WORK IN PROCESS	16.0%	2.7%	11.1%	4.8%	4.5%	1.3%	19.1%	15.8%	43.0%	9.7%	7.4%
OUTPUT INVENTORIES	35.5%	40.5%	50.6%	47.8%	29.9%	37.2%	43.7%	40.5%	22.0%	51.9%	43.7%

Table 6: Distribution of inventories by the type of inventory in the manufacturing industry.

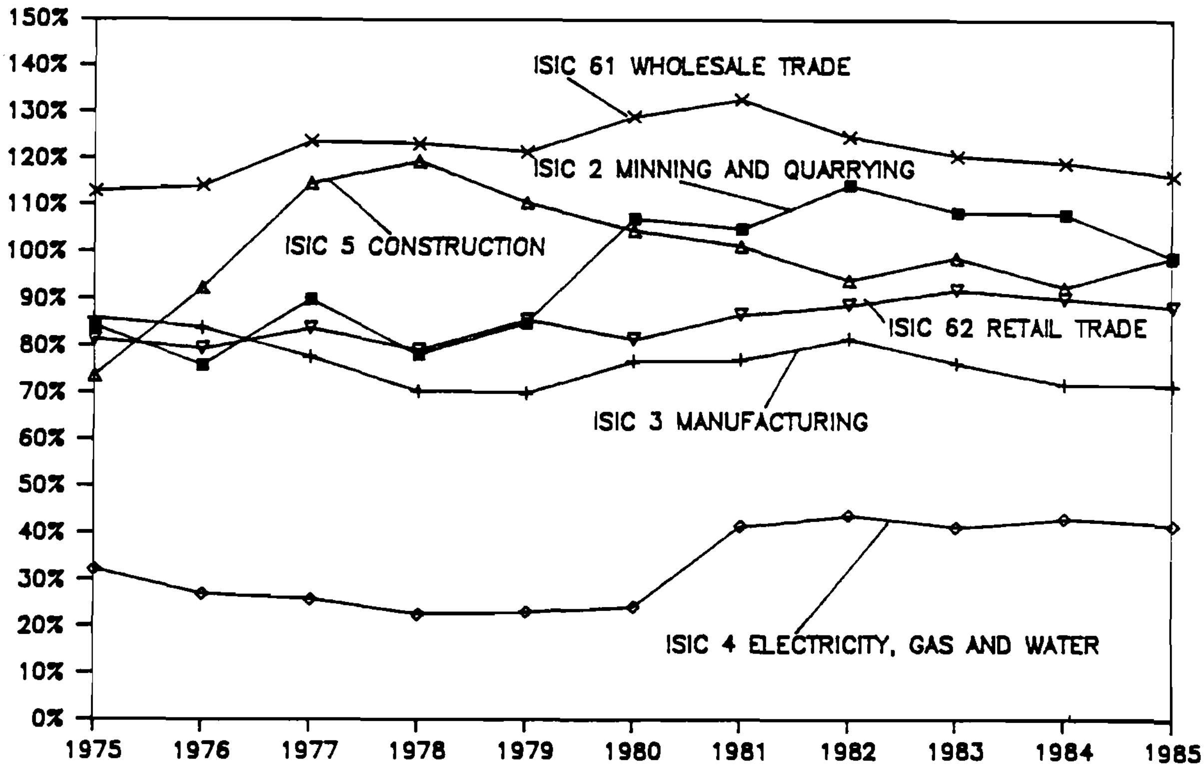

Figure 8: The total inventories / value added ratio in the main sectors.

Figure 8 shows the development of the inventory ratio in the various sectors during 1975 - 1985. It has been characteristic to this period that there has been no remarkable change in any sector. The development has been also rather stable during this period, excluding the sectors ISIC 2 and ISIC 5. Only the manufacturing industry has managed to accelerate its inventory turnover (at an average annual rate of 1.8 per cent). ISIC 4 (electricity, gas and water) has had a much lower inventory ratio than the other sectors. Its inventory ratio has, however increased after 1980. The explanation can be the so called second energy crisis and probably the increase in coal consumption.

Figure 9 shows the development of the inventory ratios of the six biggest branches in Finland during the years 1975 - 1985. The trend is that almost every branch has managed to reduce lightly their inventory ratios, except ISIC 31 (manufacture of food, beverages and tobacco) and ISIC 35 (manufacture of chemicals and chemical products), whose inventories have increased substantially since 1979. In ISIC 33 (manufacturing of wood and wood products) the business based fluctuation is clearly observable. However ISIC 33 has succeeded in improving its inventory ratio during the period.

In the whole manufacturing sector the total inventory ratio has decreased on the average 1.8 % per year (Table 7). The development has been fastest in work in process inventories, on the average three % decrease per year.

If we first look at the development of total inventories, it can be seen that the branch ISIC 34 (manufacture of paper and paper products) takes the lead, with ISIC 30 (multibranch companies) and ISIC 38 (manufacture of metal products and machinery) following in the wake, and ISIC 35 (manufacture of chemicals and chemical products) lagging behind. It is remarkable that both important export oriented branches (ISIC 34 and ISIC 38) have managed to reduce their inventory ratios.

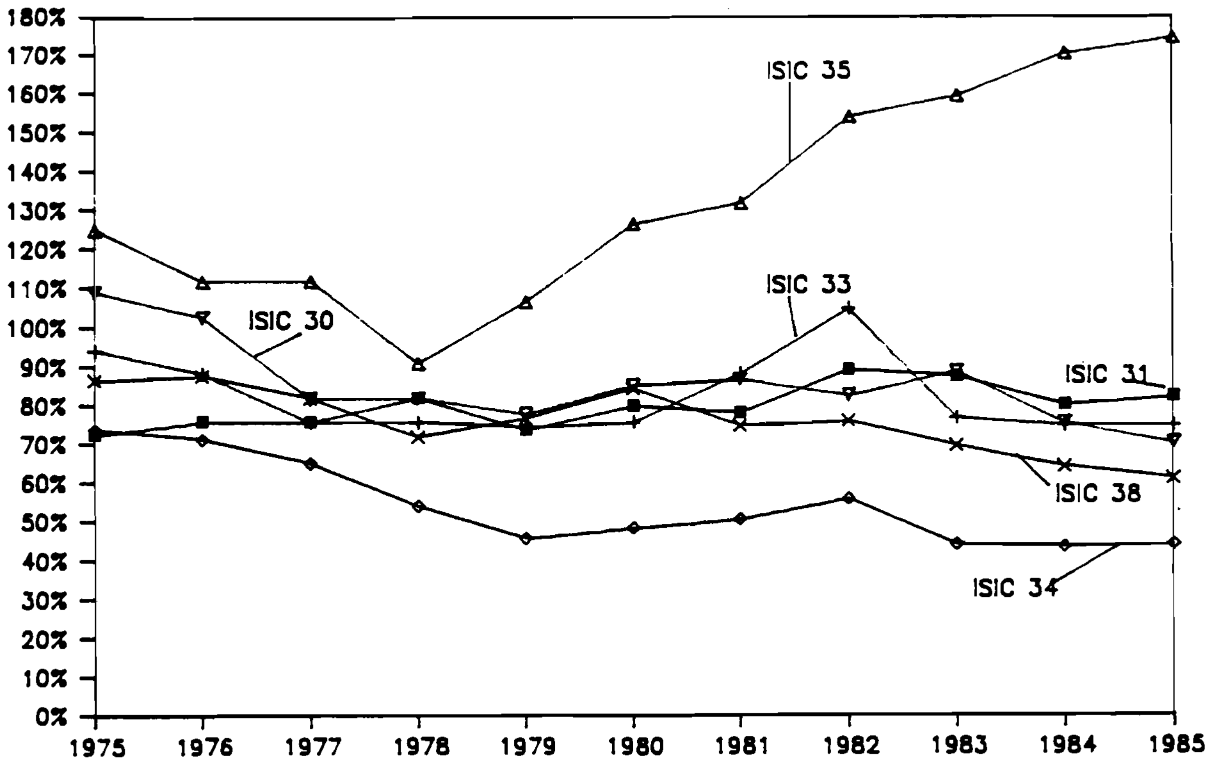

Figure 9: The total inventories / value added ratio in manufacturing industry (the six biggest branches).

One explanation for ISIC 35's regrettable situation is governmental policy, which expects this branch to large buffer inventories in order to guarantee oil and other raw material supply in possible disturbance situations.

In input type of inventories the ISIC 35 has the higgest inventory ratio. In general the inventory ratios of the most important branches vary from 0.24 to 0.42. ISIC 34, ISIC 30 and ISIC 38 have experienced the fastest improvement.

	TOTAL	INPUT	WIP	OUTPUT
ISIC3	0.72	0.37	0.10	0.25
	-1.8%	-1.2%	-3.0%	-2.2%
ISIC31	0.82	0.42	0.04	0.37
	1.2%	0.2%	6.2%	2.2%
ISIC32	0.70	0.32	0.08	0.30
	-0.8%	0.8%	0.0%	-2.4%
ISIC33	0.75	0.38	0.04	0.33
	-2.3%	-1.5%	-2.1%	-3.1%
ISIC34	0.44	0.30	0.01	0.13
	-5.0%	-4.7%	-7.8%	-5.4%
ISIC35	1.75	1.13	0.02	0.60
	3.4%	3.9%	1.0%	2.5%
ISIC36	0.37	0.16	0.05	0.16
	-1.6%	0.2%	-4.9%	-1.9%
ISIC37	0.56	0.21	0.13	0.22
	-2.0%	-3.5%	1.7%	-2.3%
ISIC38	0.61	0.24	0.22	0.15
	-3.4%	-2.4%	-5.0%	-2.3%
ISIC39	0.73	0.30	0.07	0.35
	-1.5%	-0.7%	-1.3%	-2.1%
ISIC30	0.70	0.34	0.14	0.22
	-4.3%	-4.5%	5.7%	-7.3%

Table 7: Distribution of inventory ratios by type of inventory in the manufacturing industry.

The highest work-in-process inventory ratios can be found in the ISIC 38 (metal product and machinery), the ISIC 30 (multi-branch companies) and the ISIC 37 (basic metal). The development has been fastest in the branches ISIC 34, ISIC 38 and ISIC 36.

Finally of all we examine the output inventories. ISIC 35, ISIC 39, ISIC 31 and ISIC 33 have the lowest inventory turnover. Whereas the ISIC 30, ISIC 34 and ISIC 32 have made the fastest improvement. In the branch ISIC 37 and ISIC 39 the inventory ratio is highest in the output stage.

5. SUMMARY

The aim of this paper was to present some general characteristics of logistics structure and trends in Finland during the period 1975 - 1985.

The most substantial shift in the Finnish economy during this period has been the development in capital markets. The increasing role of market forces in the rate of interest determination and decreased inflation have resulted in a considerably higher real rate of interest than before. This could have affected inventory investments least in some sectors of manufacturing industry. Generally the inventories have behaved procyclically in Finland, intensifying the amplitude of business cycles. A possible explanation for this behavior is in the first place the so called transaction motive, but also variation in the cash-flows of the companies and the business tax system in Finland.

When we look at the structure of inventories in Finland it can be seen that the manufacturing sector has the major share of all the aggregate inventories, but its share has however decreased during the last ten years. At the same time the inventories of the trade sector have increased. The development of inventory turnover has been rather stable in the main sectors. Even a slight decrease can be seen during the studied period. However, the manufacturing sector has succeeded in improving its turnover slightly. The development has been fastest in two important export oriented branches, in the paper and paper product and the metal product and machinery industries.

The transportation sector in Finland is characterised by high transportation intensity, which is due to low population density and the openess of economy. The most important mode of domestic transport is roadtransport and in international transports the role of ships is overwhelming.

REFERENCES

Kyläheiko, K. Pirttilä, T. (1985 a)	How do Inventories in Finnish Industry Stand up to International Comparison ? Lappeenranta University of Technology, Dept. of Eng. Economics, Report 2/1985.
Kyläheiko, K. Pirttilä, T. (1985 b)	Interest rates, Inflation, and Inventory Investment: Some Finnish Experiences, Engineering Costs and Production Economics, 9 (1985) 259-266.
Kyläheiko, K. Pirttilä, T. (1985 c)	On Inventory Investment Determinants, in Bullinger-Warnecke (eds.): Toward the Factory of the Future, pp 10-16. Berlin 1985.
Kyläheiko, K. Pirttilä, T. (1985 d)	The Dependence of Inventory Investment on Expectation Factors, Lappeenranta University of Technology, Dept. of Eng. Economics, Report 1/1985.
Kyläheiko, K. Pirttilä, T. (1986)	Short-term Inventory Dynamics in the Finnish Forest Industry, Lappeenranta University of Technology. Dept. of Eng. Economics, Report 20/1986.
Kyläheiko, K. Pirttilä, T. (1987)	Econometric Analysis of Inventory Investment and the Role of Short-term Expectations, Engineering Costs and Production Economics, 12 (1987) 293-298.

Long-Term Trends in U.S. Inventory Stocks

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Time series on inventory stocks or inventory to sales ratios are dominated by fluctuations associated with business cycles. In this paper we look past these short-run fluctuations in an attempt to discern long-term trends in inventory accumulation. In the U.S., the business press has carried stories for years on how new computerized inventory control systems are helping industry control stocks. In business school classrooms the virtues of these inventory and production control systems are being taught. Corporations feel pressure to adopt these systems in order to regain competitiveness internationally. In particular, it is emphasized that the Japanese are sucessfully utilizing the Just-in-time system of production. In this paper we look at data on aggregate stocks as well as data from the retail, wholesale, and manufacturing sectors in an attempt to see if we can find evidence that stocks may have been reduced by the introduction of this new logistics technology.

The term new logistics technology incorporates much more than new production and inventory control systems. It stands for the whole set of innovations of technological, organizational, economic and managerial character in trade, production, transportation, and communication aimed at raising the efficiency of material flows in the economy. Theoretically the adoption of these innovations should reduce the level of inventory stocks relative to the volume of output and, in turn, save resources since inventories require substantial financial and nonfinancial carrying costs. Of course, if the introduction of new logistics technology (hereafter NLT) by one industry causes the stocks of another industry to be increased, there may not be net gains to the overall economy. Also it is possible that the costs of implementing a particular NLT may outweigh the benefits; in this case, holding stocks may simply be the best alternative. We will look for any of these spillover effects as we examine the evidence from individual sectors.

Before a reduction in stocks can be attributed to the introduction of NLT the other factors influencing long term inventory levels need to be identified. Ideally econometric studies need to be done controlling for the influence of these factors. Factors identified and discussed here are (a) the rate of sales growth, (b) the rate of price inflation of the particular goods inventoried (c) the real rate of interest (d) delivery problems created by shortages at suppliers of inputs, (e) the degree of vertical integration of both production and distribution , (f) the share of stocks which are imported and lastly, (e) the composition of sales and stocks.

In the next section we examine the composition of U.S. inventory stocks (in constant 1982 dollars) using quarterly data from the National Income Accounts extending from 1947 through the second quarter of 1987. The ratio of total stocks to final sales is plotted. More detailed stocks and sales are available for the manufacturing and trade sectors. After discussing the overall pattern of inventory accumulation, each sector is examined individually in the subsequent sections: Retailers in section III, Merchant Wholesalers in section IV, Nondurable Manufacturing in section V, and finally Durable Goods Manufacturing in section VI. Trends in stocks by stage of processing are examined for manufacturing subsectors. The last section consists of a summary of our findings and points to areas of needed future research.

II. COMPOSITION AND TRENDS IN AGGREGATE INVENTORY STOCKS

As one can see from figure 1 total nonfarm inventory stocks are approaching 800 billion 1982 dollars. Total National Income Account (NIA) stocks consist of these plus stocks held on farms which are currently about 80 billion. The focus here will be on nonfarm stocks since farm stocks have been about the same since the early 1970s (see fig. 6). As is shown in the bottom half of Table 1, farm stocks have declined from 17.3 percent of total stocks in 1949 to about 10 percent today. In Table 1 both the absolute levels of subsector stocks and the proportion of total NIA stocks held in the subsector are reported at ten year intervals. The figures 1 to 6 illustrate both the size and trends in these stocks. From figure 1 it is obvious that the rate of growth of stocks accelerated in the mid 1960s. This acceleration occured in nearly all sectors. From figure 2 we can see that the rates of growth of stocks at manufacturers and wholesalers have slowed in the 1980s whereas retail stocks continue to accumulate relatively rapidly.

This increased accumulation has occurred mainly in sectors stocking durable goods. Before 1965 nondurable and durable stocks were about equal in size and grew at about the same rate (see fig. 1). Since then the growth rates of durable stocks have been much faster. This relatively faster growth of durable stocks occurred in manufacturing, in wholesaling, and retailing. As is shown in Table 1, durable stocks as percent of total stocks increased 13.0 percent between 1949 and 1979 whereas the nondurable share decreased by 6.2 percent.

Of course one expects to see stocks accumulate in an economy experiencing real income growth. Hence, to judge the efficiency of stock usage, one must scale inventories by a metric representing the size of the economy. Typically this metric is sales; hence, the emphasis on stock to sales ratios in the literature. There is a question, however, of which sales should be utilized. Since GNP equals final sales plus inventory investment, at the aggregate level total final sales is often used. This I would like to argue is inappropriate since much of final sales are sales of sectors that hold little or no stocks. In a country like the U.S. which has had an expanding government sector (as a percent of GNP) and in the postwar period, a fast growing service sector, using total final sales as the denominator in inventory to sales ratios introduces a downward bias in the aggregate stock to sales ratio. The fact that the composition of GNP has shifted to services such as financial services, and personal services should not lead one to believe that the economy is economizing on stocks. Rather one needs to divide stocks by the sales of those sectors which hold stocks to judge whether they are carrying less stocks per dollar of sales. Hence, we divided total nonfarm stocks by final sales of goods and structures. Structures were included since substantial stocks of materials are inventoried during construction. This ratio is plotted in figure 7.

Relative to final sales this graph makes it clear that the U.S. economy has not reduced its stocks. Rather the aggregate inventory to sales ratio has grown by 27 percent or over a month's worth of sales between the early 1960s and early 1980s. Moreover, the growth occurred in two distinct periods: the late 1960s and 1974-75. In figure 8 the ratio of durable goods stocks to final sales of durable goods and the ratio of nondurable goods to final sales of nondurable goods are plotted.

TABLE 1. MEAN INVENTORY LEVEL in 1982 DOLLARS

Annual Average held in	1949	1959	1969	1979
TOTAL INVENTORIES	258.75	356.33	554.85	774.03
FARM	44.78	57.58	69.80	81.10
NONFARM	213.95	298.75	485.75	692.90
Durable Goods	101.08	154.00	266.90	403.05
Nondurable Goods	112.88	144.78	218.85	289.88
MANUFACTURING	106.03	150.88	245.90	321.55
Durable Goods	60.55	90.32	156.80	208.98
Nondurable Goods	45.43	60.55	89.10	112.58
WHOLESALE TRADE	42.73	58.85	97.20	155.10
Durable Goods	24.35	31.85	56.70	98.78
Nondurable Goods	18.38	27.00	40.48	56.30
MERCHANT WHOLESALERS		46.08	75.50	127.75
Durable Goods		26.85	46.63	84.75
Nondurable Goods		19.23	28.90	43.03
NONMERCHANT WHOLESALERS		12.80	21.68	27.33
Durable Goods		4.98	10.10	14.03
Nondurable Goods		7.80	11.58	13.35
RETAIL TRADE	43.05	61.55	93.73	139.00
Durable Goods	16.20	22.93	38.48	69.10
Nondurable Goods	26.88	38.55	55.25	69.88
OTHER	22.18	27.53	48.95	77.30

SUBSECTOR INVENTORY LEVELS AS A PERCENT OF TOTAL NIA STOCKS

Annual Average held in	1949	1959	1969	1979
TOTAL INVENTORIES	100.00%	100.00%	100.00%	100.00%
FARM	17.30%	16.16%	12.58%	10.48%
NONFARM	82.69%	83.84%	87.55%	89.52%
Durable Goods	39.06%	43.22%	48.10%	52.07%
Nondurable Goods	43.62%	40.63%	39.44%	37.45%
MANUFACTURING	40.98%	42.34%	44.32%	41.54%
Durable Goods	23.40%	25.35%	28.26%	27.00%
Nondurable Goods	17.56%	16.99%	16.06%	14.54%
WHOLESALE TRADE	16.51%	16.52%	17.52%	20.04%
Durable Goods	9.41%	8.94%	10.22%	12.76%
Nondurable Goods	7.10%	7.58%	7.29%	7.27%
MERCHANT WHOLESALERS		12.93%	13.61%	16.50%
Durable Goods		7.54%	8.40%	10.95%
Nondurable Goods		5.40%	5.21%	5.56%
NONMERCHANT WHOLESALERS		3.59%	3.91%	3.53%
Durable Goods		1.40%	1.82%	1.81%
Nondurable Goods		2.19%	2.09%	1.72%
RETAIL TRADE	16.64%	17.27%	16.89%	17.96%
Durable Goods	6.26%	6.43%	6.93%	8.93%
Nondurable Goods	10.39%	10.82%	9.96%	9.03%
OTHER	8.57%	7.72%	8.82%	9.99%

TABLE 2. AVERAGE QUARTERLY INVENTORY TO SALES RATIOS

For the following periods:	1959.1 thru 1965.4	1966.1 thru 1972.4	1973.1 thru 1979.4	1980.1 thru 1984.2
NIA TOTAL STOCKS	3.89	4.34	4.86	4.95
NIA DURABLE GOODS STOCKS	7.69	8.20	8.20	8.37
NIA NONDURABLE GOODS STOCKS	3.84	4.14	4.68	4.51
TOTAL MANUFACTURING & TRADE	1.54	1.59	1.61	1.64
MANUFACTURING	1.77	1.87	1.88	1.94
Durable Goods	2.09	2.24	2.29	2.41
Nondurable Goods	1.43	1.42	1.39	1.36
Food & Kindred Prod.	1.09	1.10	1.07	1.02
Nonfood Nondurables	1.62	1.59	1.54	1.53
MERCHANT WHOLESALERS	1.30	1.29	1.34	1.40
Durable Goods	1.84	1.81	1.89	2.05
Nondurable Goods	0.89	0.87	0.85	0.86
Groceries & Farm Prod.	0.75	0.73	0.65	0.63
Other Nondurables	1.04	1.02	1.07	1.13
RETAIL TRADE	1.28	1.35	1.40	1.37
Durable Goods	1.77	1.87	1.93	1.83
Automobile Dealers	1.36	1.54	1.66	1.58
Other Durable Goods	2.37	2.35	2.31	2.13
Nondurable Goods	1.08	1.11	1.12	1.14
Food Stores	0.67	0.70	0.72	0.75
Other Nondurables	1.32	1.32	1.31	1.31

NOTE: National Income Account Ratios were calculated as the ratio of inventory (1982$) to final sales of good and structures and final sales of nondurable and durable goods respectively. The remaining inventory to sales ratios for the manu^ ^turing and and trade sectors were calculated by dividing sector stocks (1972$) by the sector quarterly sales at a monthly rate.

FIGURE 1.
NONFARM STOCKS 1982 DOLLARS End of Quarter SAAR

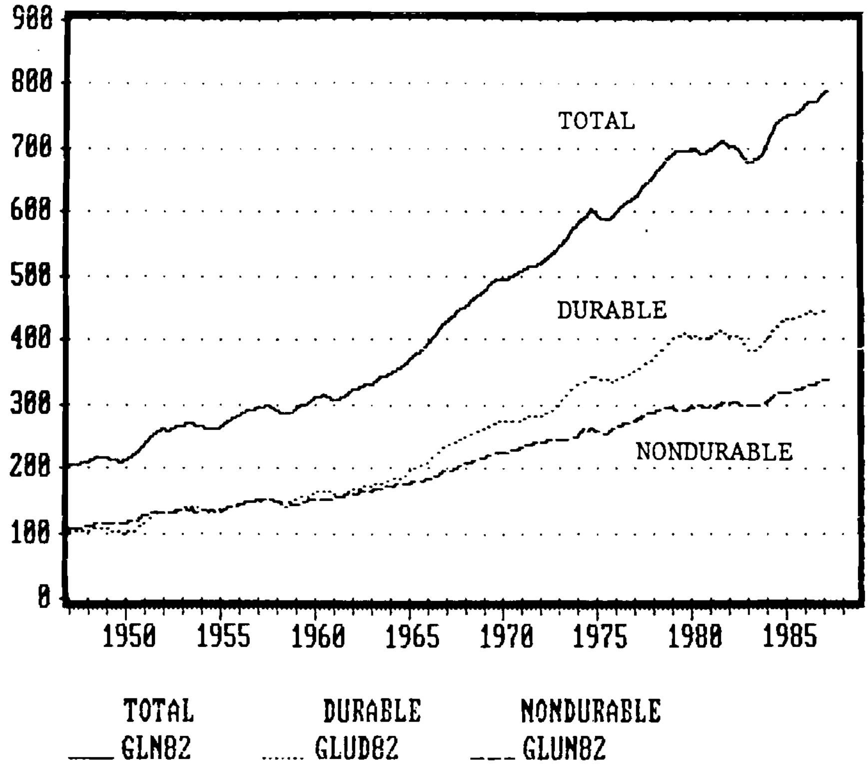


FIGURE 2.
INVENTORY STOCKS BY SECTOR End of Quarter SAAR

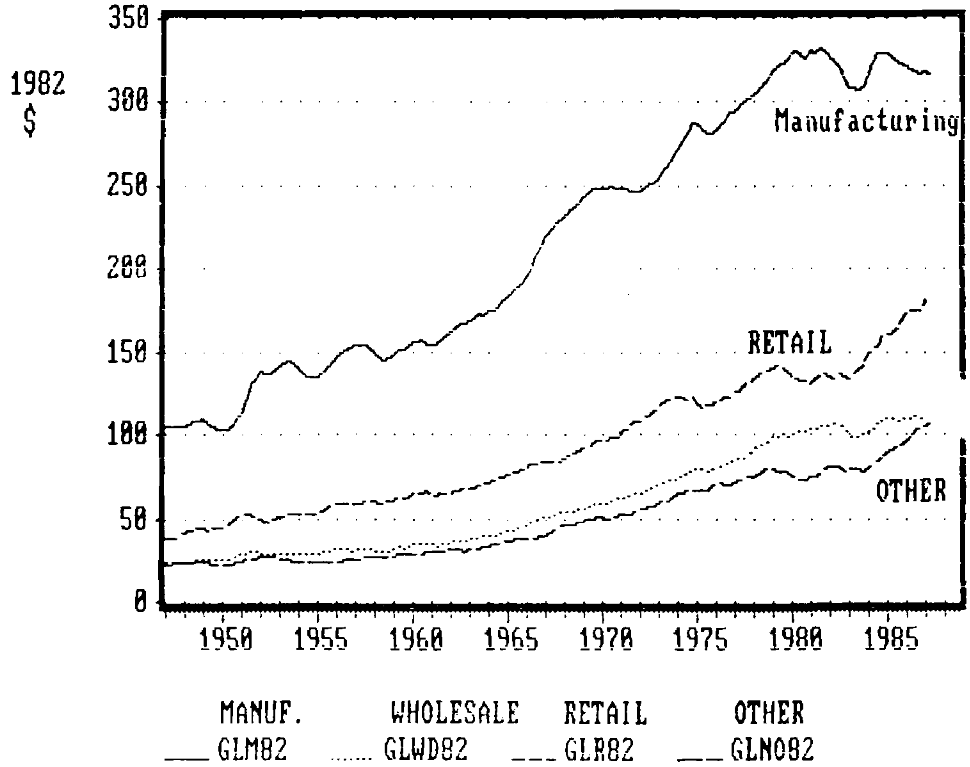


FIGURE 3.
MANUFACTURING STOCKS End of Quarter SAAR

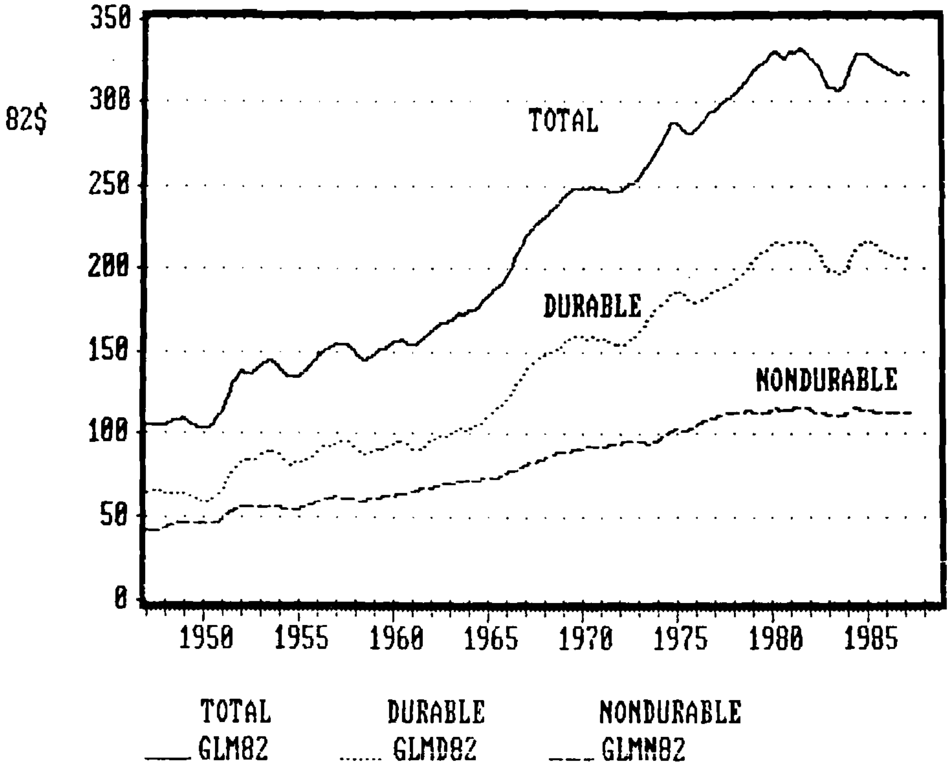


FIGURE 4.
WHOLESALE TRADE STOCKS End of Quarter SAAR

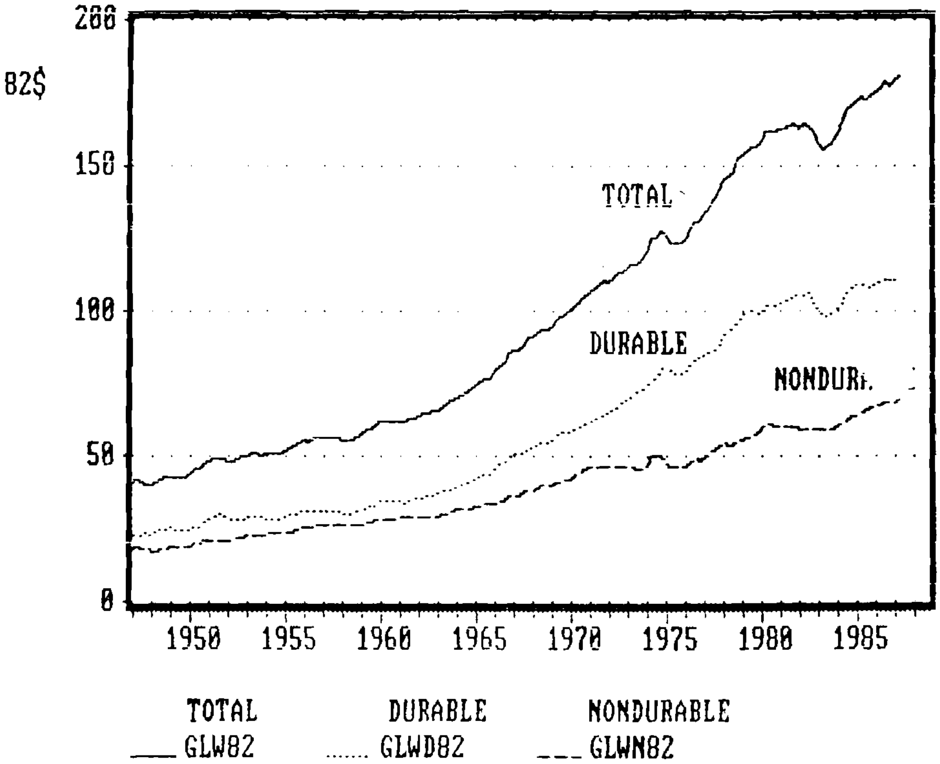


FIGURE 5.
RETAIL TRADE STOCKS End of Quarter SAAR

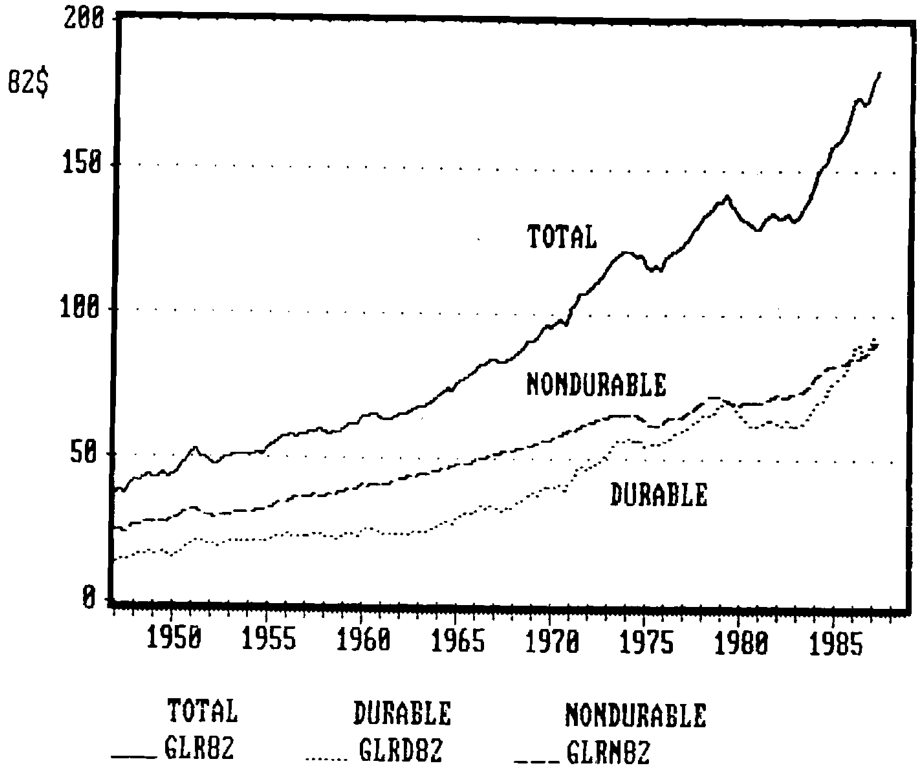


FIGURE 6.
OTHER NONFARM STOCKS and FARM STOCKS End of Qtr. SAAR

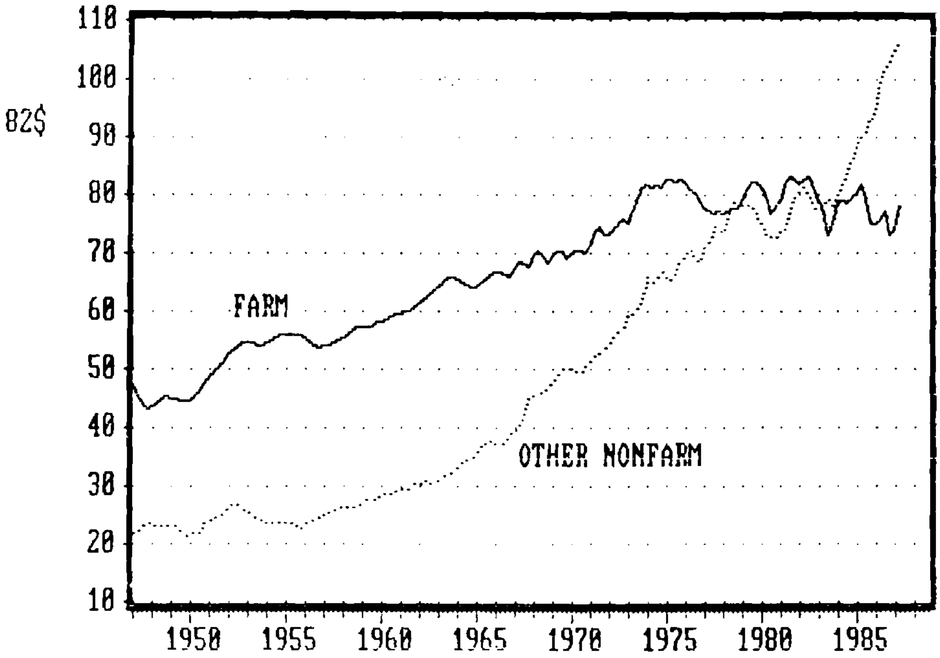


FIGURE 7.
RATIO OF NONFARM STOCKS TO FINAL SALES OF GOODS & STRUCTURES

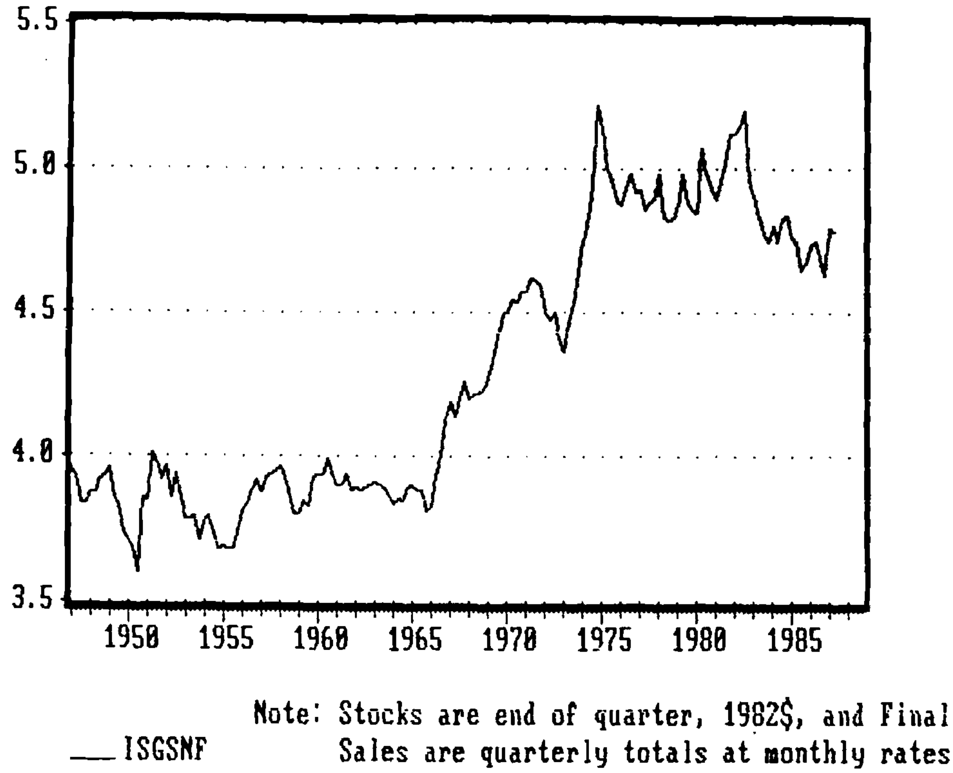
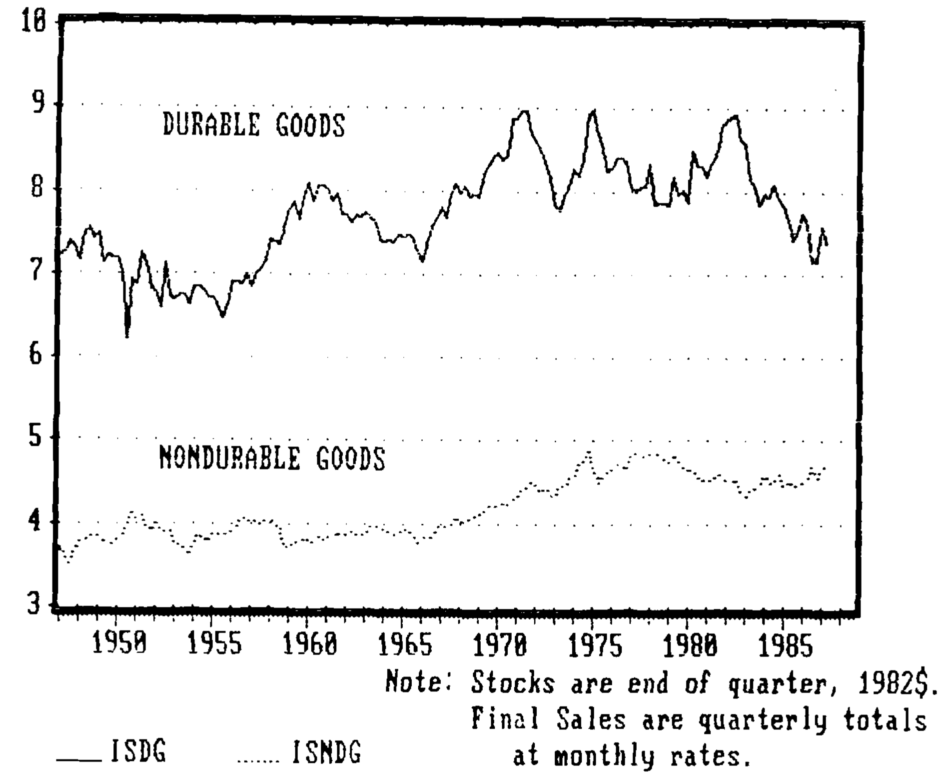


FIGURE 8.
RATIO OF STOCKS TO FINAL SALES OF GOODS



Here we see that there was an uptrend in the durable ratio starting in 1956 and ending around 1970 and an uptrend in the nondurable ratio beginning in 1966 and ending in the late 1970s. Since the late 1970s there appears to be some downtrend in both ratios, although the 1981-82 recession (in which there was involuntary accumulation of stocks) makes it difficult to sort this out.

In this paper we will examine the contribution over time of the different nonfarm sectors to the fluctuations observed in these aggregate stock to final sales ratios. In doing so we will look for common patterns, possible causes, etc. as well as an evidence that particular sectoral stocks have possibly been influenced by the introduction of NLT. We divide each sector's inventory holding by its sales, e.g. we take the ratio of retail stocks to total retail sales. Of course, if one were to add up all the sales of manufacturers, wholesalers, retailers, etc., one would get a number much larger than the final sales of goods and structures since final sales nets out sales of intermediate goods,i.e. final sales is essentially the summation of value added by each sector. Hence, the inventory to sales ratios reported for the sectors are generally lower than those using final sales.

In figure 9 the sales, stocks, and inventory to sales ratio for the total manufacturing and trade sector are plotted. These stocks are about 80 percent of total NIA stocks. This stock to sales ratio increased between the early 1960s and early 1980s by a much more modest 6.5 percent (the equivalent of about one-tenth of a month of sales). Note that these figures start in 1959 and end in 1984.2 and that the data are in 1972 dollars. This series was selected because the series incorporating the latest revisions only extends back to 1967. In figure 10 one can observe the relative sizes of the subsector stocks.

Before examining these subsectors individually, it is important to note that these stock to sales ratios could also be affected by changes in the degree of vertical integration. For example, if a manufacturer were to buy its supplier, that would reduce reported sales (as the supplier's sales are now an internal transfer within the firm) and not reduce stocks, hence tending to increase the observed inventory/sales ratio, ceteris paribus. Similarly, a manufacturer purchasing a distribution company might have similar affects.

III. RETAIL SECTOR

Retail [illegible]s, which currently hold about 18 percent of total NIA stocks, have continued to rapidly accumulate stocks in the 1980s (fig. 2). The stock to sales ratio for aggregate retail inventories is plotted in figure 11. As one can see from 1966 through 1975 there was a strong uptrend in this ratio which has since flattened. The 1983 decline merely reflects the sharp acceleration of sales following the 1981-82 recession. The inventory to sales ratio for nondurable retailers has slowly trended upward the entire sample (fig. 12). In contrast, the uptrend in the stock/sales ratio of durable goods retailers has leveled off since the mid-1970s despite the fact that durable stocks have increased much more rapidly than nondurable stocks. The relative sizes of retail subsector stocks can be seen in figure 13.

FIGURE 9.
MANUFACTURING AND TRADE TOTAL STOCKS, SALES, STK./SALES RATIO

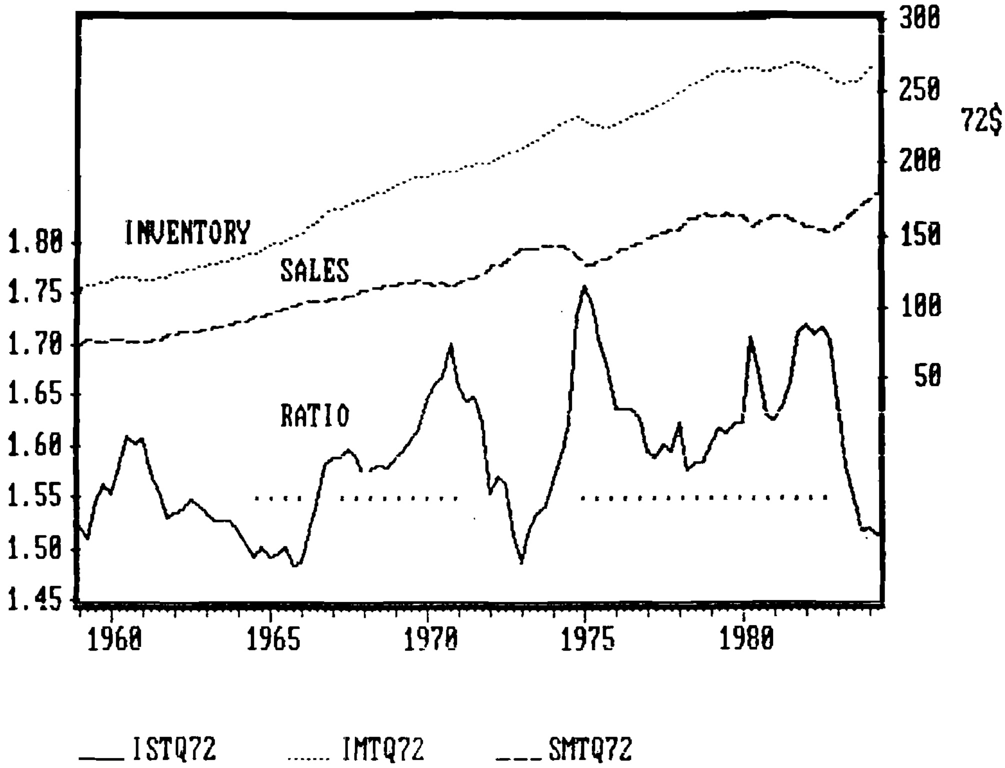


FIGURE 10.
MANUFACTURING & TRADE SECTOR STOCK LEVELS 1972 DOLLARS

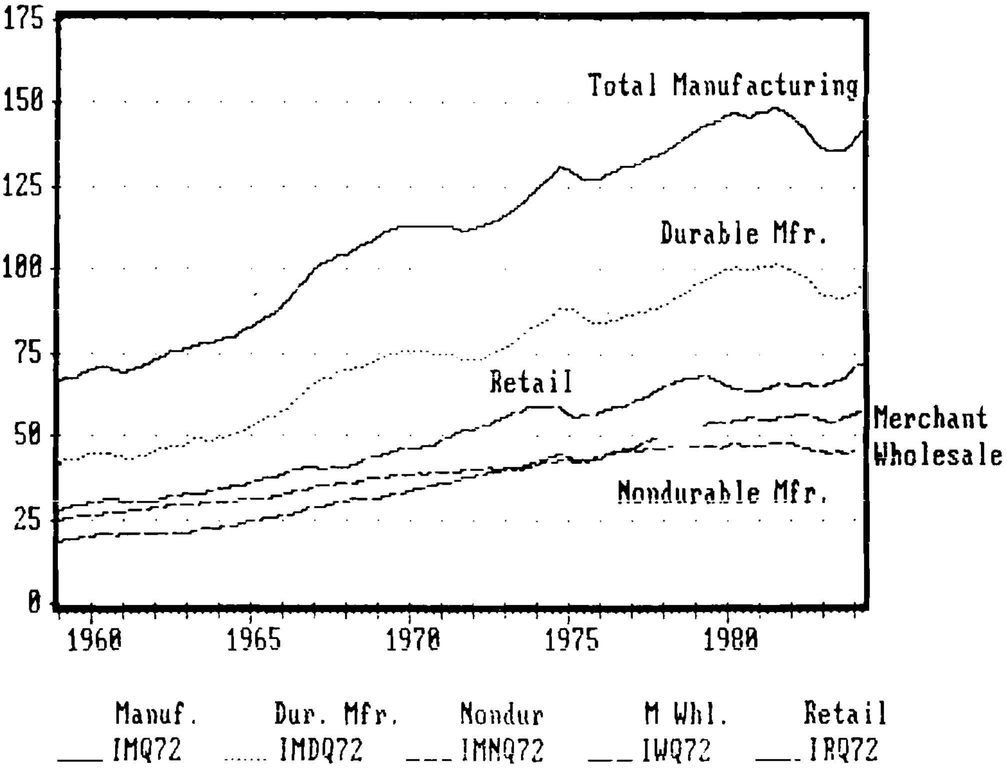


FIGURE 11.
RETAIL SECTOR INVENTORY/SALES RATIO

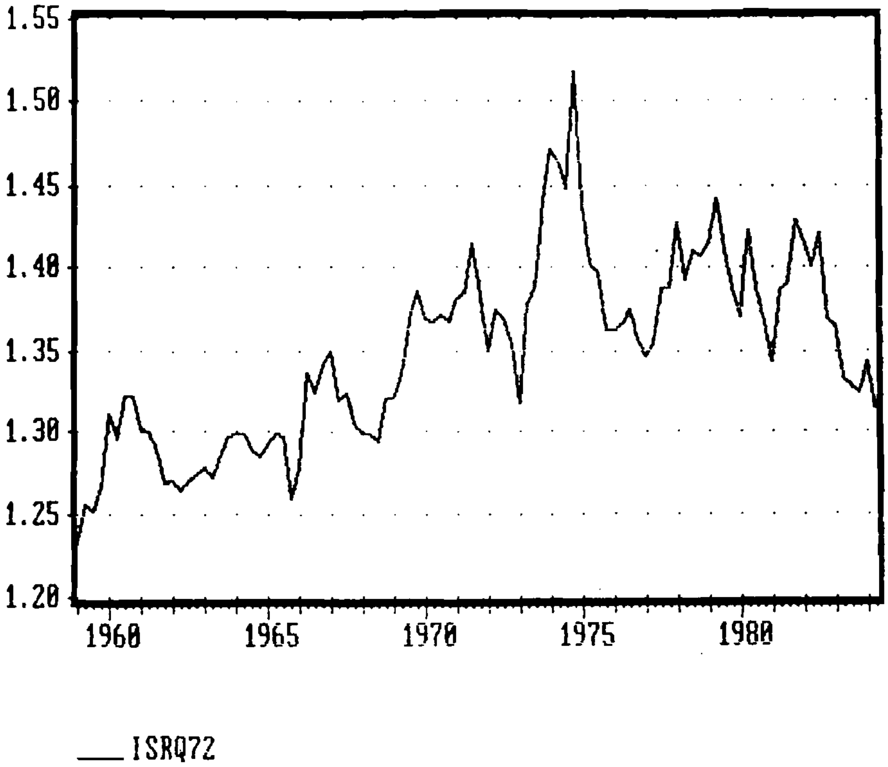
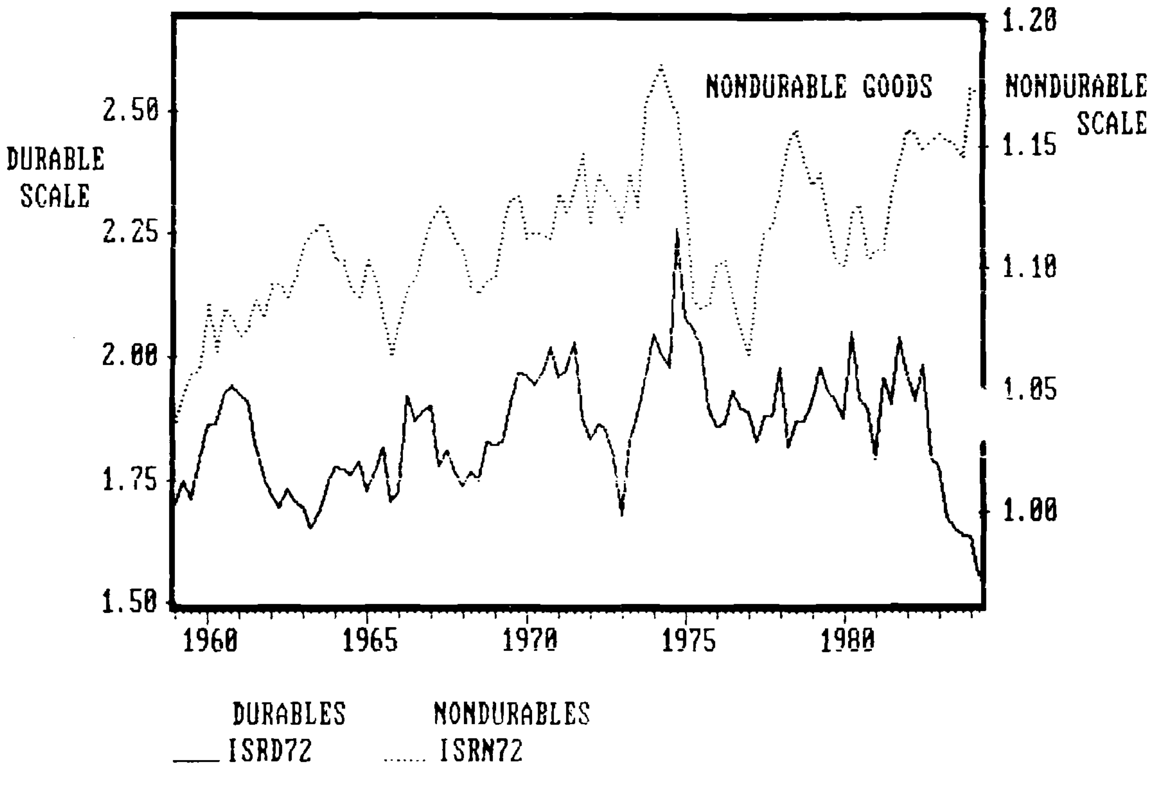


FIGURE 12.
RETAIL SECTOR INVENTORY/SALES RATIOS FOR DURABLE & NONDURABLE



The largest subsector is nonfood nondurables. Its inventory to sales ratio (see fig. 14) has no trend. This is verified by the average stock/sales ratios reported for subperiods in Table 2. In contrast, there has been a small steady uptrend in the inventory to sales ratio of food stores (see fig. 15). Hence the small food sector accounts for the uptrend seen in nondurable retailers' stock to sales ratio. Several possible factors could be contributing to this expansion. One is the great expansion of merchandise variety found in newer food stores. Many have added specialty areas stocking bakery items, coffees, etc. Secondly, it is possible that retail food stores probably have assumed some of the inventory stocks formerly held by food wholesalers and manufacturers. This would be consistent with the trend toward more and more sales of food being made by large chains of food stores supplied from central warehouses owned by the chain. It is also consistent with the observation we will make later that food manufacturers and wholesalers have reduced their inventory to sales ratios over time.

Turning to durable goods, figure 16 shows that between the early 1960s and mid-1970s automobile (and truck) dealers dramatically increased their inventory to sales ratios. As shown in figure 17 auto stocks simply increased much faster than sales over this period. This increase is probably partially due to the introduction of many new models of different size classes over this period. U.S. auto makers traditionally produced only full-sized cars. In the 1960s compact cars and then subcompact cars were introduced. Also a number of luxury specialty models were introduced. This increase in "variety" could have prompted dealers to carry more total stock relative to sales. Perhaps there was also a decrease in the percentage of cars made to order. In any case, with the increase in gasoline prices and the resulting import penetration, this upward trend in the auto stock to sales ratio stopped.

In contrast to auto dealers, the inventory to sales ratio for retail stores carrying other durables oscillated in a range of 2.3 to 2.4 until 1975 when a significant downtrend began (see fig. 18). This downtrend, which has persisted for the last ten years, does perhaps reflect the introduction of NLT. An an increasing percentage of appliance sales are now made by large chains of stores who have regional warehouses. Also many independently owned stores have joined together in buying networks which handle purchasing and warehousing. This downward trend may also reflect a change in the percentage of other durables purchased through customer special orders.

So we have found that the uptrend in the durable goods stock to sales ratio was due to automobile dealers and the uptrend in the nondurable goods stock to sales ratio was due to food stores increasing their ratio. On the other hand, there is a recent strong downtrend in the ratio of retailers carrying other durables which may partially reflect the introduction of NLT.

IV. WHOLESALE SECTOR

Next we examine data from Merchant Wholesalers, which in aggregate hold over 80 percent of the stocks held by wholesalers. Data on nonmerchant wholesalers which include firms like manufacturer distribution centers are not available on a quarterly basis. Durable

FIGURE 13.
RETAIL SUBSECTOR INVENTORY STOCKS 1972$

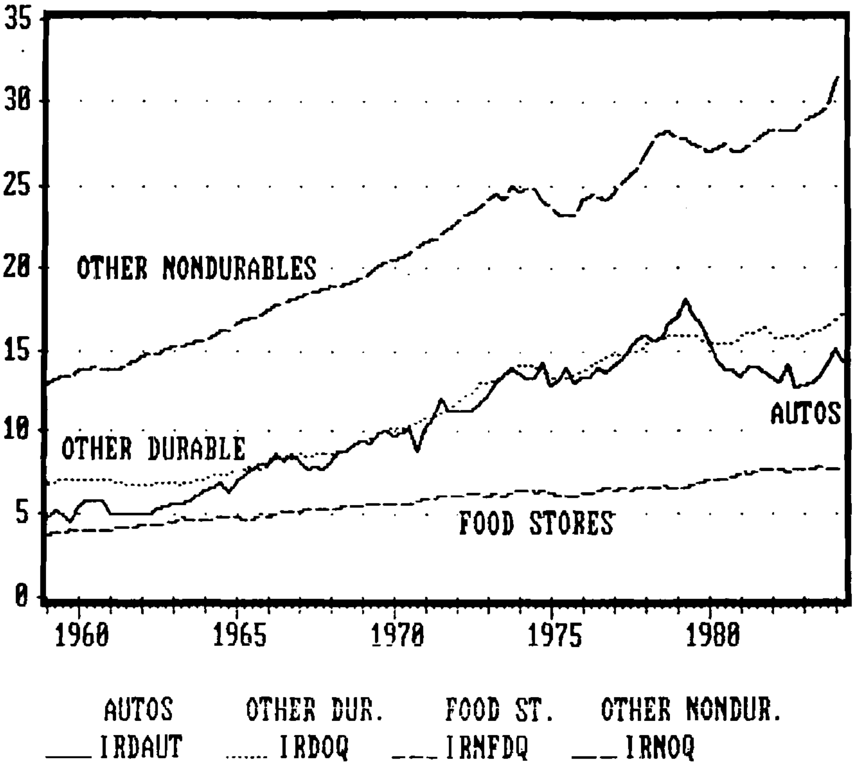


FIGURE 14.
RETAIL, OTHER NONDURABLES INVENTORY/SALES RATIO

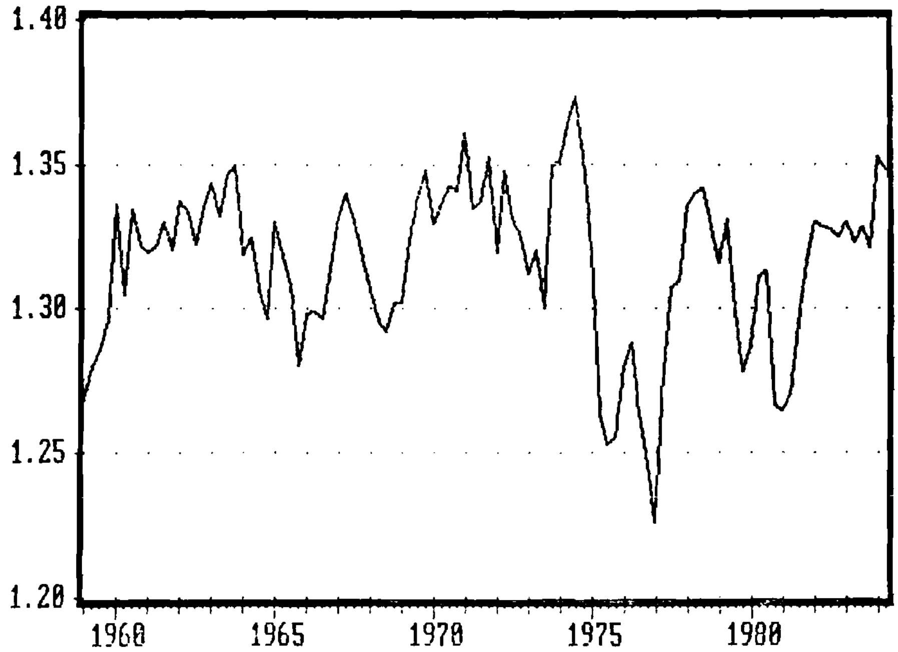


FIGURE 15.

RETAIL, FOOD STORES INVENTORY/SALES RATIO

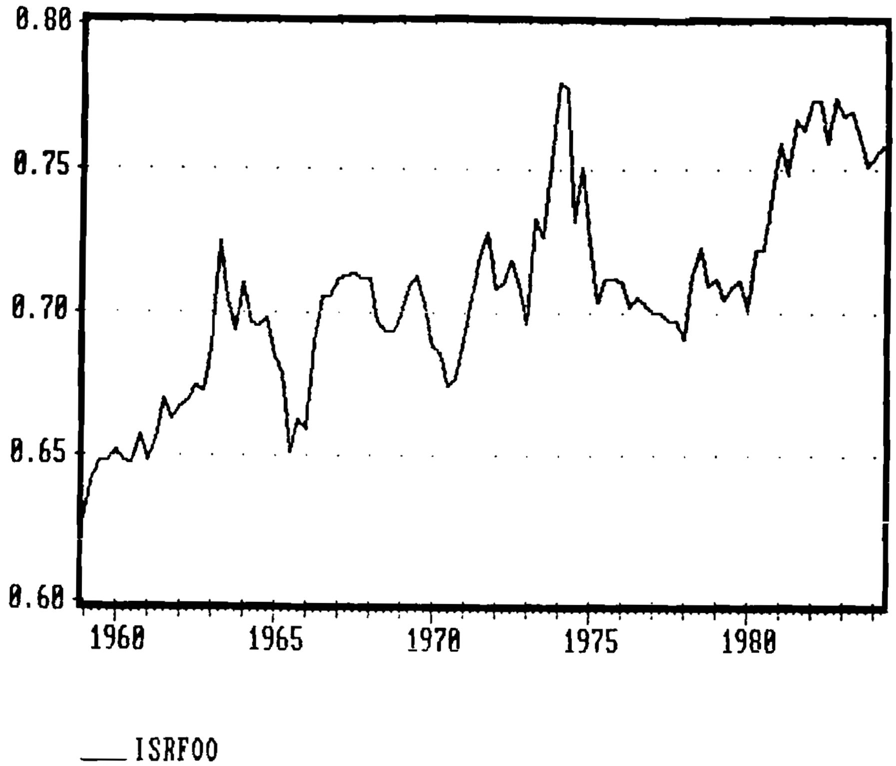


FIGURE 16.

RETAIL, AUTOMOBILE DEALERS INVENTORY/SALES RATIO

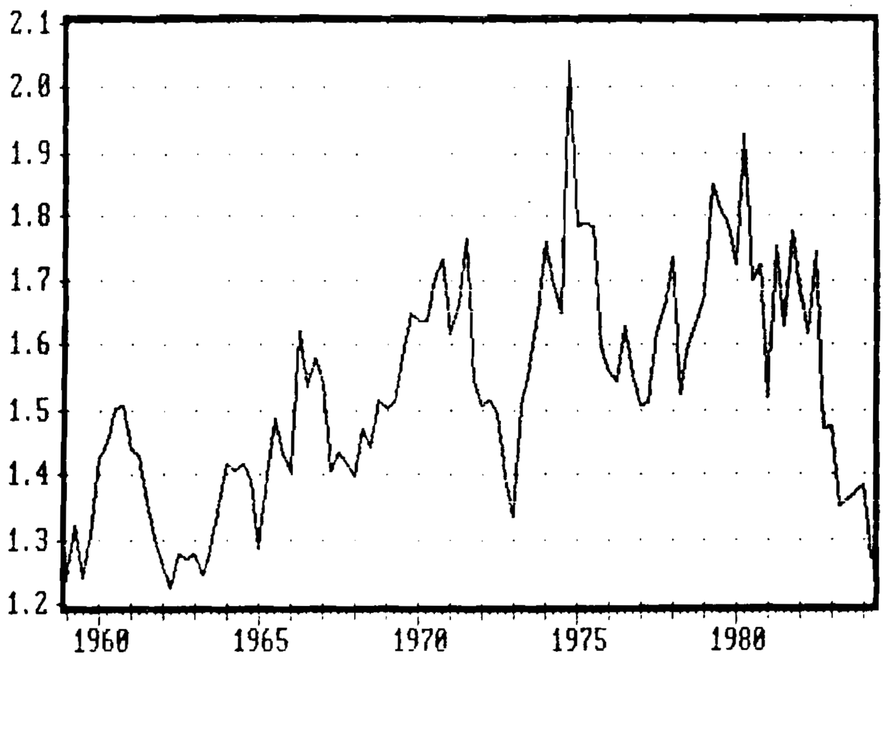


FIGURE 17.
RETAIL, AUTOMOBILE DEALERS INVENTORIES, SALES 1972$

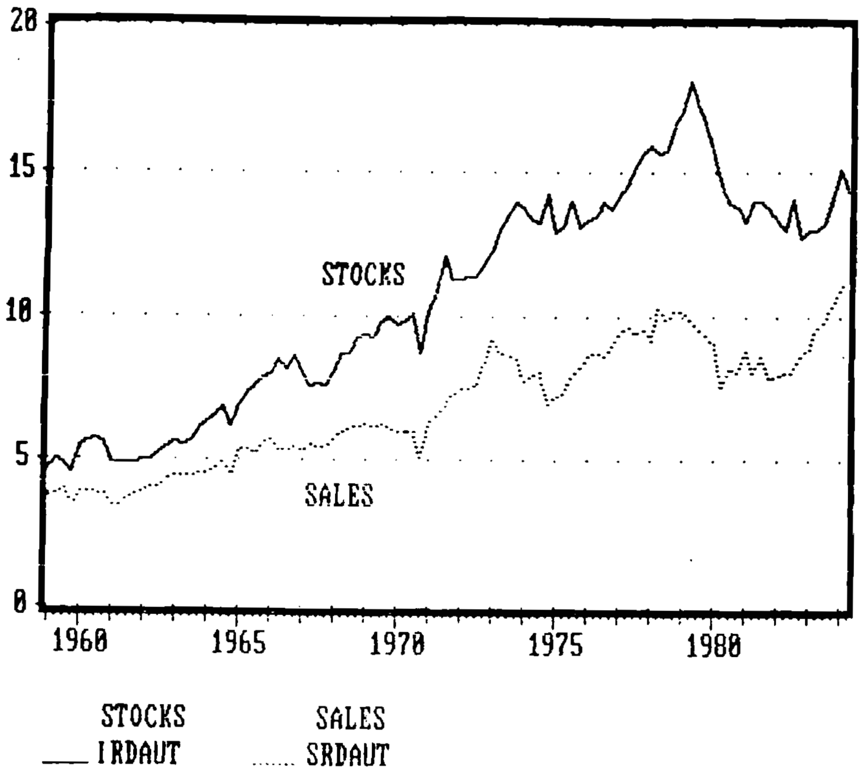


FIGURE 18.
RETAIL, OTHER DURABLE GOODS INVENTORY/SALES RATIO

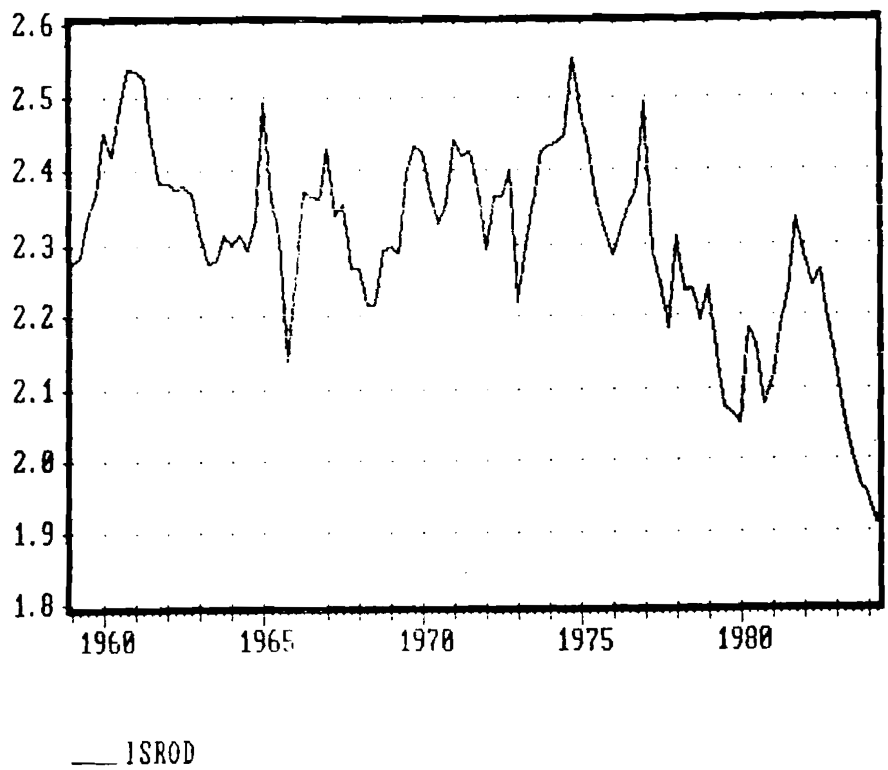
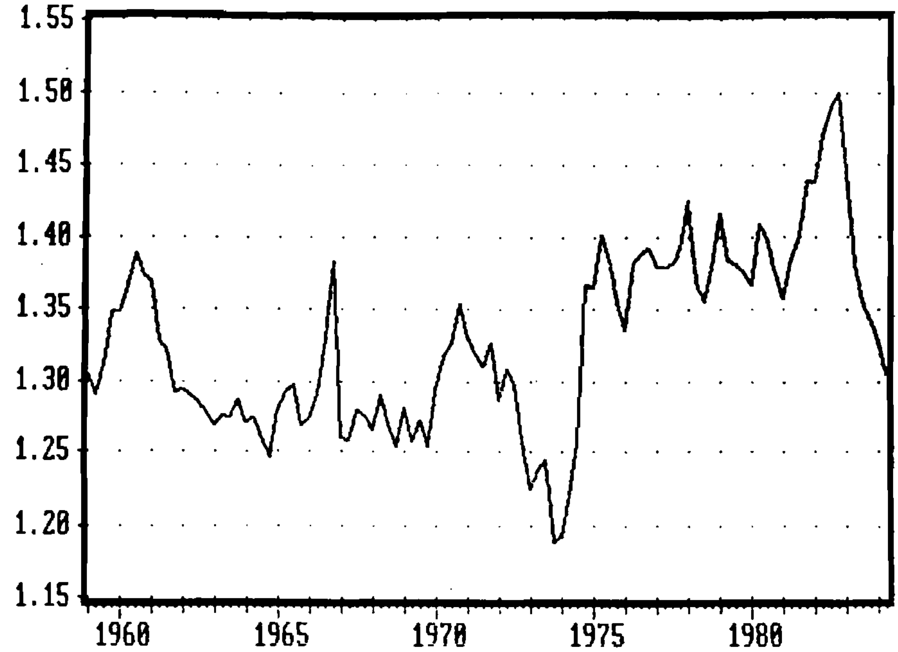


FIGURE 19. MERCHANT WHOLESALER SECTOR INVENTORY/SALES RATIO



goods stocks have increased faster over time in this sector also; they now make up two-thirds of merchant wholesaler stocks. Groceries and farm products are about half of the nondurable inventories.

Examining the plot of the overall inventory to sales ratio above, we find that there was a step increase from the pre-1975 range of 1.25 to 1.30 to a range of 1.35 to 1.40 since 1975. However, examining the subsectors we do not find uniform behavior. Wholesalers of groceries and farm products significantly reduced their stock to sales ratio between the 1960s and the last ten years (see fig. 20). As mentioned earlier, this possibly reflects the shift of some stockholding of groceries to food store chains who chose to eliminate the wholesaler in order to reduce costs. Also, it possibly reflects NLT in better transportation and information systems. On the other hand, the inventory to sales ratio of other nondurable wholesalers (fig. 21) trended upward from the mid-1960s to the 1980s. The net effect of these two trends was to produce a trendless stock to sales ratio for nondurable goods wholesalers.

For durable good wholesalers, we find a pattern like the aggregate: there was a step increase from about 1.8 in the 1960s and early 1970s to about 1.95 from 1975 through the early 1980s. Note that the sharp peaks and troughs in figure 22 for the stock to sales ratio reflect the sales volatiltiy of durable wholesalers (see fig. 23). Exactly what caused this step increase is not clear. It could be a shift of durable stocks from durable good retailers to wholesalers (we observed earlier that the ratio for other durable retailers declined), but I doubt it. Also it could also be associated with increased imports of durable goods. It could reflect the decision of durable good wholesalers, which supply for example the construction industry, to hold more stocks reflecting the low real rate of interest which accompanied the inflation of the period. Lastly, it may represent a decision to hold more buffer stocks after the

FIGURE 20.
MERCHANT WHOLESALER, GROCERIES & FARM PRODUCTS INV/SALES RATIO

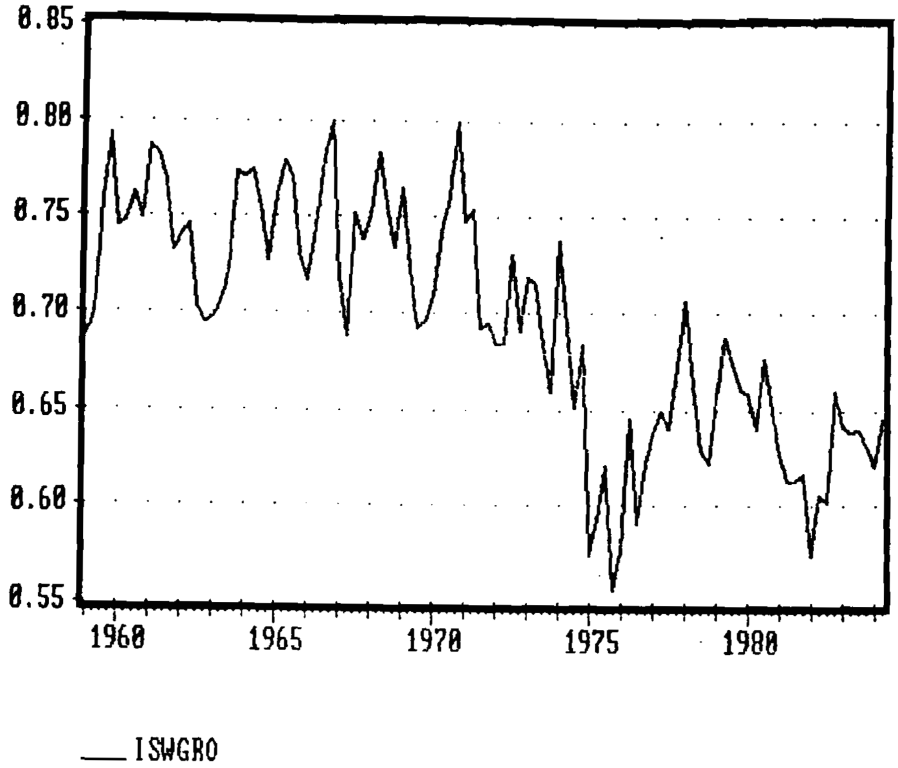


FIGURE 21. MERCHANT WHOLESALER, OTHER NONDURABLES INVENTORY/SALES RATIO

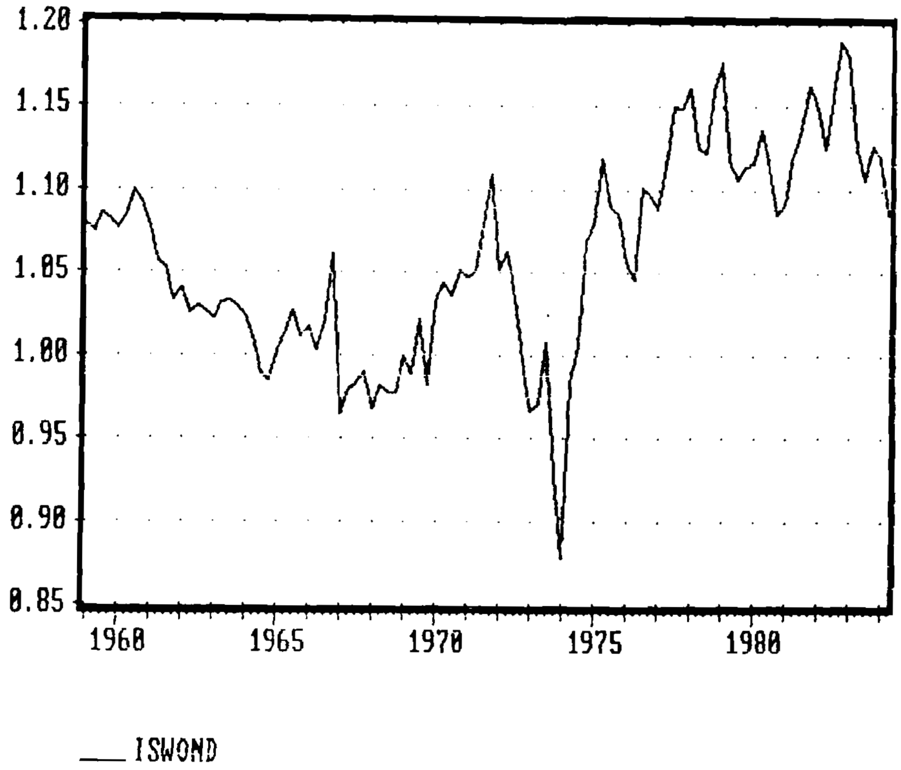


FIGURE 22.
MERCHANT WHOLESALE DURABLE GOODS INVENTORY/SALES RATIO

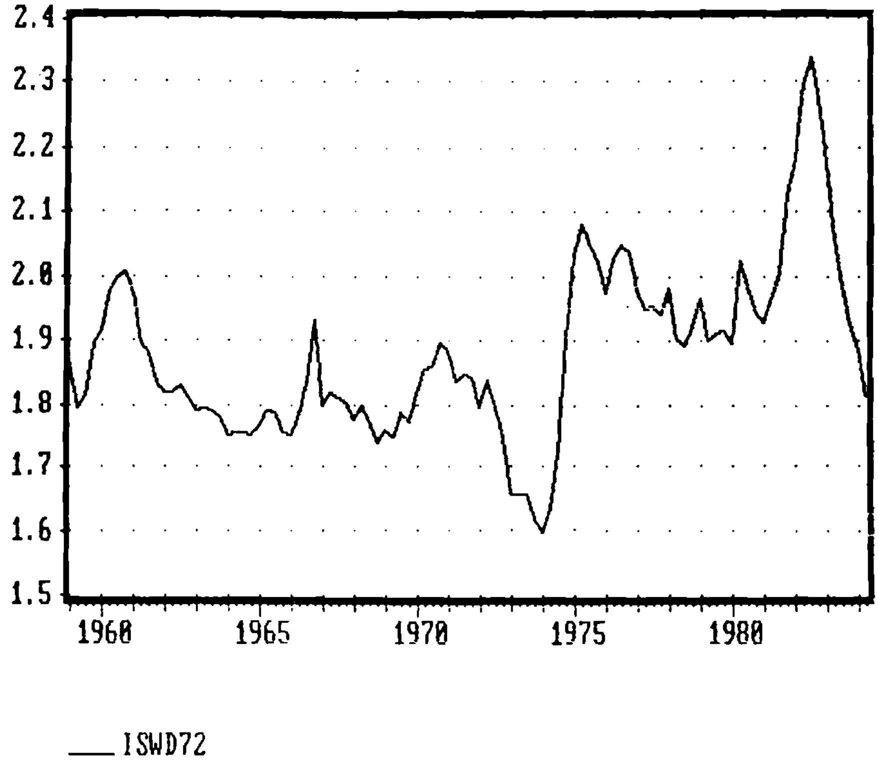
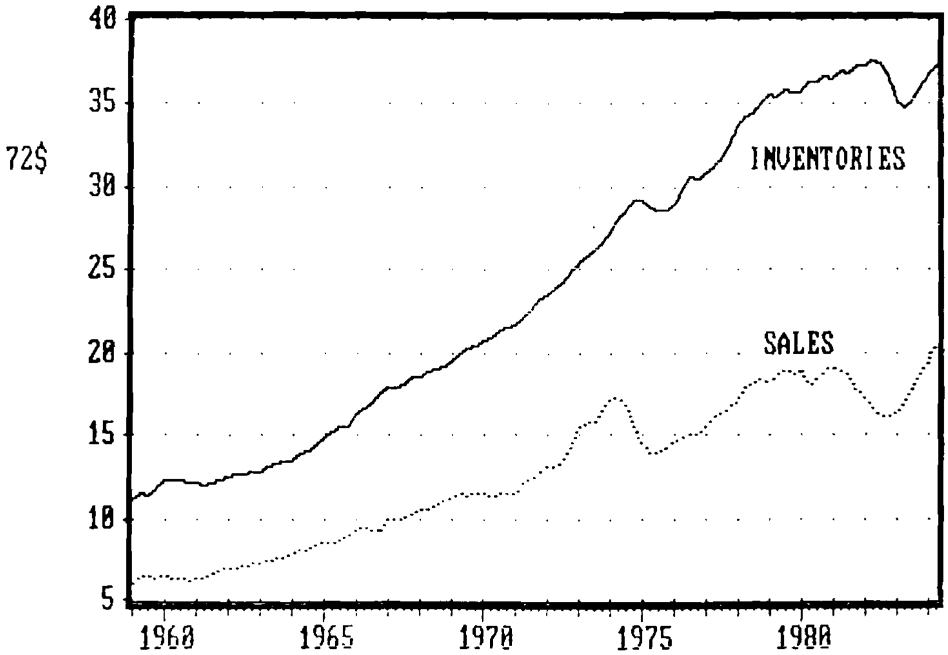


FIGURE 23.
MERCHANT WHOLESALE DURABLE GOODS INVENTORIES & SALES



NOTE: Stocks are end of quarter.

shortages experienced in 1972-73. In any case, this increase is the main reason that the inventory to sales ratio of merchant wholesalers in aggregate increases after 1975.

V. NONDURABLE GOODS MANUFACTURERS

For manufacturers data is available not only on total stocks held, but on the stocks broken down by stage of processing. Material price inflation lowers the real financial carrying cost of materials and hence theoreticaly should lead to increased stockholding. The higher the probability of a shortage, the more buffer stock of material inputs a manufacturer theoretically will desire to hold. In the early 1970s there were shortages of materials and a high rate of inflation in material and fuel prices throughout the 1970s. Hence, in examining these data we should not be surprised to see an increase in material and fuel stocks. Counterbalancing this would be the introduction of NLT which through increasing the efficiency of resource input planning and material delivery would lower material stocks.

Nondurable manufacturers hold about 35 percent of total manufacturing stocks. These stocks are primarily finished goods and materials. Most of this sector produces mainly to stock (i.e. few goods are produced to order). A priori one would expect NLT to work to reduce finished good stocks as new information technology allows the manufacturers to monitor retail and wholesale sales more closely. Examining figure 24, we indeed do find somewhat of a downtrend in aggregate nondurable stocks since the early 1970s. Note that the sharp peaks in the ratio in 1974 and the early 1980s were due to a falloff in sales during the recessions. In an attempt to find the source of this nondurable downtrend we will now examine the subsectors.

The aggregate inventory to sales ratio for Food and Kindred Products is plotted in figure 26. After being flat until the mid-1970s, this ratio trended downwards. As one can see in figure 27, this decline is mainly due to a decline in the ratio of food finished good stocks to sales which began around 1970. This pattern is also consistent with the inventory to sales ratio of food retailers increasing. In figure 28 the relative sizes of the nonfood nondurable manufacturing subsectors are illustrated. Chemicals and Allied Products industries hold twice the stocks of any of the other subsectors.

Chemical manufacturers'inventories, sales, and their ratio are plotted in figure 29. A significant downtr began in the overall inventory to sales ratio in the mid-1970s as both sales and stocks grew more slowly. This can also be verified by reference to Table 3 which reports average stock to sales ratios for each manufacturing subsector for four selected sample perods. Reference to figure 30 shows that this downtrend was caused by a decline in the stock to sales ratio of finished goods. The material and work-in-processs ratios to sales are trendless over the sample. Perhaps the decline in the finished goods ratio (and the maintenance of a flat materials ratio in face of inflation and shortages) reflects the introduction of NLT by chemical manufacturers.

FIGURE 24.
NONDURABLE MANUFACTURING INVENTORY/SALES RATIO

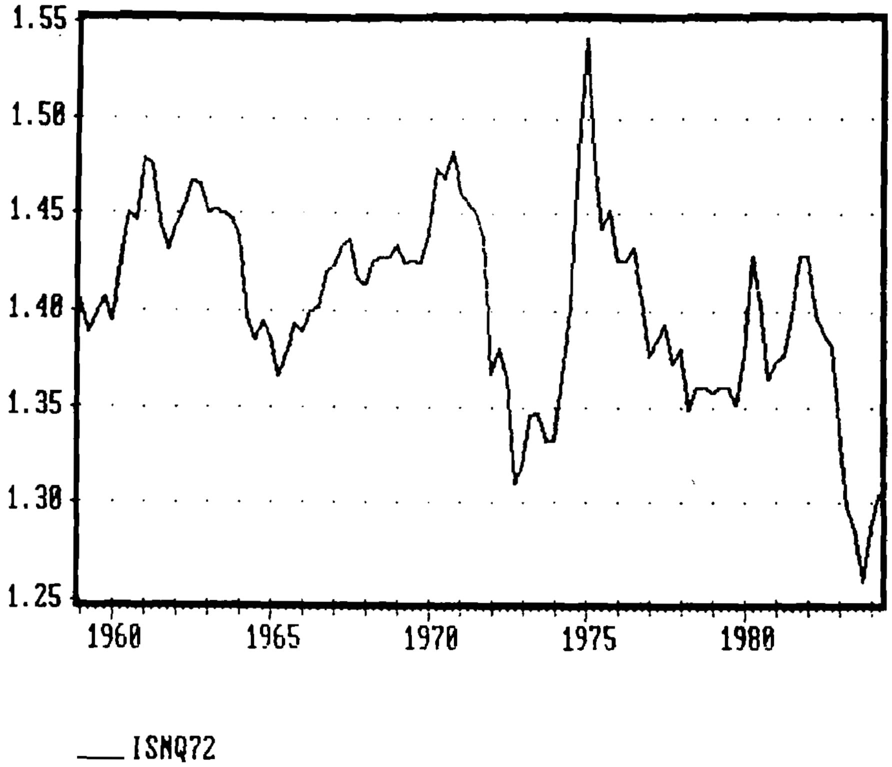


FIGURE 25.
NONDURABLE MANUFACTURING INVENTORIES, SALES 1972$

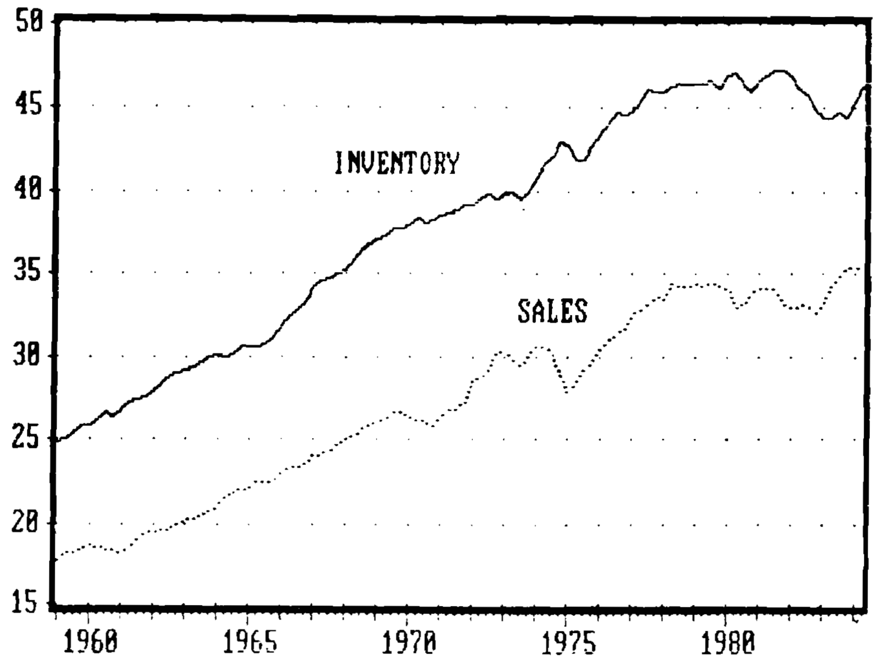


FIGURE 26.
MANUFACTURING, FOOD & KINDRED PRODUCTS

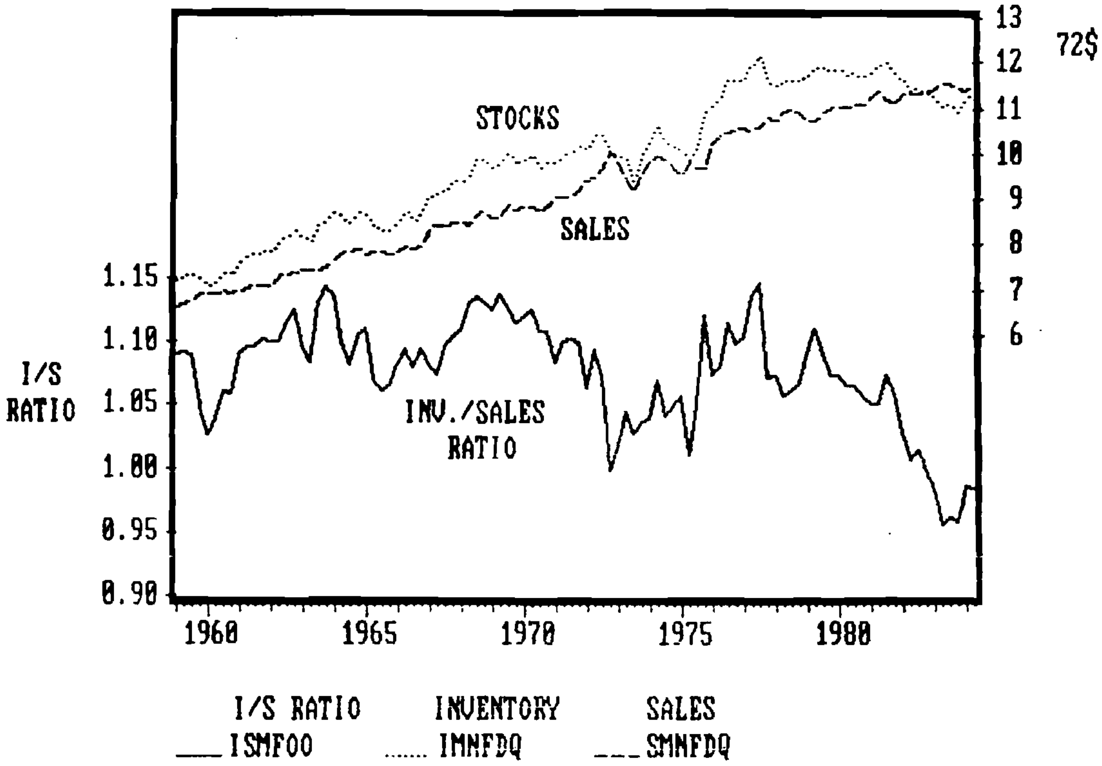


FIGURE 27.
MFR., FOOD & KINDRED STAGE OF PROCESSING STOCK/SALES RATIOS

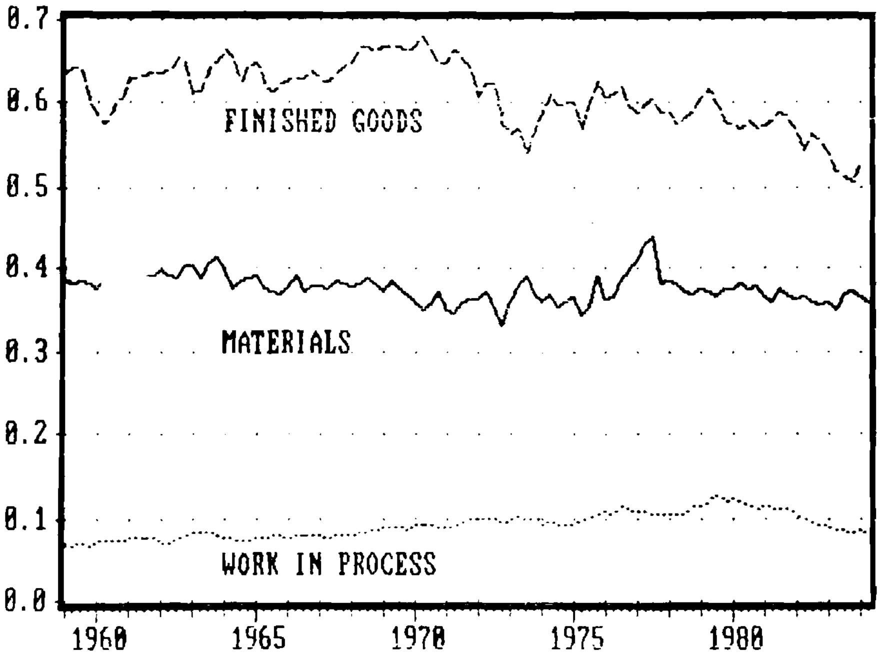
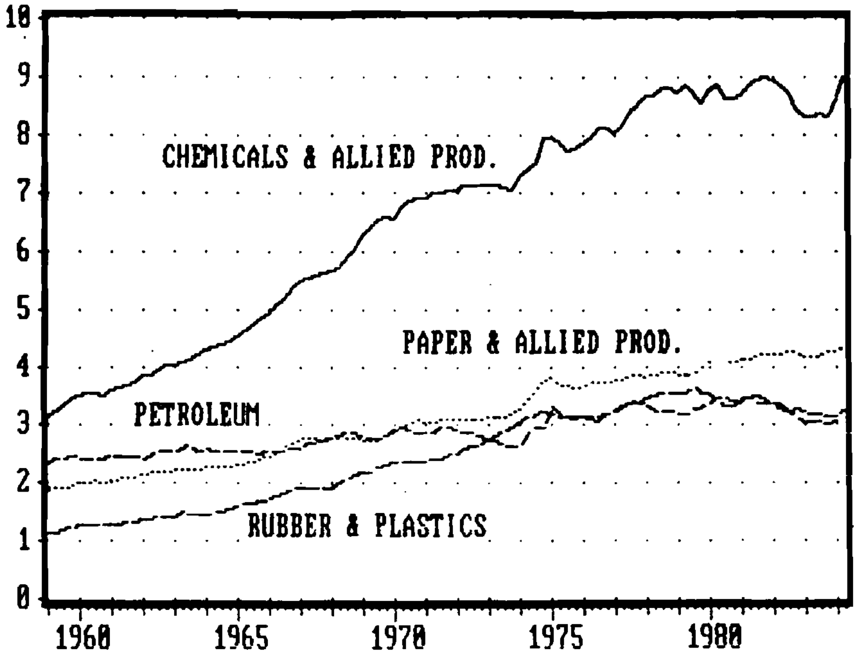


FIGURE 28.
MFR., NONFOOD NONDURABLE SUBSECTOR INVENTORY STOCKS 1972$



The largest decline in any subsector occurred in the inventory to sales ratio of the petroleum and coal products manufacturers (see fig. 31). This downtrend which began began in the early 1960s has been slowed in the 1980s by a decline in sales volume. This downtrend is mainly due to a steep decline in stocks of finished goods (see fig. 32) although there was also a significant decrease in the work-in-processs ratio from 1960 through the mid-1970s (see fig. 33). The ratio of materials to sales has been flat. This downtrend probably reflects the introduction of NLT which allowed refiners to monitor and control their highly automated production process even better and to more closely monitor stocks held in their vast distribution networks.

Turning to Rubber and Plastic Products Manufacturers, we find in figure 34 that the overall inventory to sales ratio is flat with a sizable business cycle effect. However, the stage of processing ratios below show a sustained substantial downtrend in the ratio of finished good stocks to sales perhaps again reflecting the introduction of NLT. On the other hand, in 1974 there was an increase of about 30 percent in the ratio of material stocks to sales which persisted over the remainder of the sample. This step increase possibly reflects the decision of these firms to increase material buffer stocks in light of the 1972-73 shortages and the material price inflation of the 1970s.

In the Paper and Allied Products Manufacturing subsector a similar step increase in the ratio of material stocks to sales occured in 1974 and persisted over the rest of the sample (see figures 36 & 37). Again this may have reflected a decision to increase buffer stocks after the shortages experienced and after carrying costs were lowered by material price inflation. In contrast to all the other nondurable goods manufacturing subsectors, we find a slight uptrend in the ratio of finished goods to sales of Paper and Allied Products.

FIGURE 29.
MANUFACTURING, CHEMICALS & ALLIED PRODUCTS

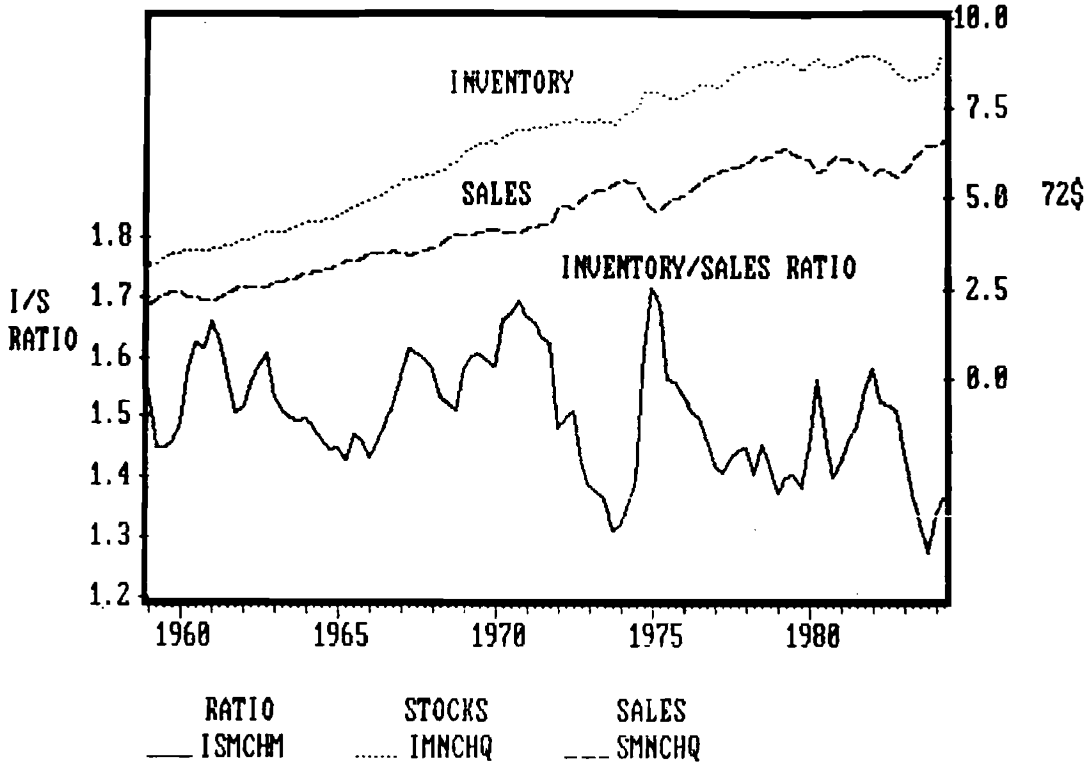


FIGURE 30.
MFR., CHEMICALS INVENTORY/SALES RATIOS BY STAGE OF PROCESSING

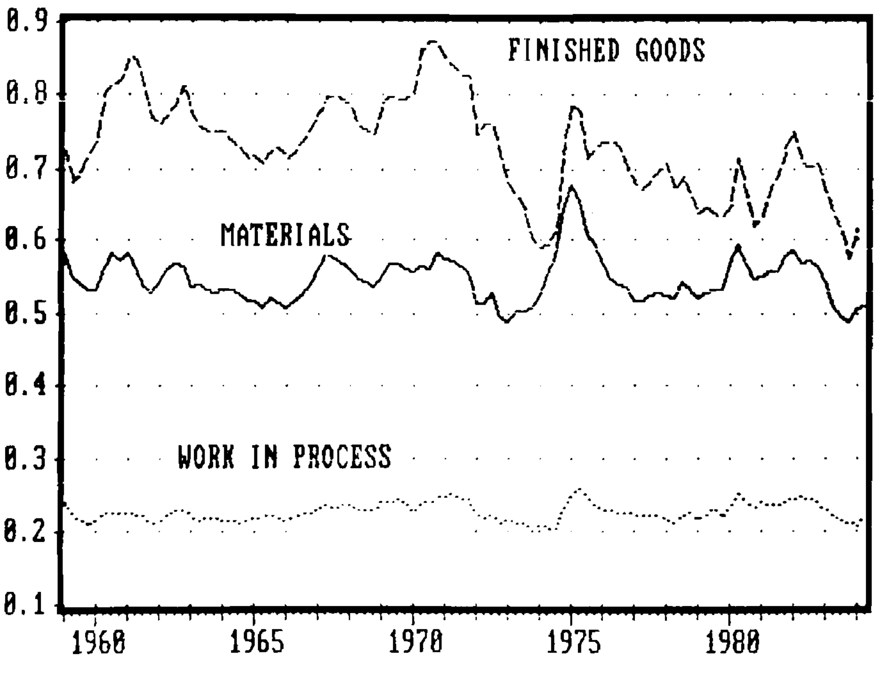


FIGURE 31.
MFR., PETROLEUM & COAL PRODUCTS

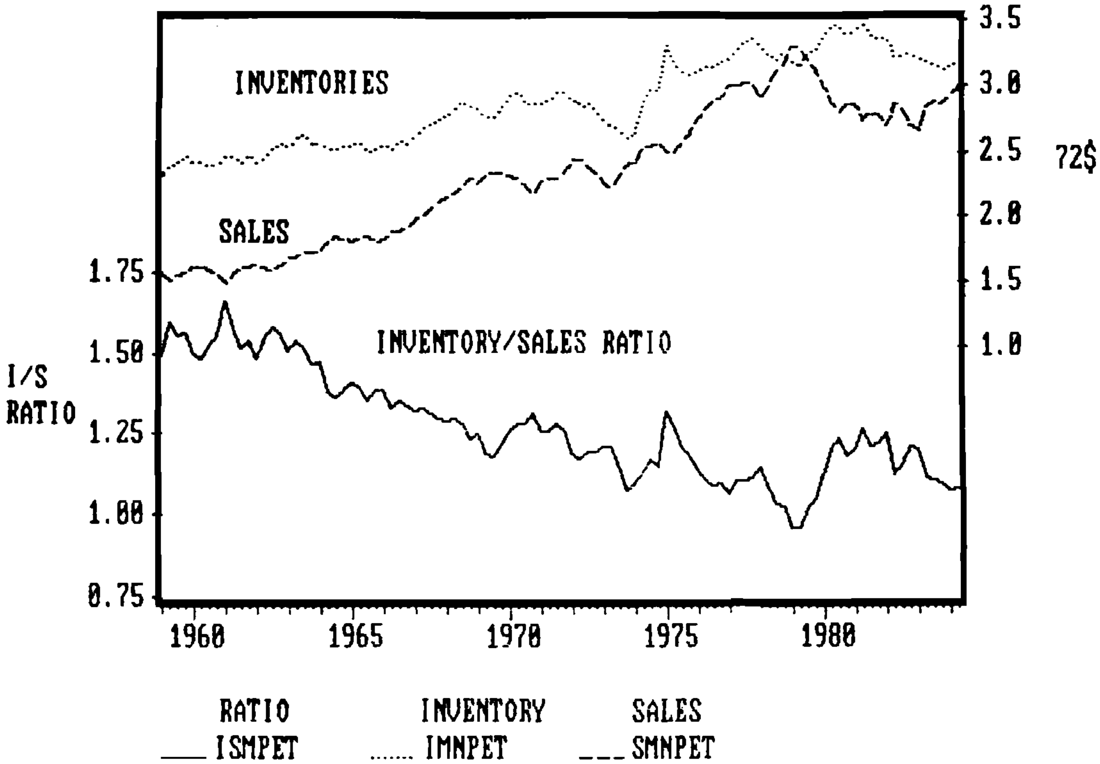


FIGURE 32.
MFR., PETROLEUM & COAL FINISHED GOODS & MATERIALS STOCK/SALES RATIOS

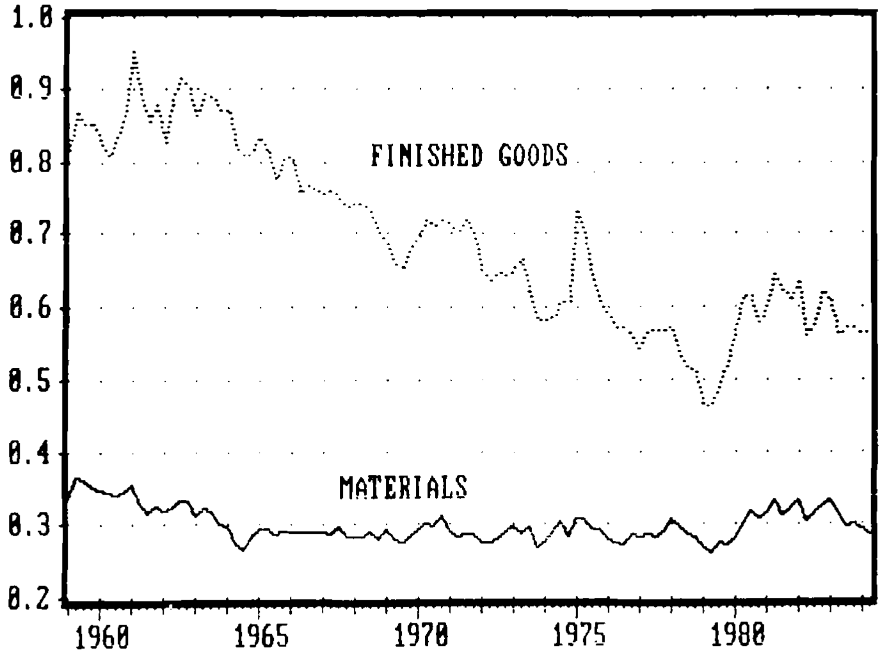
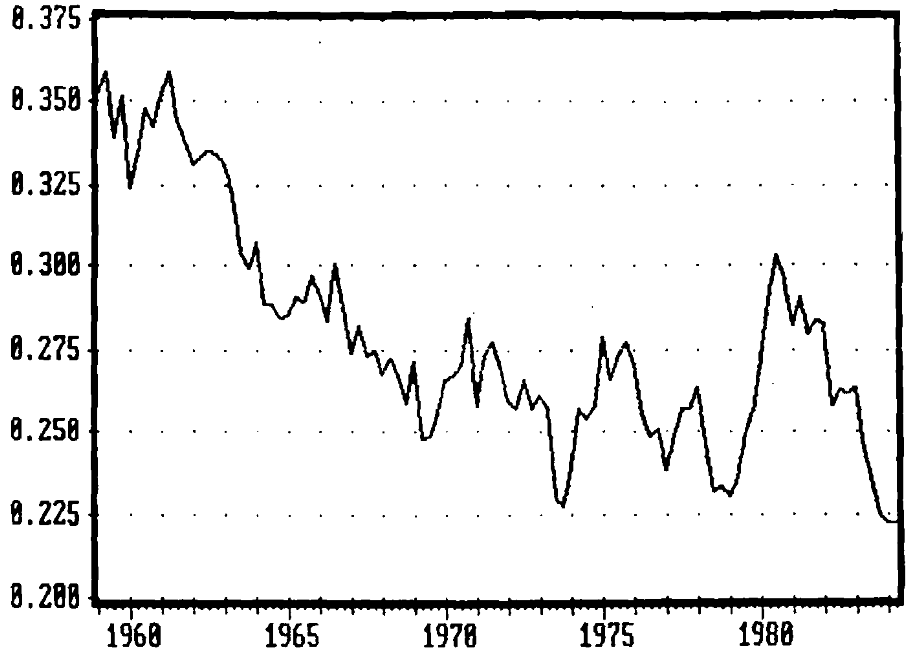


FIGURE 33. MFR., PETROLEUM & COAL WORK IN PROCESS INVENTORY/SALES RATIO



The Other Nonfood Nondurables subsector includes textiles, leather, and apparel manufacturers. After being trendless until the mid-1970s, the overall stock to sales ratio of this subsector has begun to trend downward. Recent real inventory stocks by stage of processing are not available for this subsector.

As noted at the beginning of this section, the overall stock to sales ratio for nondurable manufacturers exhibits a modest downtrend beginning in the early 1970s. Our examinations of the subsectors suggests that it is the result of downtrends in the ratio of finished good stocks to sales in the Food, Chemical, Petroleum, and Rubber subsectors especially since the mid 1970s. Offsetting this finished goods decline were step increases in the material stock to sales ratios of some subsectors like Rubber and Paper manufacturing. Examining figure 38 for the entire nondurable sector, we indeed do observe a significant decline in the ratio of finished goods stocks to sales since 1970. The overall sector ratio of material stocks to sales while increasing in 1974 has returned to the late 1960s levels as the nondurable subsectors other than Rubber and Paper gradually reduced their material stock to sales ratios. These recent trends observed in the inventory to sales ratios of Nondurable Manufacturers are consistent with the hypothesis that they have adopted NLT to economize on stockholding.

VI. DURABLE GOOD MANUFACTURERS

Durable goods manufactuers, who in aggregate hold about 65 percent of manufacturing stocks, tend to have higher inventory to sales ratios than nondurable manufacturers. This partially reflects the nature of the production technology. Within this sector are many firms who produce to order such as those in the transportation equipment subsector and the machinery subsector. Reflecting this, work-in-process stocks are the largest category of stocks with finished goods being the smallest.

FIGURE 34.
MANUFACTURING, RUBBER & PLASTIC PRODUCTS

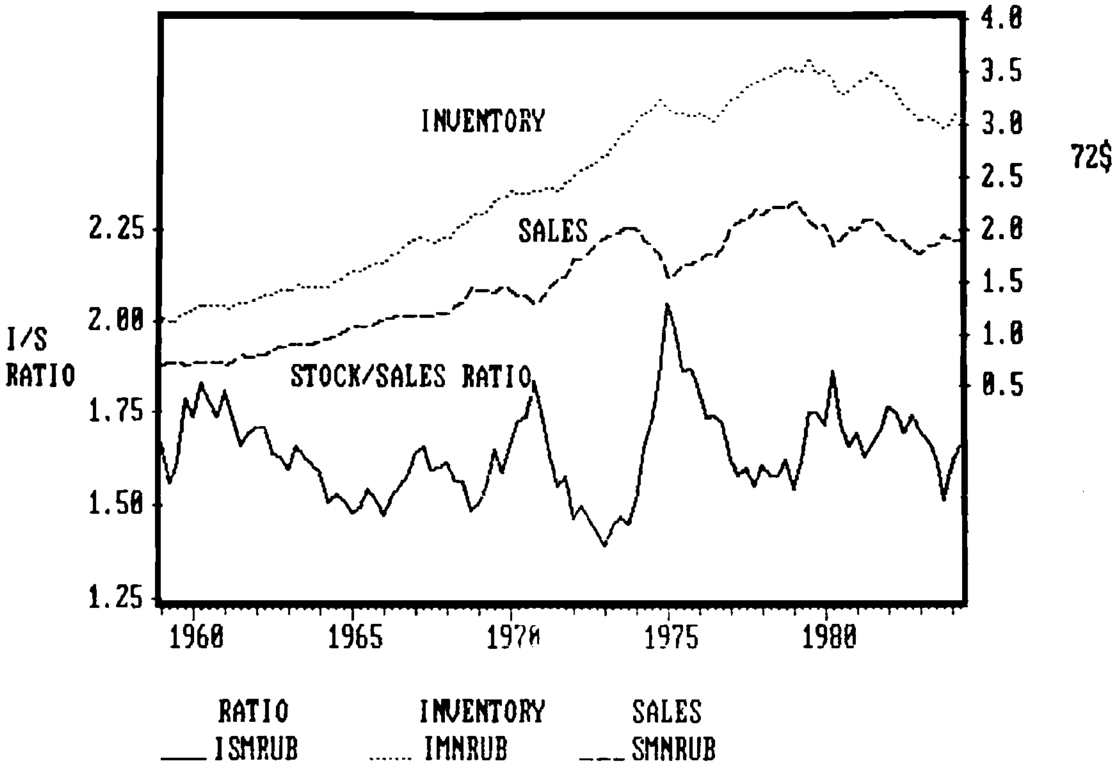


FIGURE 35.
MFR., RUBBER & PLASTICS STAGE OF PROCESSING INVENTORY/SALES RATIOS

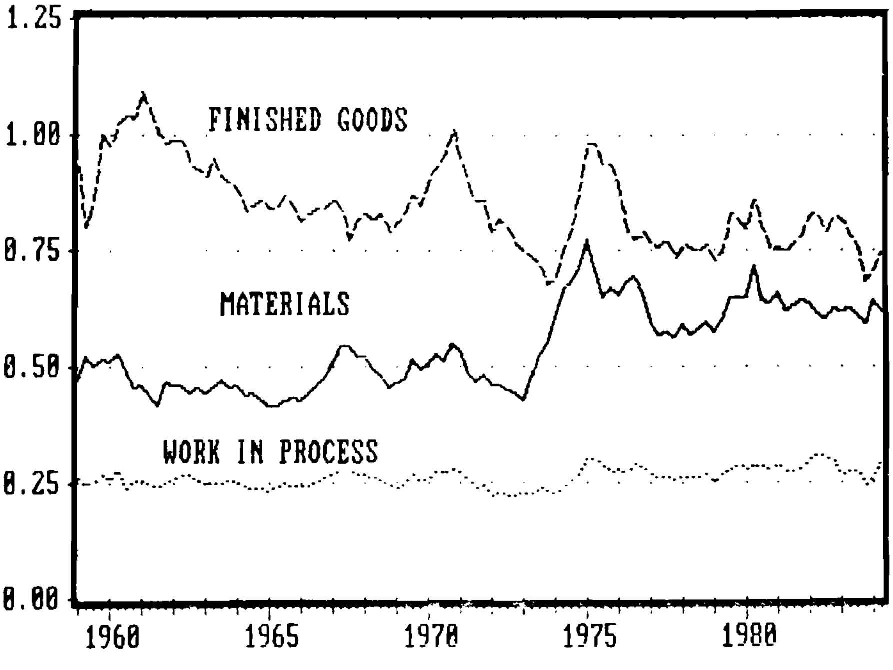


FIGURE 36.
MANUFACTURING, PAPER & ALLIED PRODUCTS

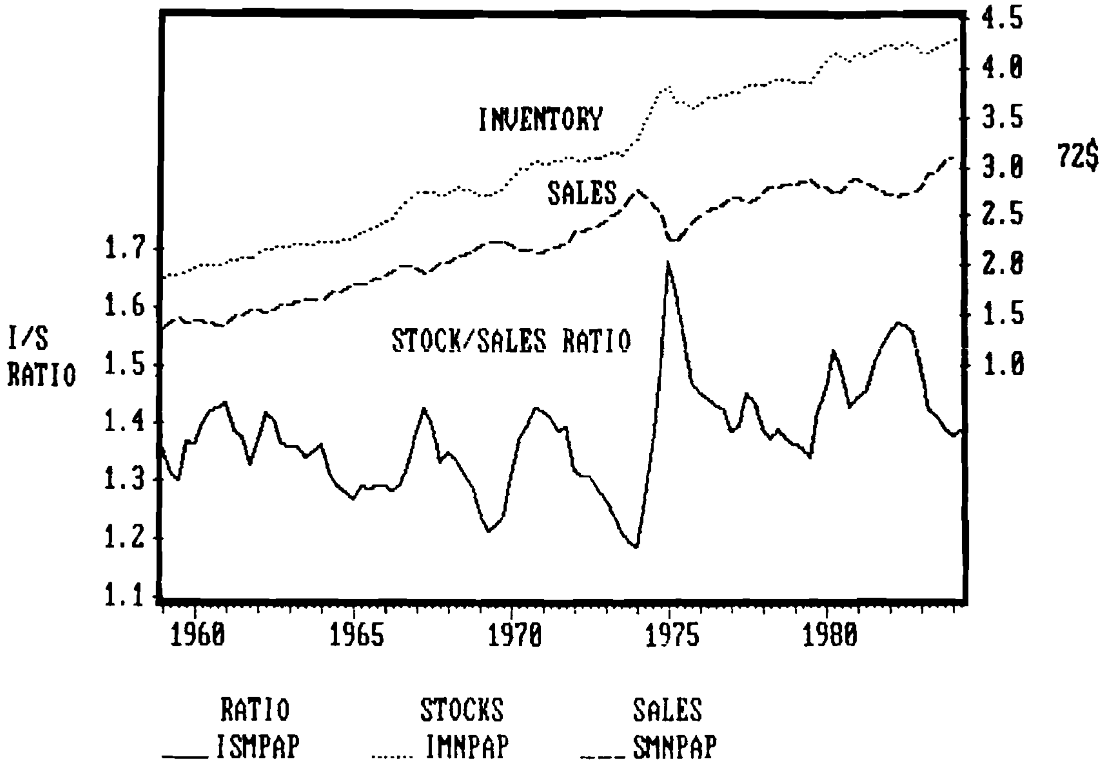


FIGURE 37.
MFR., PAPER & ALLIED PROD. STAGE OF PROCESSING STOCK/SALES RATIOS

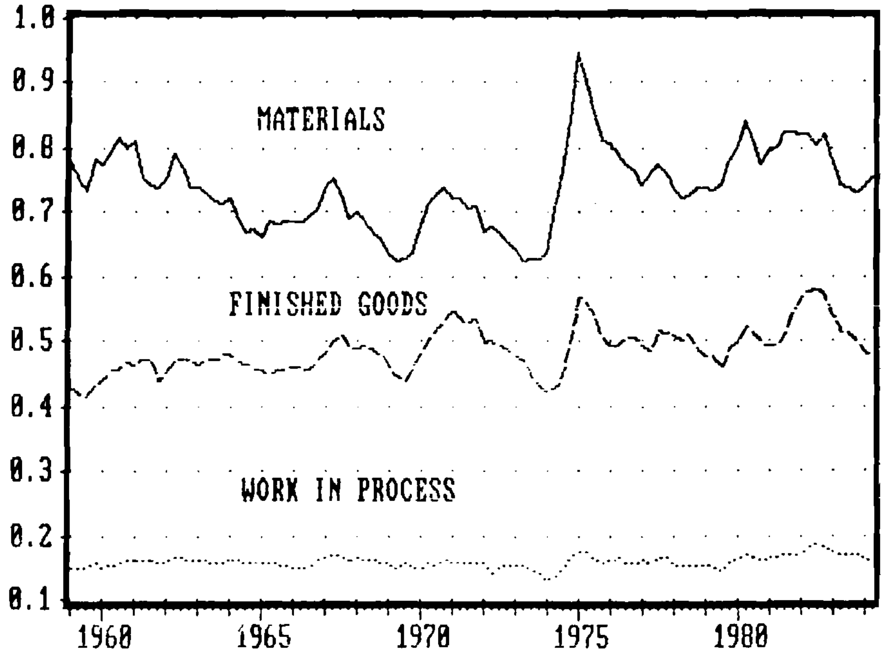
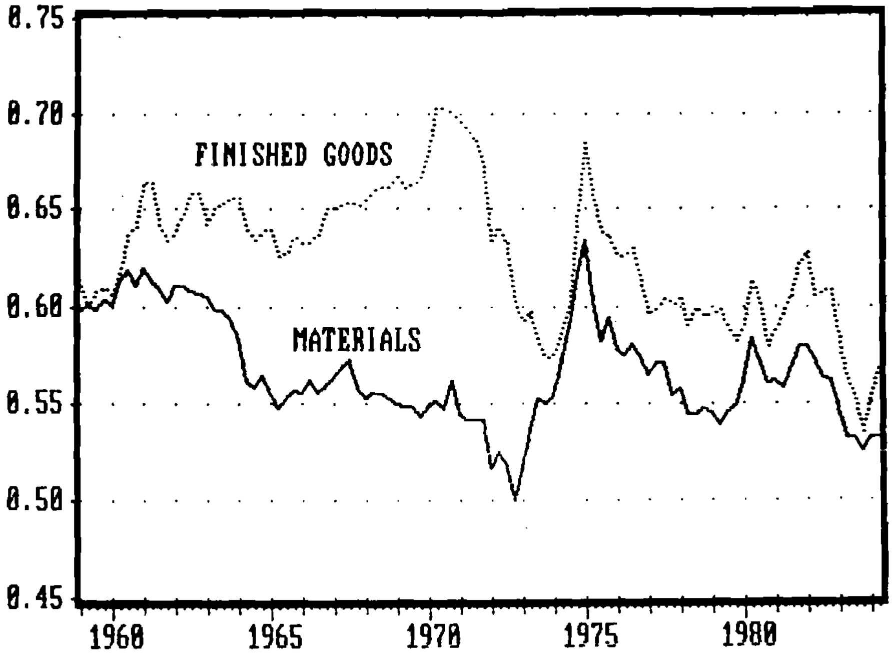


FIGURE 38.
NONDURABLE GOODS MANUFACTURING STAGE OF PROCESSING STOCK/SALES RATIOS



Hence, in this sector, a priori one would expect to observe a reduction in mainly work-in-process stocks as the result of the introduction of NLT like just-in-time production systems. Also, to the extent NLT allows better scheduling of material input deliveries, material stock to sales ratios should be reduced.

As figure 39 illustrates, sales and inventories are quite cylical in this sector. In turn, the overall stock to sales ratio is quite cylical; the big peaks here are associated with the substantial sales declines accompanying the 1970, 1974-75, and 1981-82 recessions. Abstracting from the cycle, we observe a substantial upward trend over our sample period. Looking at the stage of processing stock to sales ratios in figure 40, we see that this upward trend is actually the result of (1) an increase in the work-in-process ratio in 1966 from an average of about .83 to a new higher plateau of about 1.0 and (2) a step increase in the materials ratio in 1974 to a higher average level. The finished goods ratio has been trendless over the sample. Hence it seems that in aggregate, any reduction durable stocks that may have come from the introduction of NLT appea. o have been offset by other factors leading to increased stock to sales ratios. We turn now to an examination of the durable subsectors where we will be looking for the source of this uptrend and secondly for any evidence that individual subsectors may have reduced stocks by introducing NLT.

Among the durable manufacturing industries, the largely production to order subsectors, Nonelectrical Machinery and Transportation Equipment, hold the largest stocks (see figures 41 & 42) whereas Primary Metals and Fabricated Metals hold the smallest. The composition of stocks is similar across the subsectors except in the Other Durables subsector where finished goods are the largest component.

FIGURE 39.
DURABLE GOODS MANUFACTURING INVENTORY/SALES RATIO

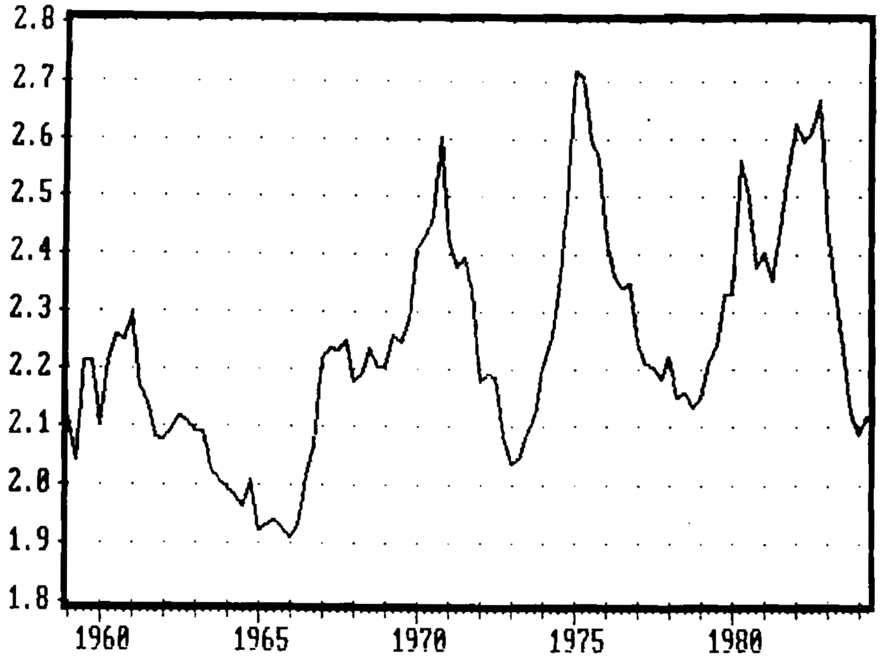


FIGURE 40.
DURABLE GOODS MANUFACTURING STOCKS BY STAGE OF PROCESSING

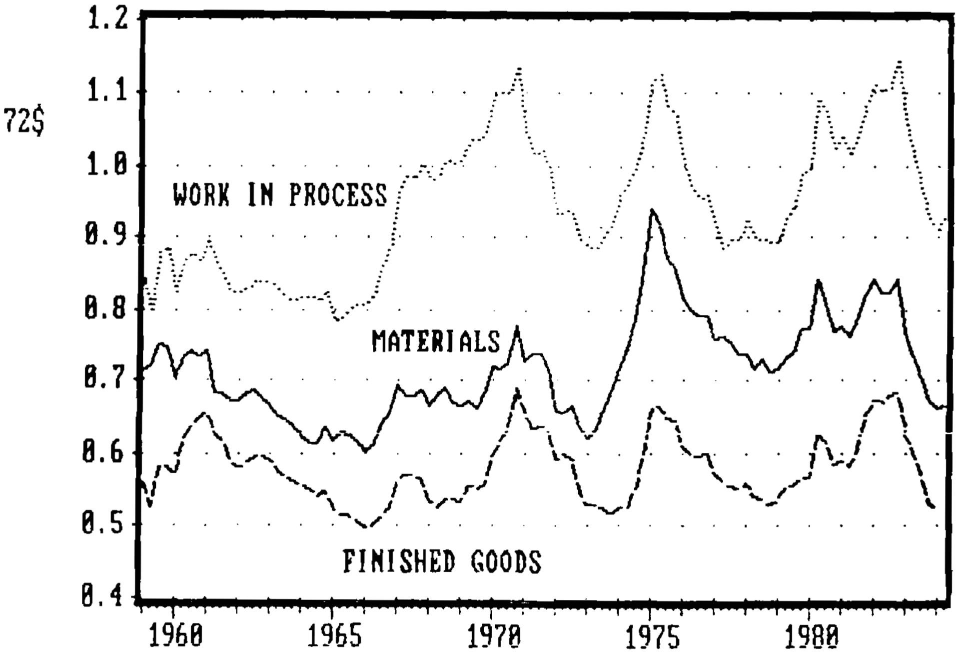


FIGURE 41.

MANUFACTURING, DURABLE SUBSECTOR STOCKS 1972$

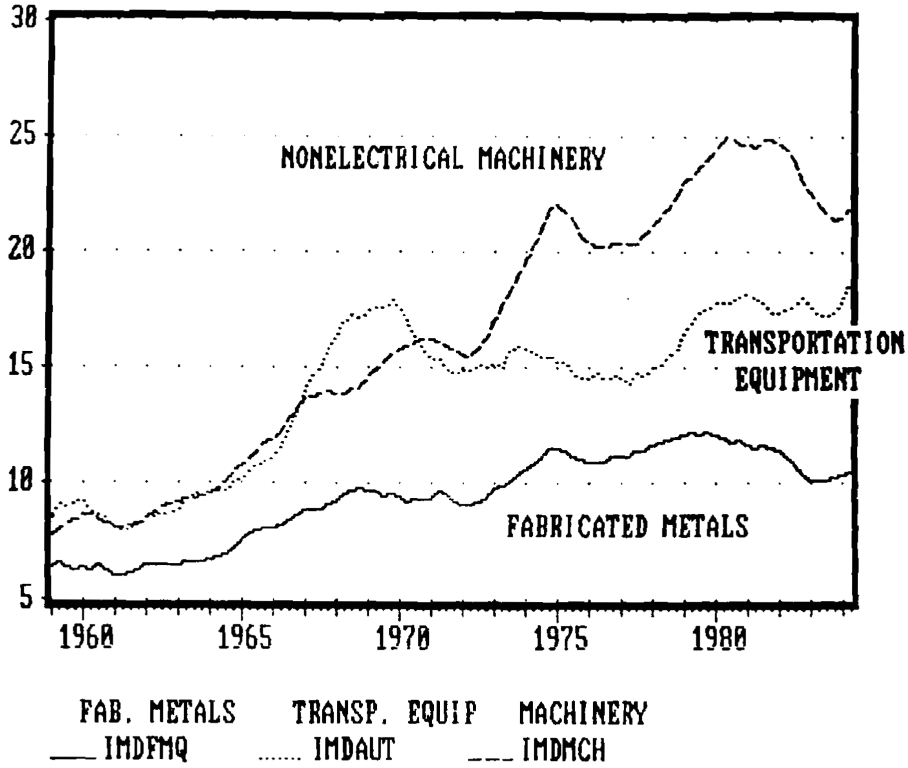
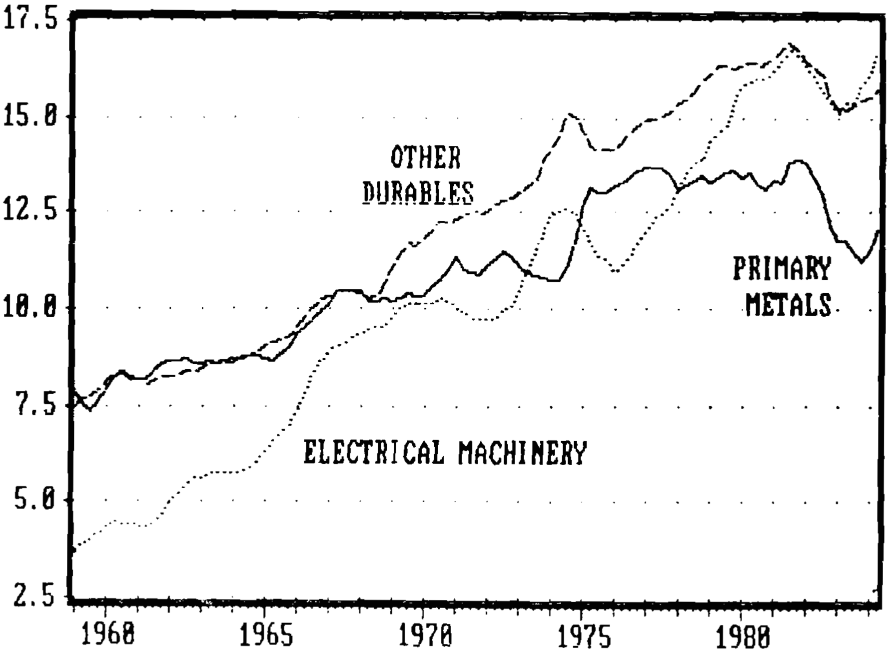


FIGURE 42.

MANUFACTURING, DURABLE SUBSECTOR STOCKS 1972$



The overall inventory to sales ratio for Nonelectrical Machinery increased to a new higher level in 1966 where it has remained (see fig. 43) until very recently when there has been a substantial decline in the absolute level of stocks due probably to the 1981-82 recession and substantial import competition. Looking at the stage of processing ratios in figure 44, we observe that in the late 1960s both work-in-process and material stocks accumulated relative to sales. However since the mid-1970s there has been a definite downtrend in work-in-process stocks. The materials ratio, which reached a new high in 1974, has also gradually declined. Hence there appears to be some evidence that these machinery manufacturers may be benefiting from the introduction of NLT.

Turning to Electrical Machinery Manufacturers, whose sales also have been steadily rising, we find a similar pattern. Their overall stock to sales ratio increased in 1966 from a range averaging 2.0 to a range averaging about 2.35. As is shown in figure 45 this range was maintained until the late 1970s when a downtrend began. The 1966 increase was mainly due to an increased work-in-process ratio but also the level of material stocks increased (see fig.46). The downtrend which began in the mid-1970s is primarily the result of a substantial decline in the finished goods ratio and a gradual reduction in the materials ratio. The work-in-process ratio has also declined from the higher range maintained over 1965-75. These recent downtrends are consistent with what one would expect to observe if these manufacturers were benefitting from NLT.

Sales and inventories of Other Durable Manufacturers have also been steadily rising. This subsectors' inventory to sales ratio increased abit in the late 1960s and has basically maintained this higher level since. Relative to sales, the component ratios show that material stocks increased the most especially in 1974. However, relative to the cylical variation, the trends in these ratios are hardly discernable. Given the amorphous nature of this sector, it is hard to conclude anything about the possible adoption of NLT.

The Transportation Equipment subsector includes automobiles, trucks, ships, airplanes, railway cars, and military transport production. The automobile manufacturing industry in the U.S. is unusual in that retail auto dealers hold nearly all of the finished good stocks because each car is already ordered by some dealer before it is produced. Decreases in auto sales during recessions are responsible for much of the cylical nature of this sector. Ideally one would like to divide this subsector in its ε and nonauto components. The inventory to sales ratio of this subsector, however, is not dominated by the business cycle as figure 47 makes clear. Rather there have been two periods of large inventory accumulation, 1966-69 and 1979-82, with a liquidation in between.

Reference to figure 48 shows that this pattern resulted from the buildup and liquidation of work-in-process stocks. Relative to sales, material stocks and finished goods stocks show little trend. The periods of accumulation correspond to periods of rapid military equipment buildup including aircraft orders. Also both periods correspond to periods when commerical aircraft sales where increasing. Hence it seems likely that the variation in work-in-process stocks was due to variation in military equipment and commerial aircraft orders. In an industry with long production periods, an acceleration in orders will almost by definition

FIGURE 43.
MFR., NONELECTRICAL MACHINERY INVENTORY/SALES RATIO

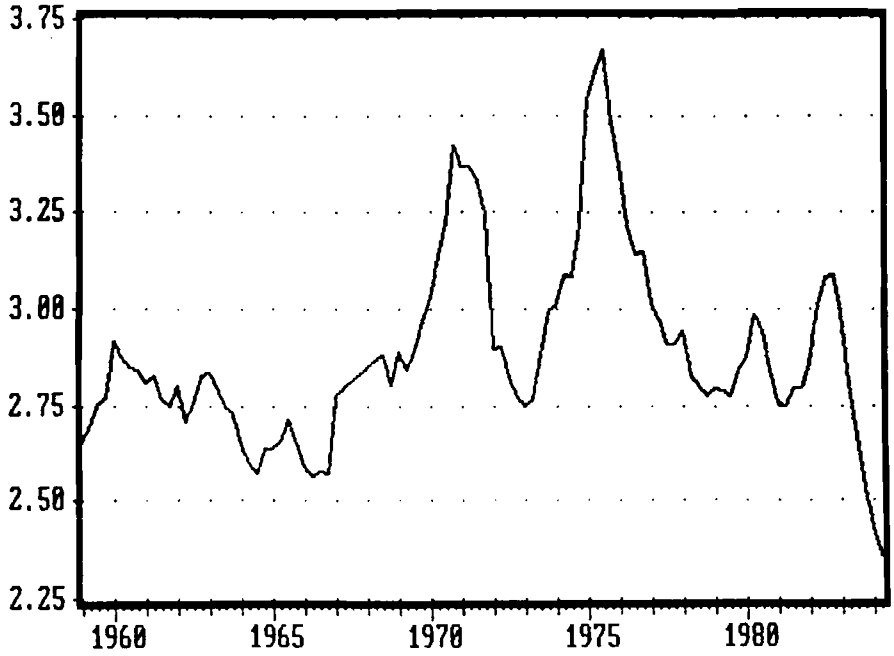


FIGURE 44.
MFR., NONELECTRICAL MACHINERY MATERIALS & WIP STOCK/SALES RATIOS

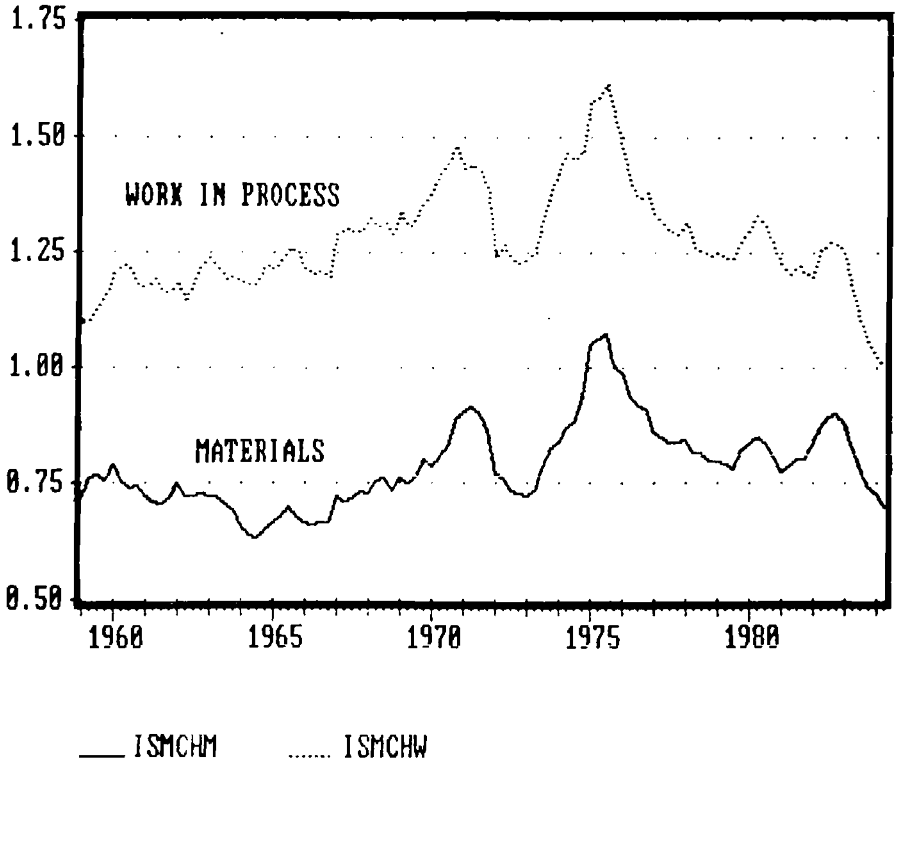


FIGURE 45.
MANUFACTURING, ELECTRICAL MACHINERY

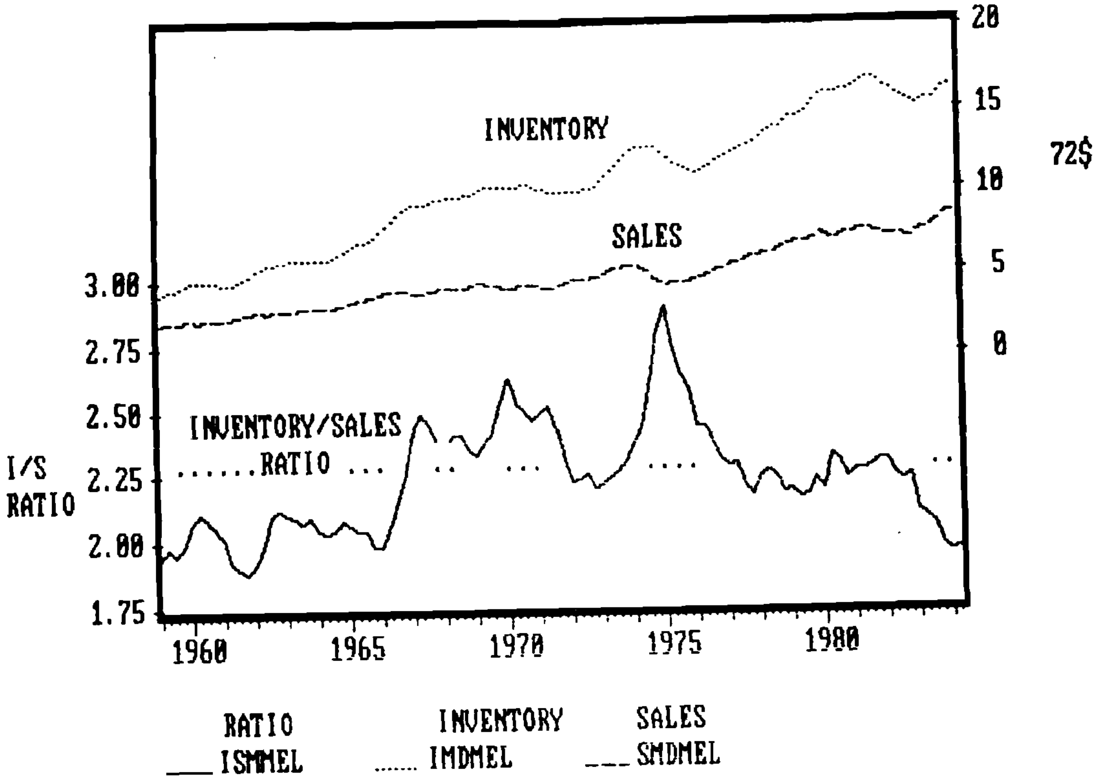


FIGURE 46.
MFR., ELECTRICAL MACHINERY STAGE OF PROCESSING STOCK/SALES RATIOS

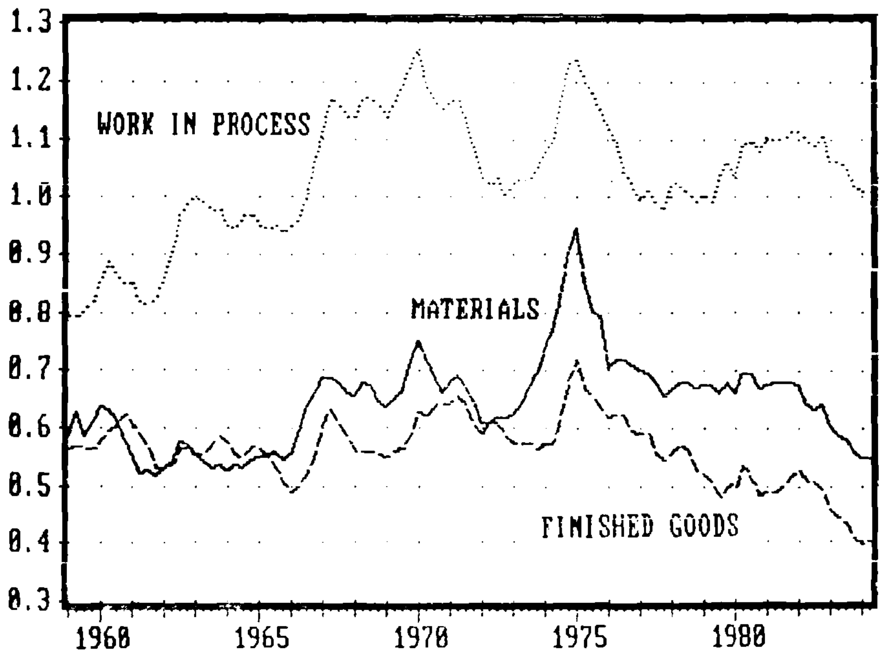


FIGURE 47.
MANUFACTURING, TRANSPORTATION EQUIPMENT

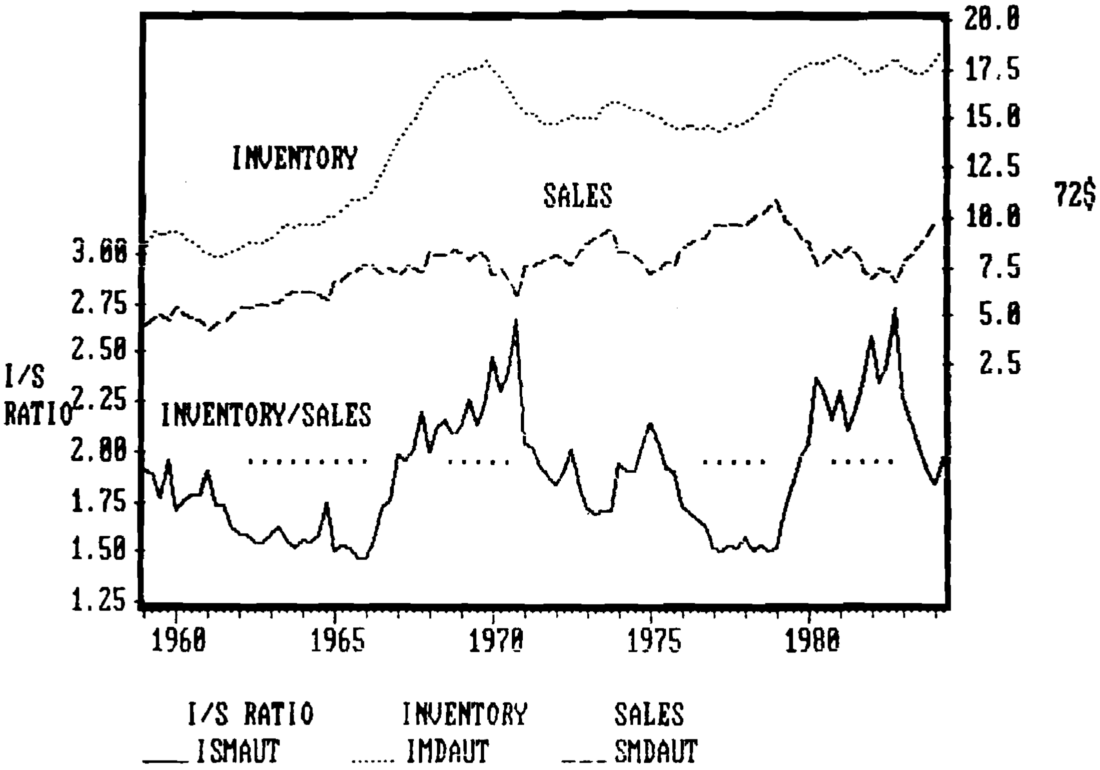
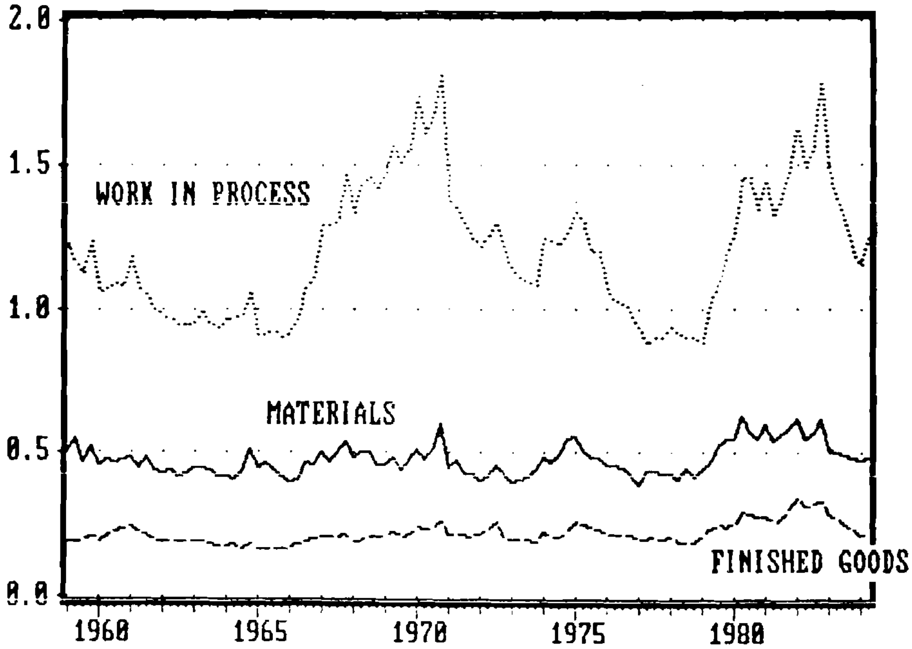


FIGURE 48.
MFR., TRANSPORTATION EQUIP. STAGE OF PROCESSING STOCK/SALES RATIOS



lead to more units being started and in turn to an increase in work-in-process stocks. Hence, the ratio of stocks to sales may not be the best measure of the efficiency of this type of industry's use of stockholding. Perhaps in industries with long production periods, one should rather scale inventory stocks by the sum of sales plus the order backlog. At a minimum, to assess the efficiency of the use of work-in-process stocks, they should be divided by the level of order backlogs.

The sales of U.S. manufacturers of Fabricated Metal Products have leveled off since the mid-1970s (see fig. 49). The ratio of inventory to sales increased in 1974 from about 2.25 to 2.5 where it has remained. Looking at the plot of ratios by stage of processing we see that while the largest increase was in material stocks, both work in process and finished goods stocks also increased somewhat in 1974. Whether these increases were in response to prior shortages, inflation, or merely the slowdown in this sector's sales remains to be sorted out. In any case, if NLT were introduced, their effect on stocks were more than offset by these other factors.

Similarly, the sales of U.S. manufacturers of Primary Metals have been flat or declining for the last decade. This has led to much consolidation among firms and the shutdown of capacity in this industry. Referring to figure 51 we observe that there was a large increase in the overall inventory to sales ratio in 1974 that has been maintained since then. Also this figure shows a distinct increase in absolute inventory stocks in 1974 which only recently has started to decline. The plots of inventory ratios by stage of processing show that large increases occurred in both work-in-process and material stocks. As in other industries, these may be due to shortages experienced in 1972-73 and/or to the price inflation in materials which persisted in the 1970s. Additionally there is the possibility that in a declining industry, an increasing percentage of the stocks which are held are are obselete and still being carried on the firm's books rather than being written off as losses. In any case, there is little evidence of NLT having had an effect in this industry.

In the beginning of this section we observed that the uptrend in the overall durable stock to sales ratio was due to a 1966 increase in work-in-process stocks and a 1974 increase in material stocks. The 1966 increase apparently originated mainly in the transportation equipment sector but also in the electrical machinery and the nonelectrical machinery sectors as order backlogs increased due to the Vietnam War military buildup. Since the mid-1970s the ratio of work in process to sales has decreased in the machinery sectors, however, another large buildup occurred in the transportation equipment sector. The 1974 material stock buildup is seen in the ratios of all the subsectors except transportation equipment. Presumably this buildup reflected the early 1970s shortage experience and the inflation in material prices. Since then, Nonelectrical Machinery and Electrial Machinery manufacturers have reduced their material stock to sales ratios to the pre-1974 levels. Whether this reduction merely reflects a reduction in the probability of shortages and reduced material price inflation or the introduction of NLT remains to be determined. In the other sectors like Primary Metals and Fabricated Metals, which have not reduced their ratios, its unlikely that NLT effects will be found.

FIGURE 49.

MANUFACTURING, FABRICATED METAL PRODUCTS

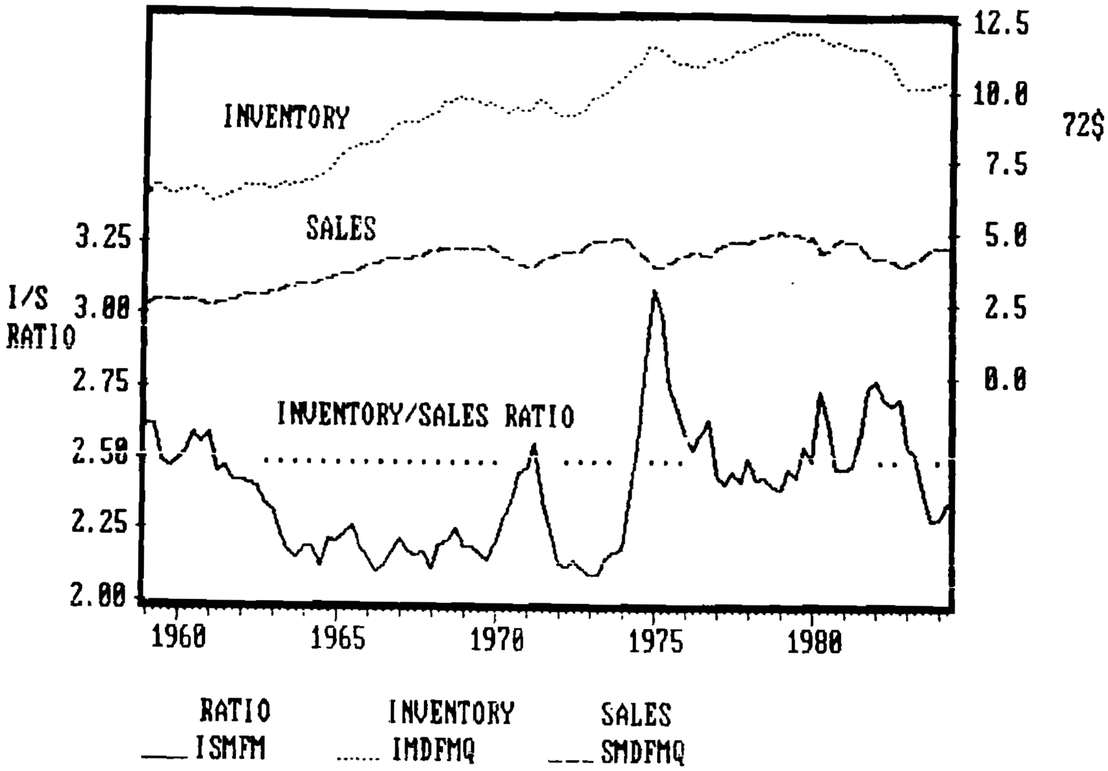


FIGURE 50.

MFR., FABRICATED METALS STAGE OF PROCESSING INVENTORY/SALES RATIOS

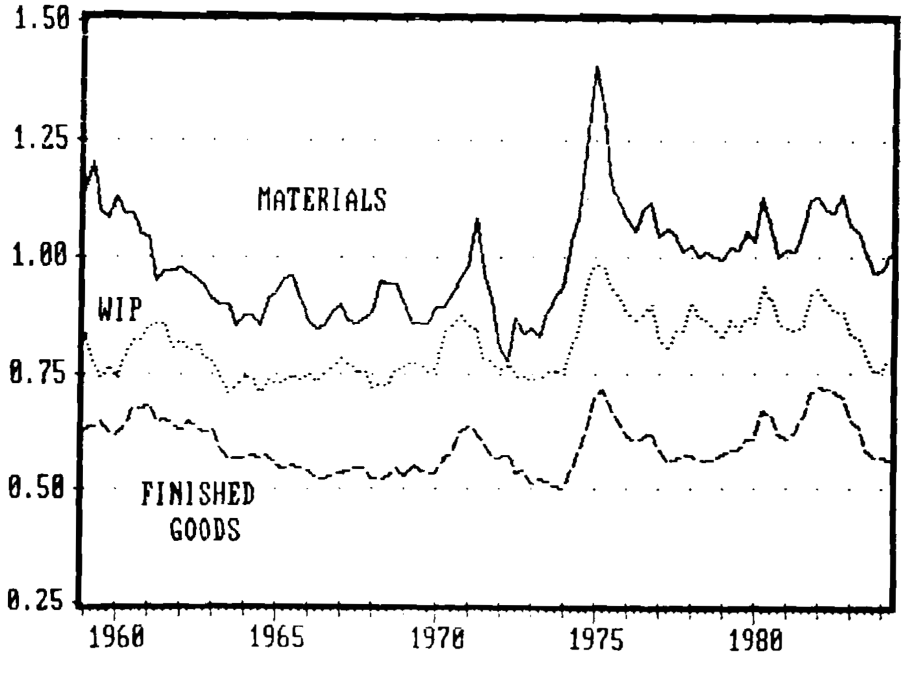


FIGURE 51.
MANUFACTURING, PRIMARY METALS

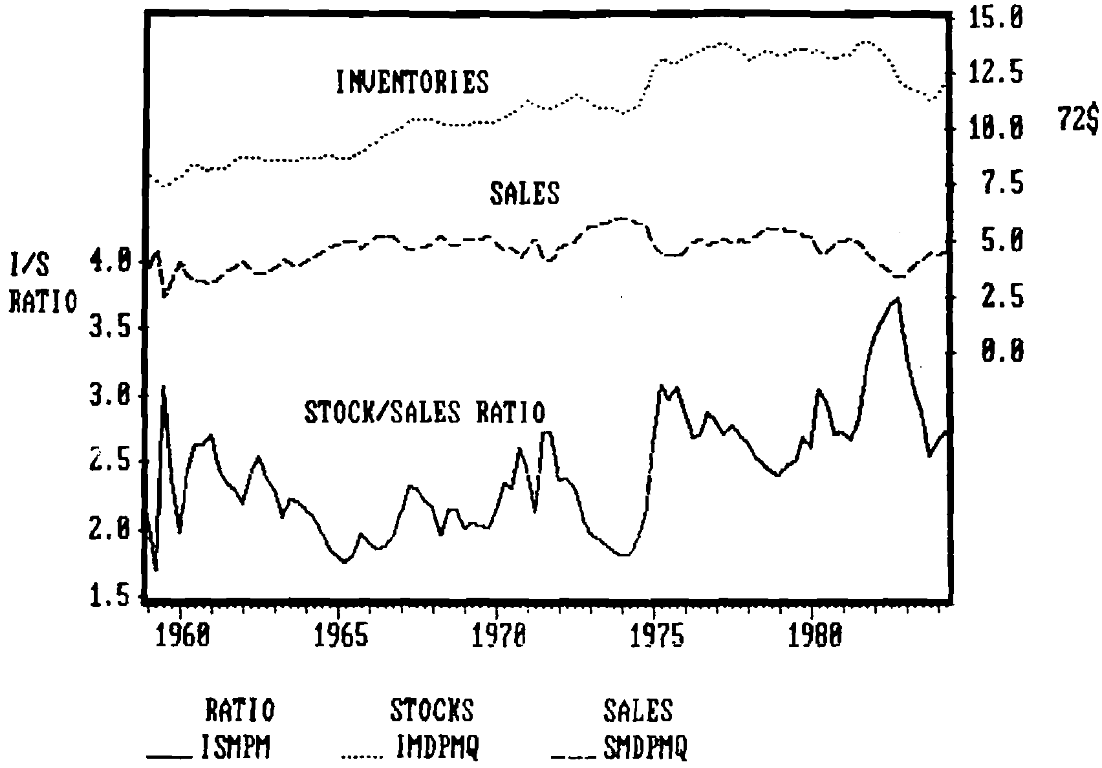


FIGURE 52.
MFR., PRIMARY METALS STOCK/SALES FOR MATERIALS AND WIP

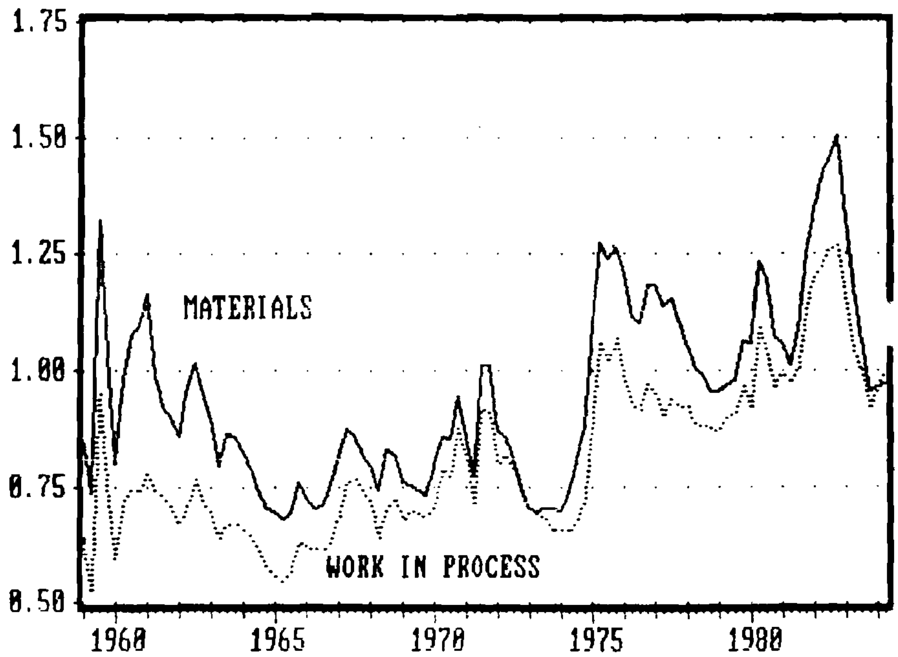


TABLE 3. AVERAGE QUARTERLY INVENTORY TO SALES RATIOS BY STAGE OF PROCESSING FOR MANUFACTURING

For the following periods:	1959.1 thru 1965.4	1966.1 thru 1972.4	1973.1 thru 1979.4	1980.1 thru 1984.2
NONDURABLE GOODS MANUFACTURERS	1.43	1.42	1.39	1.36
Materials	0.59	0.55	0.57	0.56
Work in Process	0.20	0.21	0.22	0.22
Finished Goods	0.64	0.66	0.61	0.59
FOOD AND KINDRED PRODUCTS	1.09	1.10	1.07	1.02
Materials	0.39	0.37	0.38	0.37
Work in Process	0.07	0.09	0.10	0.10
Finished Goods	0.63	0.64	0.59	0.55
NONFOOD NONDURABLE MFRS.	1.62	1.59	1.54	1.53
Materials	0.71	0.64	0.66	0.65
Work in Process	0.27	0.28	0.27	0.28
Finished Goods	0.64	0.67	0.62	0.61
PAPER AND ALLIED PRODUCTS	1.35	1.33	1.39	1.48
Materials	0.74	0.69	0.75	0.79
Work in Process	0.16	0.15	0.15	0.17
Finished Goods	0.46	0.49	0.49	0.52
CHEMICALS & ALLIED PRODUC	1.52	1.57	1.45	1.45
Materials	0.54	0.55	0.55	0.55
Work in Process	0.22	0.23	0.22	0.23
Finished Goods	0.76	0.79	0.68	0.66
PETROLEUM & COAL PRODUCTS	1.50	1.27	1.12	1.17
Materials	0.32	0.29	0.29	0.31
Work in Process	0.32	0.27	0.25	0.27
Finished Goods	0.85	0.71	0.58	0.59
RUBBER & PLASTIC PRODUCTS	1.64	1.59	1.67	1.69
Materials	0.46	0.49	0.62	0.63
Work in Process	0.25	0.25	0.26	0.28
Finished Goods	0.93	0.85	0.79	0.78
OTHER NONFOOD NONDURABLES	1.77	1.76	1.77	1.69
DURABLE GOODS MANUFACTURERS	2.09	2.24	2.29	2.41
Materials	0.68	0.68	0.76	0.77
Work in Process	0.83	0.99	0.96	1.03
Finished Goods	0.57	0.57	0.57	0.60
PRIMARY METALS	2.23	2.[illegible]	2.48	3.02
Materials	0.89	0.82	1.00	1.18
Work in Process	0.67	0.73	0.86	1.06
Finished Goods	0.67	0.65	0.62	0.78
FABRICATED METAL PRODUCTS	2.37	2.22	2.49	2.54
Materials	0.98	0.89	1.05	1.05
Work in Process	0.77	0.77	0.85	0.85
Finished Goods	0.61	0.55	0.58	0.64

NONELECTRICAL MACHINERY	2.74	2.93	3.05	2.81
Materials	0.71	0.77	0.87	0.81
Work in Process	1.19	1.32	1.36	1.20
Finished Goods	0.84	0.85	0.82	0.80
ELECTRICAL MACHINERY	2.03	2.36	2.37	2.18
Materials	0.56	0.66	0.72	0.64
Work in Process	0.90	1.12	1.06	1.07
Finished Goods	0.56	0.59	0.58	0.48
TRANSPORTATION EQUIPMENT	1.66	2.04	1.74	2.23
Materials	0.46	0.47	0.46	0.55
Work in Process	1.02	1.36	1.07	1.40
Finished Goods	0.19	0.21	0.21	0.28
OTHER DURABLE MFRS.	1.86	1.90	1.98	2.00
Materials	0.62	0.65	0.73	0.72
Work in Process	0.49	0.50	0.53	0.55
Finished Goods	0.76	0.75	0.72	0.73

VII. SUMMARY

As we saw in figures 7 & 8, the ratio of nonfarm stocks to final sales increased first in the late 1960s and then again in 1974-75 to a level where it has remained until very recently. In reviewing the individual manufacturing and trade sectors, one objective was to observe the origin of these step increases. As we have found most of the 1966 increase was due to an increase in work-in-process stocks (relative to sales) of durable goods manufacturers including electrical machinery, nonelectrical machinery, and especially transportation equipment. There was also some buildup of durable manufacturers material stocks due mainly to an increase in the material stock to sales ratio of electrical machinery manufacturers. There was also a small but distinct increase in the the work-in-process stock to sales ratio of nondurable manufacturers. This 1966 stock buildup probably reflects the increase in equipment orders (and increased backlogs) associated with the Vietnam war and a fully employed economy.

In 1974-75 the increases in stock to sales ratios were more widespread. In manufacturing, the largest increase occurred in material stocks. The work-in-process stock to sales ratios also increased. These increases were observed in the ratios of manufacturers of food, chemicals, rubber, paper, other nondurables, machinery, electrical machinery, fabricated metals, primary metals, and other durables. Additionally step increases were observed in the stock to sales ratios of durable good merchant wholesalers and merchant wholesalers of nonfood nondurables. These increases in 1974-75 probably reflect (a) a decision to increase buffer stocks after shortages were experienced in 1972-73 and (b) a lowering of financial inventory carrying costs associated with the rapid inflation experienced in the 1970s (especially in material prices)

In examining the individual sectors we were also looking for the possible influence of the introduction of new logistics technologies. Ceteris paribus, the introduction of these NLT should lead to observed downtrends in stock to sales ratios. In our examination of the subsector stocks, many other possible influences on stock to sales ratios were identified. These factors included: (1) variation in financial inventory carrying costs and (2) changes in the probability of shortages. As discussed above, these both probably had an important influence on stocks in the 1970s. Also (3) the rate of growth of sales seemed to have an influence; as sales growth accelerates, backlogs develop, raising the stock to sales ratio in production to order industries. On the other hand, in declining industries, the the stock to sales ratio may rise due to an increase in the percentage of dead stocks on hand (e.g. inputs to production processes which have been shut down).

Other factors influencing the aggregate inventory to sales ratio are related to changes in the composition of stocks. As documented there has been (4) a large shift in the composition of stocks towards durable goods and away from nondurable goods. Since stock to sales ratios for durable manufacturers and trade firms carrying durable goods are considerably higher than the ratios for firms manufacturing or selling nondurable goods, this shift has been responsible for some of the observed uptrend in the aggregate stock to sales ratio. This shift in composition reflects a shift in the composition of final demand toward durable goods. As documented, there was (5) a shift in the composition of manufacturing stocks toward work-in-process stocks in the late 1960s and again in 1979-84 reflecting an increase in orders for military equipment and aircraft. As noted above, these shifts were large enough to significantly increase the aggregate stock to sales ratio. Also it was noted that (6) an increase in the variety of merchandise stocked could necessitate an increase in the stock to sales ratio as apparently was the case in food stores and automobile dealers (as new size classes of autos were introduced). Finally (7) as the share of stocks which are imported increases, one would expect an increase in the stock to sales ratios due to the long lead times and greater shipping uncertainties involved. In the 1980s this may be important in the retail sector and in those manufacturing industries which import parts for assembly.

To explain trends in either the aggregate stock to sales ratio or in any of the subsector stock to sales ratios, econometric analysis needs to be done with the above factors serving as possible explanatory variables. Also, one would like to have direct measures of the degree of introduction of new logistics technologies in each sector. Without such measures of NLT, the influence of NLT could alternatively be inferred from the trend remaining after statistically controlling for the influence of the seven factors discussed above. This econometric analysis should be the agenda of future research as it is necessa to accurately assess the influence of NLT on stockholding.

In our examination of subsectors, we noted those with a recent downtrend in their stock to sales ratios. These sectors should be viewed as candidates where the introduction of NLT may have contributed to the downtrend. In the retail sector we observed a downtrend in the stock to sales ratio of other durable good retailers which has persisted for the last 10 years. In the manufacturing sector, since the 1970s there have been downtrends in the ratio of finished good stocks to sales in the chemicals, petroleum, rubber and plastic, food, and electrical machinery industries. On the other hand, among manufacturers only those producing nonelectrical machinery and electrical machinery have reduced their work-in-process and material stock to sales ratios (these downtrends began in the mid-1970s).

CHAPTER III

LOGISTICS IN THE EASTERN ECONOMIES

Logistics in Bulgaria

by

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I N T R O D U C T I O N

Bulgaria is situated in the South-Eastern part of Europe. Its territory is 110 994 square kilometres and the population is 8 970 000 inhabitants (Census of 1987). The population density is 81 inhabitants per square kilometre. Seventeen percent of the total border length are sea borders (the Black Sea), 30 percent - river borders (of which 68 percent along the Danube) and 53 percent are land borders.

Bulgaria ranks 15th in Europe in territory and 20th in population.

State property is the basic form of property. In 1986 86,5% of the Net Material Product were generated in the state enterprises, 4.3% in the cooperative enterprises and 9.2% in subsidiary and individual firms.

The growth rates of the economy are relatively high (see Table 1).

Table 1. Average Annual Rates of Growth

Indicators	1961 1965	1966 1970	1971 1975	1976 1980	1981 1985
Gross Output	8.60	9.50	7.75	5.90	3.90
Net Material Product	6.70	8.75	7.80	6.10	3.70
Industrial Output	11.70	10.90	9.10	6.00	4.30
Agricultural Output	3.20	3.50	2.90	0.90	-0.60
Foreign Trade Turnover	14.60	11.25	12.00	8.50	6.60

Source: [1]

Significant structural changes took place in the economy of the country as a result of the industrial development.

Figure 1 depicts the structural changes of the Net Material Product for the 1960-1986 period.

Industry is of decisive importance in the strategy for economic development. The development of industry was accompanied by considerable changes in its structure. Priority was given to the development of machine-building, electrotechnical and electronic industries, and chemical industry. Figure 2 shows the structural changes in industry. These structural changes affected the development of the logistics activities, i.e. transport, storage, material and technical supply, and trade.

The intensive participation in the international division of labour, by increasing the foreign trade exchange, is typical for Bulgaria (as well as for the other small countries). The relative share of import in relation to the net material product increased from 40.4% in 1980 to 53.5% in 1986. The raw and other materials, intended for production use, come to about 55 - 58% of the total import. The increase in the prices of oil, metals, and some other products at the international market, had an unfavourable impact on the effective performance of the Bulgarian economy and especially on logistics performance.

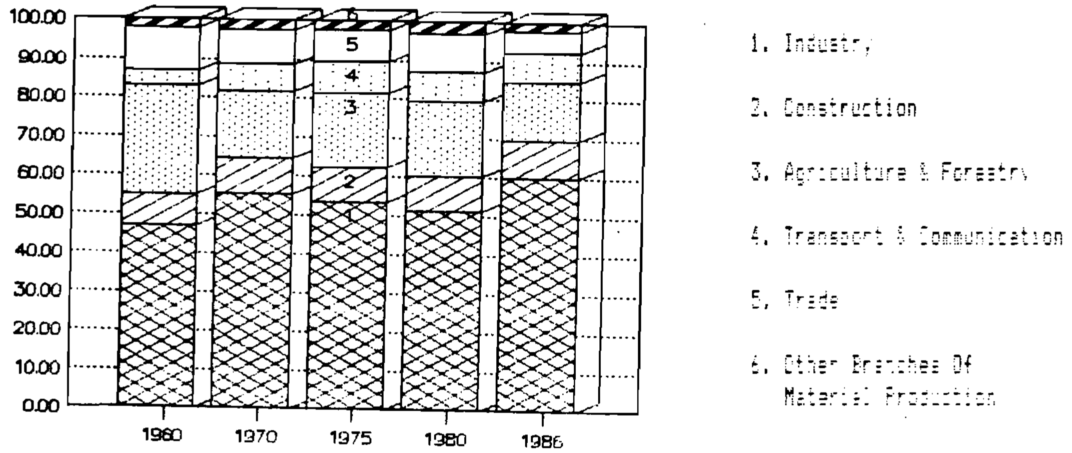

Figure 1. Structure of the Net Material Product
Source: [1]

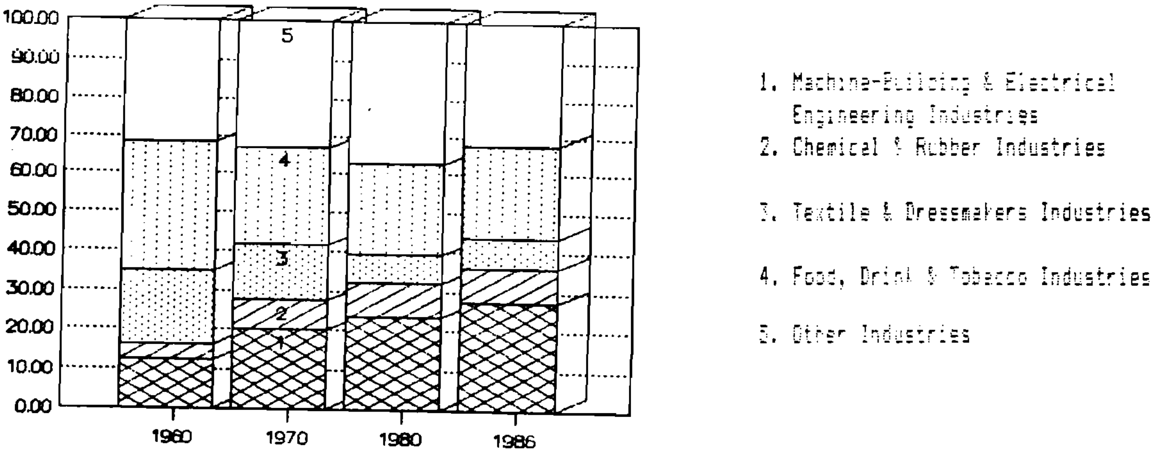

Figure 2. Branch Structure of Industrial Output
Source: [1]

1. PHYSICAL LOGISTICS STRUCTURES

1.1 Inventories in the national economy

The main indicator used in this study for analyzing inventory levels as well as the trends in their development is the "value added/inventory[1] ratio", which can be considered as an indicator for inventory productivity. This is done in order to provide cross-country comperability of the results. In Bulgaria as inventory indicators the ratios "inventory/net material product" or "inventory/gross output" are commonly used.

The value added/inventory ratio for the national economy as a whole and for the manufacturing sector for the 1971-1985 period are shown in figure 3.

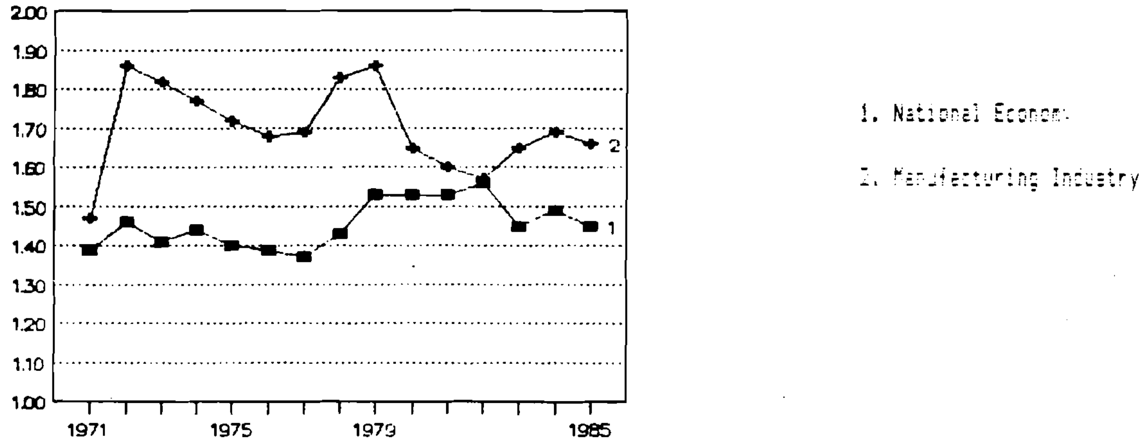

Figure 3. Value Added/Inventory Ratio for the 1971 - 1985 period.

The following conclusions can be drawn regarding inventory productivity, measured by the value added/inventory ratio:

1. The inventory productivity of the national economy as a whole is lower than that of the manufacturing sector; the inventory productivity of the other sectors of the national

---

1/ Unfinished construction is not included economy is also lower than the inventory productivity of the manufacturing sector

The lower value of this indicator for the national economy is mainly influenced by the sector "Trade, material supply and purchasing" where a great part of the inventories are held while at the same time it contributes insignificantly to the value added of the national economy.

The inventory productivity of the manufacturing sector in Bulgaria is a little higher than in Hungary and Poland and lower than in the western countries [4].

2. The development trends of the inventory productivity are quite different for the national economy and for the manufacturing sector. The inventory productivity of the national economy is relatively stable with a slight tendency of growth, while for the manufacturing sector there is a clear tendency of decrease. The differences in the development trends are due to the influence of the other sectors of the national economy as well as structural changes in the economy.

The level of inventories is strongly affected by their structure. The inventory structure is studied according to a) their branch structure (their distribution among sectors of the national economy) and b) the stages of fabrication (their division into raw materials inventories, work-in-progress inventories and finished goods inventories).

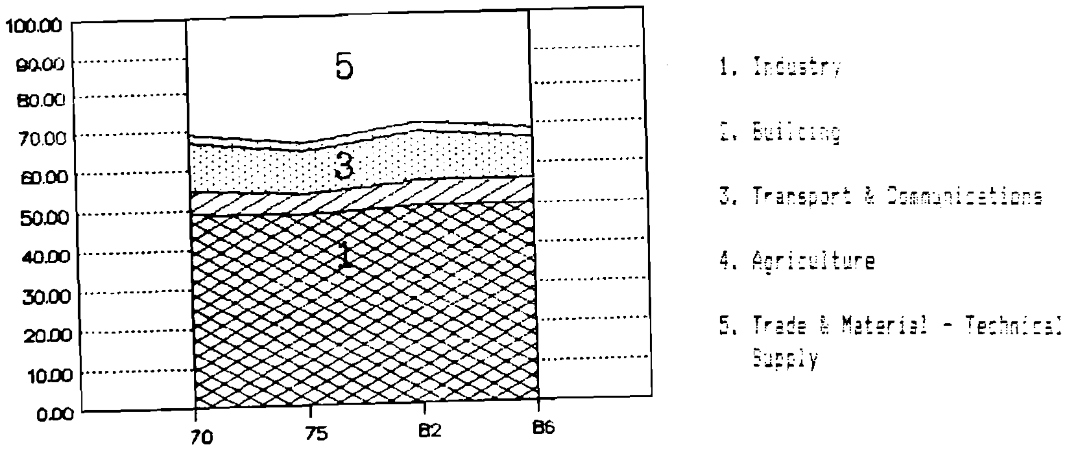

Figure 4. Distribution of Inventories Among Sectors of the National Economy (1970-1986)

The distribution of the inventories among the main inventory holders (sectors of the economy) for the 1970 - 1986 period is shown on figure 4.

The sectoral structure of the inventories is quite stable over time. More than 50% of the total inventories are allocated in the industrial sector, which is natural having in mind its role in the Bulgarian economy. About 68% of the total inventories are formed in the production sectors (including construction). Almost one third of the inventories are concentrated in the companies belonging to the trade sector (both production goods and consumer goods trade). With the exeption of this sector the share of the inventories in the other sectors correspond to their role in the national economy

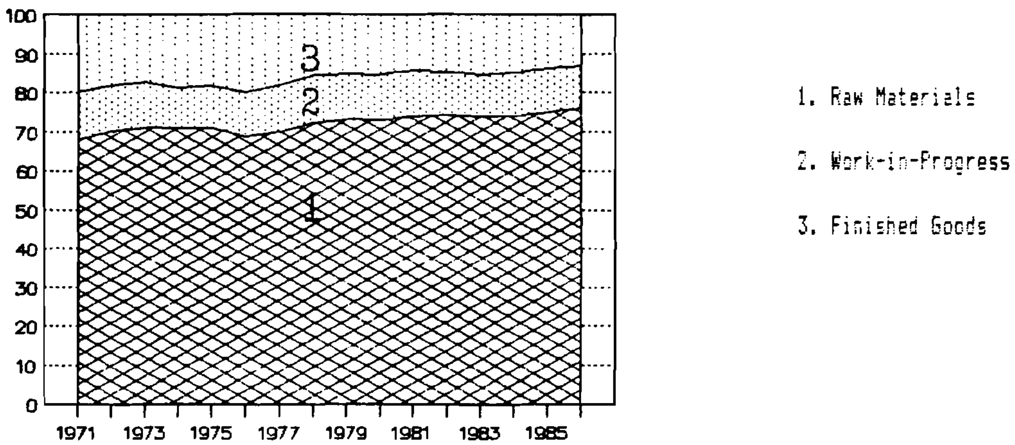

Figure 5. Inventory Structure in Manufacturing Industry (1970 - 1986)

The greater part of the manufacturing inventories consists of raw materials and supplies held as input stocks by the enterprises. Their share is constantly increasing on the expense of the share of the finished goods inventories, while the share of the work-in-progress inventories is relatively constant (see figure 5).

This inventory structure can not be considered rational. The high relative share of raw materials inventories has a negative influence on the mobility of inventories and the reliability of the material flow in the national economy.

The main reasons for this state of the inventories are very complex [2],[3]. Some of them relate to basic principles and features of the socialist economy (such as high rates of growth accompanied by high investment rates, the policy of full employment and capacity utilization, etc.), others - to the subjective activity of the state and the manufacturing trade and transportation companies. The following explicit reasons among the most important are:

(a) Disequilibrium of the internal market, determined by excess demand, e.g. the shortage economy.

This is considered to be a basic reason that has different implications, the most important of which are as follows:

- Monopolistic position of the suppliers (sellers) who can dictate the delivery conditions according to their interests;

- Deprived position of the buyers who build up high inventories and order more than necessary in order to protect themselves from the low reliability of the supplies. This, in turn, increases excess demand and thus contributes to a vicious circle.

(b) Shortcomings in the economic mechanism, particularly in:

- The system of prices;
- The financial and taxation policy;
- The system of distributing company's income;
- The economic indicators used for evaluating the performance of enterprises, etc.

The acting economic mechanism did not sufficiently stimulate, for quite a long period of time, the suppliers (sellers) to build up enough inventories in order to assure high reliability of supply. At the same time due to the fact that inventory costs did not affect the profit of the enterprises, suppliers did not meet any resistance to their inventory policy from the buyers. Moreover, due to extremely centralized system of establishing economic links together with the disequilibrium in the producers' goods market, the buyers did not have the resources to resist the suppliers' strategy.

(c) The prevailing administrative approach to inventory problems.

Many examples can be given, concerning not only the Bulgarian case, which indicate the low efficiency of the central administrative interventions related to inventory formation. This is due to the fact that inventory formation is not the cause, but the effect, of a whole set of economic and other factors and conditions. Considerable change in the type of inventory formation cannot be achieved by central administrative directives regarding stock reduction or reallocation without changing the objective conditions and factors of inventory formation.

(d) The open character of the economy and its high dependence on the import of materials and supplies. Of the total imports 57.6% consisted of raw materials and production goods (excluding machines and equipment). For many reasons (large shipment sizes and delivery intervals, higher irregularity in volume and overtime, etc.) inventory levels of imported products are higher than those of domestically produced goods.

(e) Shortcomings in the operation of the logistics activities - irrational economic links, suboptimal ratio between direct and indirect flows, slow penetration rates of new logistics technologies, etc.

(f) The insufficient development of logistics in infrastructure (storage, transport, etc.) both in the organization for trade with material resources, and in the production enterprises.

With a view to reducing the negative influence on inventories of some of the above-mentioned factors, very considerable changes in the management of Bulgarian economy have been introduced in the recent two or three years. The centralized administrative influence on the market and the material flows is being reduced. Efforts are made for the development of the logistics infrastructure and for applying new logistics technologies. The shortage of material resources has not been overcome, and it still influences the entire logistics system, and the inventories, too.

1.2 Transportation system

The development of industry, construction and agriculture is accompanied by an increase in the transport intensity of the economy. The transported loads per capita has increased from 66 tons in 1970 to 120 tons in 1986.

The transport work per capita increased more than two times for the 1970 - 1986 period and reached 4021 tonnes-kms/capita.

These figures characterize the Bulgarian economy as a high transport intensive one.

A typical tendency, for the period indicated is, that the volume of loads carried (in tonnes), as well as the transport work done, expressed in tonnes-kms, are increasing considerably slower than the growth of the Net material product and the Gross output. This is due mainly to structural changes of the economy as well as the decrease in the matérial intensity of production.

Figure 6 shows the trends in the development of the domestic freight transport for the 1970 - 1986 period.

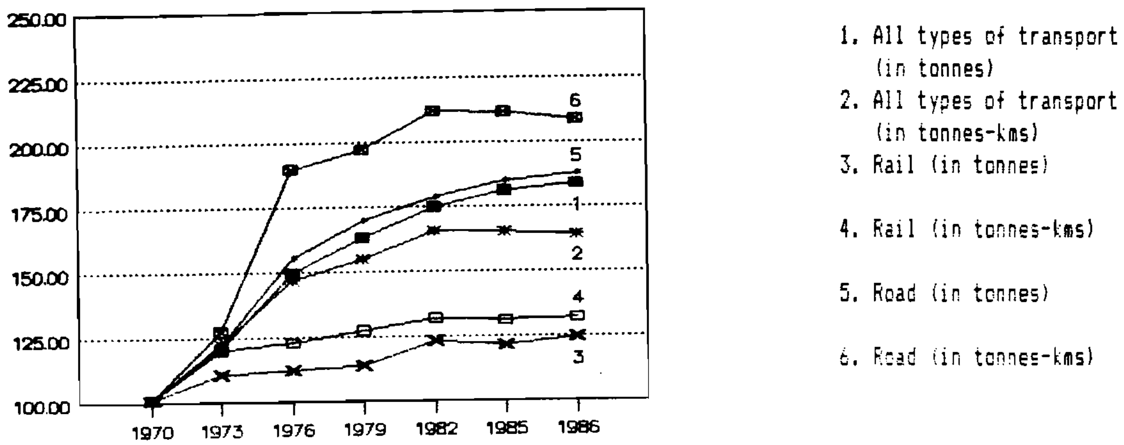

Figure 6 Trends in Freight Transport Development
Source: [1]

The road transport shows the highest rates of growth, in terms of both tonnes-lifted and tonnes-kms.

The differences in the growth rates of the different modes of transport, have caused considerable changes in the freight modal split.

Figures 7 and 8 show the freight modal split for the 1970-1986 period by tonnes-lifted and tonnes-kms, respectively.

Rail and road transport play decisive role in the domestic freight transport.The other types of transport - air, inland waterways, coastal shipping are practically of a very small importance for the domestic freight transport.

The tendency in the modal split development is towards the decrease of the relative share of railway transport with both indicators.

In the period 1970-1986 the loads transported by rail increased by 25%, while the length of the railway lines in that period increased only by 7.4 percent. A basic trend in the development of railway network is the construction of double railway lines, which reached 21% of the railway lines in 1986. The relative share of electrified railway lines amounting 19% in 1970 increased to 55% in 1986. The total volume of electrified railway goods traffic reached 75% in

1986. By the level of electrification of its railway network Bulgaria is close to Italy, Belgium and Norway, and is progressing further than Hungary, CSSR, Poland, and Yugoslavia.

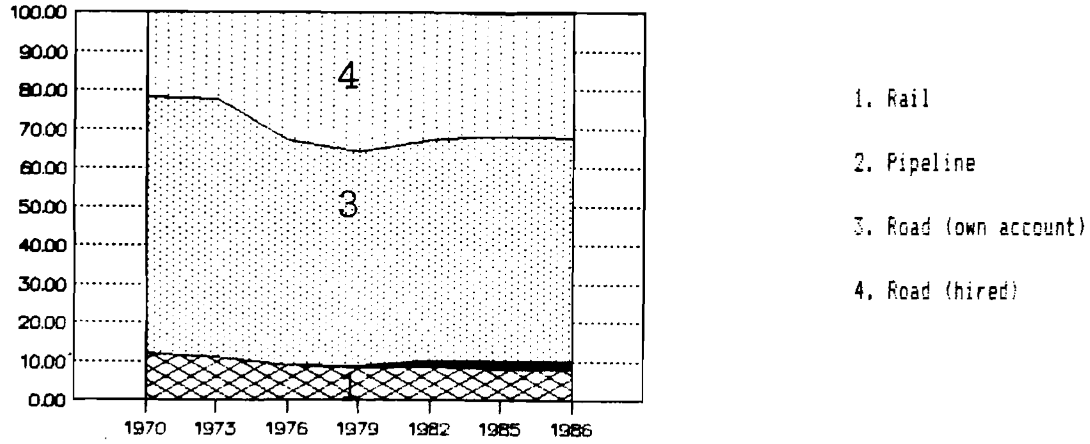

Figure 7 Freight Modal Split by Tonnes-Lifted
Source: [1]

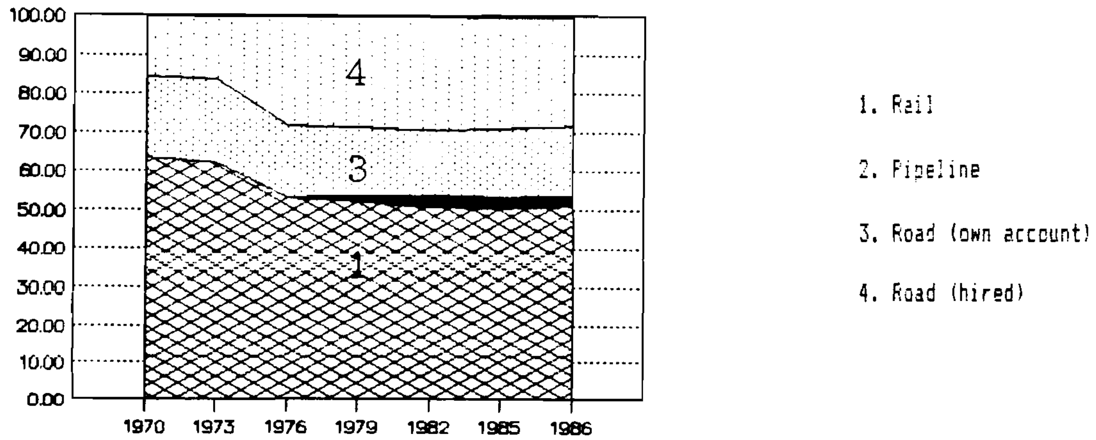

Figure 8 Freight Modal Split by Tonnes-Kms
Source: [1]

The length of railway lines per 1000 sq.km territory amounted in 1986 to 38.7 km. This figure is considerably smaller than the respective one for Hungary, CSSR, GDR, United Kingdom, and some other countries, and close to that in Yugoslavia.

The average length of haul by rail increased in the period 1970-1980 from 203 to 227 km, then gradually declined, and reached 216 km in 1986. This type of transport is used mainly for bulk loads. Ten groups of products were responsible for 72% of the total tonnes-lifted by rail in 1986 (coal and coke 16.6%, liquid fuel - 12.2%, cement and other building materials - 19.2%, etc.).

While railway transport is very important for the transportation of bulk goods, road transport is used for the transportation of goods, which are complex, are used in small quantities, or/and can be quickly spoiled (perishable products), etc. In many cases road transport is complementing rail transport - from the railway stations to the enterprises, and to the warehouses of trade and other economic organizations, which have no direct connection to the railway network. Road transport is also of great importance for goods transportation from wholesale warehouses to retail shops.

The more rapid development of road transport in comparison with the other types of transport contributes to the creation of higher reliability of the logistics system, but it also causes an increase in the delivery costs.

The road network density reached in 1985 328.7 km per 1000 sq.kms. The average length of haul by road had increased, for the period 1970-1980, then started gradually to decline, coming down to 18 km in 1986.

Public (hired) road transport has increased its share (in tonnes lifted) from 25% in 1970 to 36% in 1986, of the total volume of road transport. The average length of haul for this type of transport is higher than for the entire road transport (in 1986 it was 30 km).

Despite of the structural changes accompanied by technical reconstruction, the present transport system is not contributing to the wide and mass application of new logistics technologies. A considerable transport tension in economy is created in certain periods of time. The rate of using the capacity of road transport is comparatively low, and the same can be said about the use of containers. The mechanization level of loading-unloading activities does not meet the requirements for implementation of modern transport-handling technologies.

Bulgarian transport system development strategy is emphasizing the uniform development of rail and road transport.

During the 10 - 15 years to come a wide range of measures are planned aiming at improving the efficiency of the inland freight transport. Among them are: the construction of two motorway rings, increasing of the truck fleet especially the number of the small-load trucks, complete electrification of the railway and closing of the double railway ring, reconstruction of the railway stations, wider use of containers and development of combined transportation, computerization of the transportation processes and activities, etc.

1.3 Distribution Channels and Patterns

It is typical for Bulgaria that for a long period of time a policy had been pursued for organizational, technological and economic differentiation and parallel development of two big groups of distribution channels:

a) For production goods;
b) For consumer goods.

Though the administrative interventions concerning the interaction of these two groups of distribution channels have become more moderate in the recent four or five years, still the links between them are too weak and insignificant. The existence of these separate groups of distribution channels correspond to the two separate and independent markets: production goods market and consumer goods market.

The distribution channels of petrol products, fruits and vegetables make an exception of that general situation. The distribution networks of these goods perform simultaneous sale both to the enterprises and to the population. A more detailed analysis shows, however, that within these channels there are other restrictions contributing to the separation of the material flows. For example, the outlets selling petrol (the petrol stations) have columns for refuelling with petrol, separated in two groups: for state vehicles, and for personal vehicles.

Figure 9 gives a general idea of the distribution channels in Bulgaria nowadays.

In order to make the picture of the production goods distribution channels clearer, the figure shows the 'producer-firm' and the 'consumer-firm' as independent units. As a matter of fact, every producer-firm is at the same time consumer-firm.

A typical feature of the Bulgarian economy, for a long period of time, was the pursuing of a policy for concentration and specialization of the industrial production, by the establishment of highly specialized, comparatively big enterprises. Monopolized production was strongly developed on this

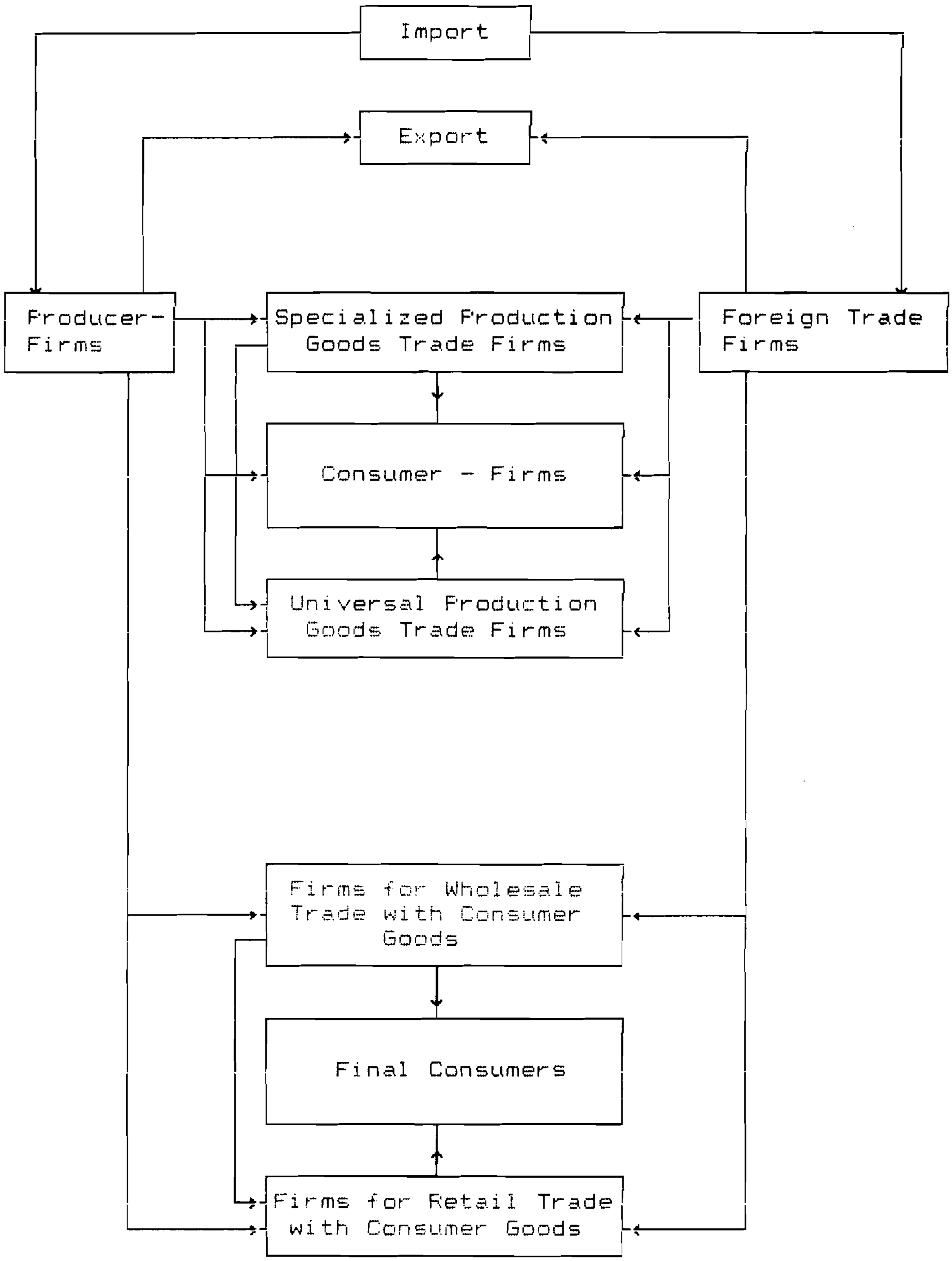

Figure 9 Principle Scheme of the Distribution Channels in Bulgaria

basis, accompanied by all its negative consequences - deprived position of the customers - buyer-enterprises and the population. Under the conditions of shortages and centralized management, the negative influence of the monopoly strengthened more and more.

In the early 80s a policy for restricting monopolization and centralized administrative interventions started in Bulgaria. Firms (as well as their subdivisions - the enterprises) were granted the right to an independent choice of both the supply and the distribution channels. In the recent two years a consistent policy has been carried out for restricting the centralized distribution of material resources, and the centralized state assignment of obligatory tasks to the firms.

Two basic schemes are applied to the production goods distribution:

(a) Direct Distribution

In this case no intermediator takes part in the distribution process. As a rule, the deliveries are sent directly from the producer-firm to the user-firm, and all economic, financial and other relations are settled between the production firms themselves on a contract basis.

(b) Indirect Distribution

The distributions is carried out with the participation of an intermediator (production goods trade firms). These firms purchase goods from the producer-enterprises (or from foreign trade companies) and sell them to the consumer-enterprises. They enter into contract relations with both the producers and the buyer-enterprises.

The production goods trade companies have comparatively well developed warehouse network spread over the territory of the country. According to the types of goods they are trading with, they are:

(a) Specialized - for trade with specific products - metals, chemicals, oil products, etc.; or

(b) Universal - for trade with almost the whole variety of products.

Figure 10 shows the development of the shares of the direct and indirect distribution of production goods for the national economy as a whole.

The following basic conclusions can be drawn from Figure 10:

- The direct distribution has a bigger share - an average of more than 65% of the production goods are distributed directly;

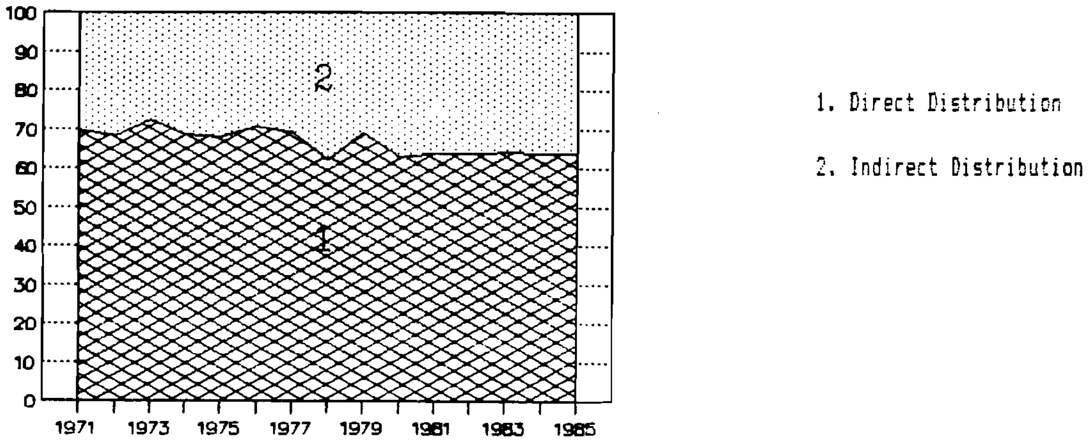

Figure 10. Development of the Shares of the Direct and Indirect Production Goods Distribution

- There is a tendency towards reducing the relative share of the direct distribution and increasing the share of the distribution with the participation of the production goods trade companies.

The indicated general tendency on the national economy level is logical to a great extent, because in this period priority was given to the branches of the economy with more complex material links and flows, such as machine-building and metal-processing industries, electrical and electronic industries, chemical industry, and the share of the branches with relatively simpler links decreased, as for example textile and knitwear industries, leather and shoe industries, etc. This general tendency, however, is not valid for all types of products. For some important products (metals, chemical products and building materials) the reverse tendency is observed, i.e. increasing the relative share of the direct flows.

For each type of product, the direct/indirect distribution ratio is different depending upon:

- The rate of concentration of production and/or consumption;
- The number of producers and/or consumers;

- The ratio between domestic production and import;
- Some other factors of technological, organizational, economic and transport character.

Beside the quantitative characteristics of the distribution channels and the tendencies in their development, the question about the efficiency and the speed of the goods flows through the respective distribution channels is of great importance. A more detailed analysis reveals the existence of irrational direct as well as indirect distribution.

Regarding the structure of the indirect production goods distribution channels, a policy has been pursued, on the one hand, for specialization of the distribution channels by types of products: for metals, chemicals, building materials, technical products, etc. (the products move along these channels to bigger consumers), and, on the other hand, for the development of a network of trade enterprises, universal by nature as far as the type of products is concerned. These enterprises facilitate the flows of goods to small and irregular users (the enterprises belonging to co-operative industry, to municipal economy and public services, schools, hospitals, etc.). The network of the universal trade enterprises is considerably better developed than the network of the specialized ones.

When considering the distribution channels of production goods, with the participation of the trade companies, one should also take into consideration two very important questions:

- What is the part of the goods passing through the warehouses of these companies (the transit - warehouse delivery ratio)?

- How many are the trade enterprises, through which the goods pass on their way from producers to consumers?

Figure 11 shows the shares of transit and warehouse types of delivery, for the specialized companies for trade with metals and chemical products, as well as for the universal trade companies. These ratios are for the 1970 - 1985 period. The relative share of the transit deliveries is too small for the universal trade companies, that correspond completely to their nature. These shares had been comparatively stable for the whole 1970 - 1985 period. As for the companies trading with metals and chemical products, a tendency exists (especially after 1980), for increasing the share of the warehouse deliveries. This is determined by the increase in the share of the direct distribution of these products, as well as by the development of the storage capacity of the trade companies. This tendency will continue in the future, under the influence of the factors indicated.

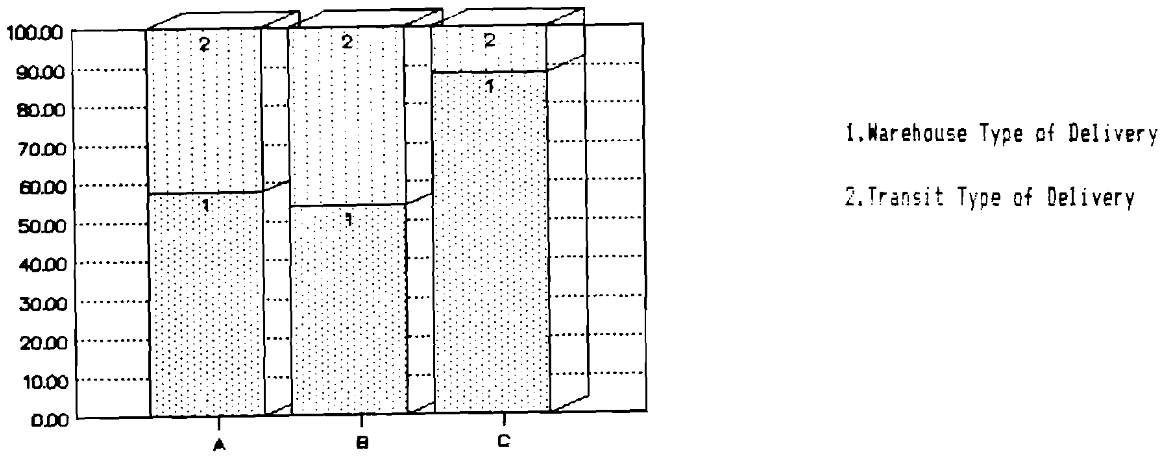

Figure 11.Ratio Between Warehouse and Transit Types of Delivery for Specialized Trade Companies for Metals (A), Chemicals (B),and Universal Trade Companies(C)

From figure 9 it follows, that there is a possibility for multilinks in the goods flows, i.e. a product may consecutively pass through several trade enterprises. This figure, however, does not show the existence of trade subdivisions or units (enterprises) belonging to the producer- and consumer-firms. While till the 80's there were administrative restrictions concerning the establishment of such enterprises, later, and especially after 1986, the network of such units and subdivisions of the big production firms started to expand, as a result of which the picture of the distribution channels became more complicated. This process is a logical result of the democratization of the economic relations between the firms.

A considerable part of the consumer goods, as for example, milk, bread, soft drinks, meat and various products, is directly distributed from the enterprises-producers, to the shops of the retail companies.

As far as consumer goods wholesale is concerned, a policy has been pursued recently, for restricting its role. The range of direct contacts between the retail firms and the producer-firms (enterprises) is expanding. The functions and the importance of wholesale trade with goods of complex assortment (i.e. clothing, shoes, electric appliances, etc.) are preserved, but the forms of studying the consumer demand are changing, thus increasing the importance of retail firms. When expanding the direct contacts between retail firms and producer-firms new functions appear in the retail firms, which actually perform the functions of wholesale trade. On the other hand, wholesale firms develop their own network of shops for direct trade with the population.

Till the beginning of the 80's, the direct access of the firms, producing consumer goods, to the market, was restricted. They could have their own shops, only to study consumer demand for new products. In the recent 2-3 years, these firms started to expand and developed their own retail networks.

With the development of the consumer goods distribution channels, and the diversification of their functions, conditions are being created for competition in trade and increasing its influence on the production, as well as on the quality of the services for the population.

Depending on the form of property, retail trade is divided into state, co-operative, and private, the latter being of no importance practically. Though insignificantly, the share of state trade has been growing, and in 1986 reached 70% of the total consumer goods sales. As a rule, the state trade operates in the towns, while the co-operative trade - in the villages. In the years to come conditions will be created for the expansion of the co-operative trade.

1.4 Warehousing

The branch structure of inventories gives a general idea of the structure of the warehouses. In accordance with it, about 70% of the total warehouse floorspace is located in the production sphere and about 30% - in the circulation sphere.

As a rule, industrial warehouses have been adapted for storage of raw and other materials. A considerably smaller part of them is intended for storage of finished goods inventories.

Depending on the type of the products under storage, the warehouses of the production goods trade companies can be divided into:

- specialized (for storage of particular products: metals, chemical products, construction materials, petrol products, tools, bearing, etc.) and
- universal (for simultaneous storage of almost all kinds of products, with the exception of petrol products).

The specialized warehouses are located in the regions of production or import of the respective products. The universal warehouses are located in the country's administrative and economic centres.

During the period 1975 - 1986 the warehouse floorspace of the production goods trade companies has increased twice.

More than half (56%) of the total warehouses floorspace is covered.

The following basic conclusions can be drawn from the analysis of the state and the development of the warehousing.

a) The capacity of the warehouses in the circulation sphere do not correspond to the requirement for concentration of inventories in this sphere, with a view of increasing their mobility.

b) The technological level of the storage and retrieval equipment is comparatively low, and influences unfavourably the efficiency of the storage processes.

c) The infrastructure of the warehouses is underdeveloped. A significant part of the warehouses has no railway sidings.

d) The application of computers in the control of the warehouse processes is in its initial phase.

In the recent years a tendency has been observed towards the development of a comparatively modern warehouses, especially in the trade companies. The relative share of the highly mechanized warehouses, however, is still too small.

A complex program has been elaborated for the development of the warehousing in the production goods trade companies up to the year of 2000. The fulfilment of this program will assure the adaptation of the warehouses to the requirement for a more rational organization of the material flows in economy. This approach is applied as well to the development of the warehousing of the wholesale and retail trade companies.

1.5 logistics Costs

The problem of logistics costs estimation on macroeconomic level has not yet received satisfactory solution. Regarding Bulgarian economy there exist no investigation on that subject. Due to the lack of data, for the purposes of this study, it was necessary to use various sources of information and to make a lot of additional transformations and computations. For some of the missing data expert estimations have to be used. The results of the analysis, therefore, have to be treated with caution.

The available data predetermined, to a great extend, the approach of the analysis.The following elements of the logistics costs have been taken into consideration:

- transportation costs;
- costs for communication;
- trade costs;
- inventory holding costs.

The logistics costs have been estimated for the national economy as a whole and for the manufacturing sector.

The transportation costs for the national economy represent the costs for freight transport. In the case of the manufacturing sector these include the transportation services, both by the sector as well as the transportation costs of the sector's own transport.

The same approach is applied when defining the communication costs. It was assumed, however, that 35% of total communication costs are associated with logistics activities.

The trade costs for the national economy include the costs of the trade sector (both production and consumer goods trade). As for the manufacturing sector these include the trade services bought by the sector (represented by the sum of the trade margins that have been paid to the trade firms) as well as the costs for purchasing and distribution activities, carried out without the participation of the trade companies.

Inventory holding costs are assumed to be 20% of the inventory value. This figure is an average one of the most oftenly presented in the literature estimations of inventory holding costs[2].

The level of the logistics costs is characterized by two indicators: a) in percent to value added and b) in percent to gross output.

The estimations of the average values of these indicators for the national economy and for the manufacturing sector for the 1971 - 1985 period are presented in table 2. Figure 12 and 13 show the trends of development of the logistics costs in percent to value added and gross output, respectively.

Table 2 Average Level of Logistics Costs (1971-1985) (in %)

Logistics Costs	National Economy	Manufacturing Industry
1. In percent to value added	26.1	21.0
2. In percent to Output	11.3	7.1

2/ Lagutkin, V. and Sokolov, R. (1977) Optimization of Inventories Consisting of Means of Production, Moscow, p.48-50

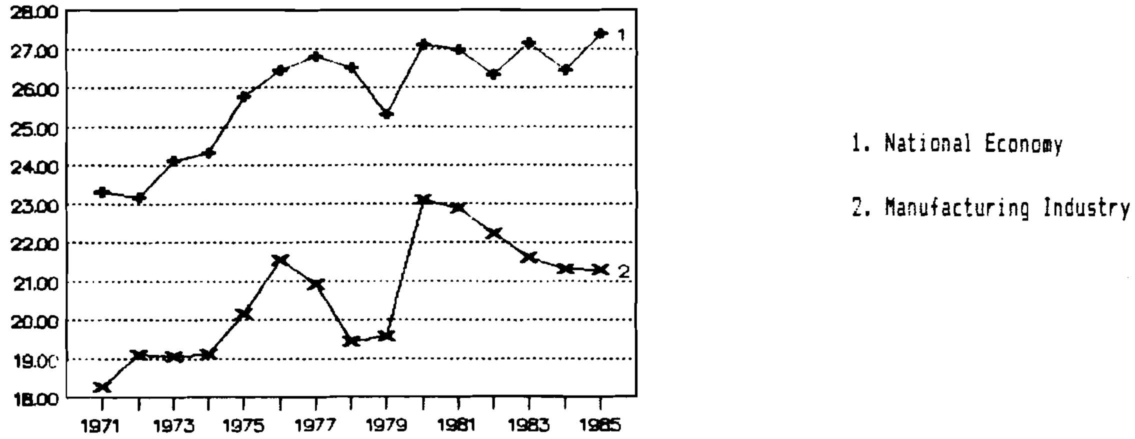

Figure 12 Logistics Costs in Percent to Value Added

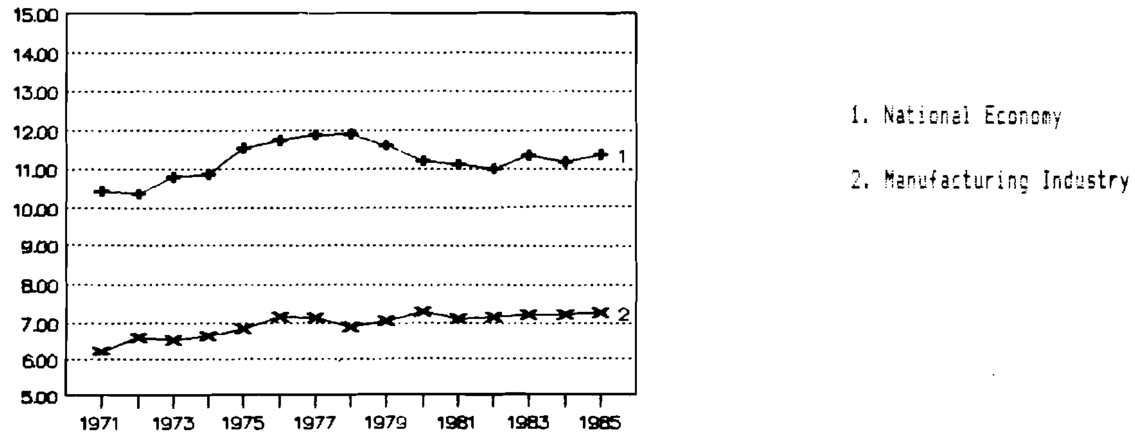

Figure 13 Logistics Costs in Percent to Gross Output

The following conclusion can be drawn from the obtained results:

1) Logistics costs constitute a great portion of the value added of the national economy (an average of 26.1% for the 1971 - 1985 period) and of the manufacturing sector (an average of 21% for the same period). The higher level of the logistics costs in the national economy in comparison with

the manufacturing sector is mainly due to the fact that they include the consumer goods distribution costs as well as the holding costs of the inventories in the trade sector which, amount to an average of 30% of the total inventories (see figure 4)

2) The level of the logistics costs is growing both in the national economy and in the manufacturing sector. This tendency is more strongly expressed when the logistics costs are measured in percent to value added. The relative growth of the logistics costs indicate the increasing importance of the logistics activities in the national economy.

The analysis of the logistics costs structure as well as the trends in its development (table 3 and fig.14) shows that inventory holding costs constitute the greater part of the total logistics costs . It was pointed out earlier that both the inventory level and the inventory structure in the Bulgarian economy are irrational. The relatively high level of raw materials inventory in the national economy and especially in the manufacturing sector is to a great extend responsible for the high share of the inventory costs in the logistics costs. The existing tendency of decreasing the share of inventory costs in the logistics costs (see fig. 14) is a positive one. However, this is mainly due to the slower growth of the inventories in the trade sector in comparison with the inventory growth in industry and the other sectors of the economy. In the manufacturing sector the decrease of share of the inventory costs in the logistics costs is not significant.

Table 3 Logistics Costs Structure

Types of Costs	National Economy			Manufacturing Industry		
	1971	1985	average 1971-85	1971	1985	average 1971-85
Transportation	18.2	28.3	25.7	28.7	31.4	30.4
Communication	0.5	0.7	0.6	0.8	0.8	0.8
Trade	19.8	20.7	21.5	11.9	11.2	12.8
Inventories	61.5	50.3	52.2	58.6	56.6	56.0
TOTAL	100.0	100.0	100.0	100.0	100.0	100.0

The transportation costs rank second in the logistics costs structure. There share shows a permanent growing trend. This is mainly due to the faster development of the road transport (for which the transportation costs are higher).

In manufacturing sector, however, the increase of the transportation costs share is marginal.

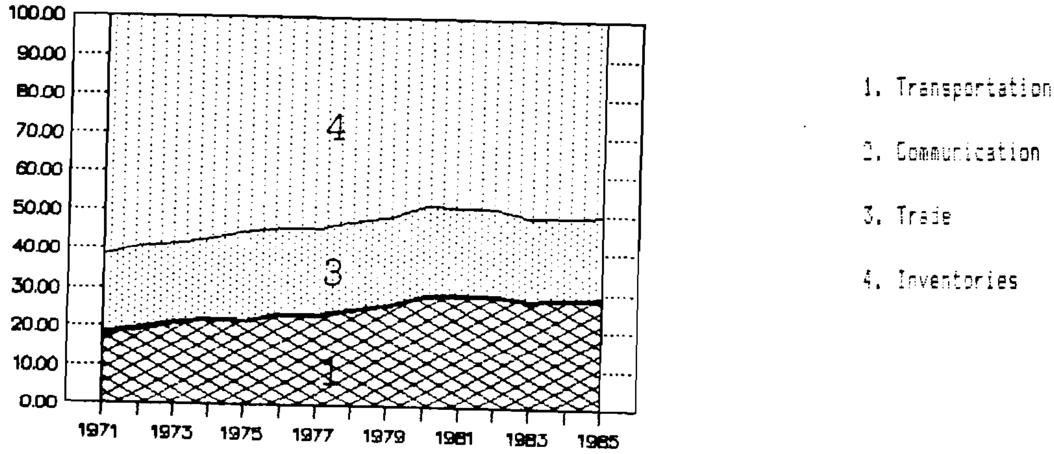

Figure 14. Logistics Costs Structure in the National Economy

The share of the trade costs in the logistics costs in the national economy is constant for the whole period of time. In the manufacturing industry their share is slightly decreasing. One of the major reason for that is the growing share of the direct distribution channels in the production goods flows.

The analysis of the changes in the logistics costs structure indicates that between the inventory level and the transport development there exist significant relation and dependency. The growth of the transport costs share is accompanied with the decrease of the share of the inventory costs in the total logistics costs.

II. MANAGERIAL STRUCTURES AND STRATEGIES

2.1 Organizational and institutional structures in logistics

There exist two managerial levels in the national economy, that perform logistic functions:

- Centralized state bodies (ministries, committees);

- Economic units (firms).

The centralized bodies perform state management of the economy, including logistics. This is achieved through:

- Legal regulation of the various economic activities (the rules regulating the relationships between the central bodies and the economic units, as well as between the economic units themselves);

- Working-out the plans for the development of the national economy and the resulting from it objectives and assignments for the economic units;

- Determining of the economic regulators of the economic activities (prices, taxes, interest rates, duties, etc.);

- Controlling the results and the efficiency of the activity of the economic units.

The rather great number of centralized state bodies (ministries and committees) was typical for the period till 1986. The following central state bodies had important functions in the management of the logistics activities in the economy:

- State Planning Committee;
- Ministry of Finance;
- Committee for Prices;
- Ministry of Supply (later the Committee for Material Economy);
- Ministry of Home Trade;
- Ministry of Transport;
- Industrial Ministries:
    * Ministry of Power Generation;
    * Ministry of Metallurgy and Mineral Resources;
    * Ministry of Machine-Building and Electronics;
    * Ministry of Chemical Industry;
    * Ministry of Light Industry; etc.
- Bulgarian National Bank.

The number of the centralized state bodies has been significantly decreased by the economic reform of 1986. The industrial ministries have been closed down and widely associative forms of management have been developed. The subordination of the economic units to a state body (ministry) has been eliminated. Now, starting from the beginning of 1989, the centralized state bodies performing logistics managerial functions are as follows:

- Ministry of Economy and Planning;
- Committee for Material Economy;
- Ministry of Transport;
- Bulgarian National Bank.

The economic units are at the second level of management of the logistic activities, and depending on their nature, they are:

- Industrial;
- Transport;
- Trade.

In the head offices of the industrial firms as well as in their production subdivisions (the enterprises) there exist structural units (departments, divisions, groups) that perform functions such as:

- Material and technical supply (purchasing of raw materials, supplies and equipment);

- Distribution of the final products;

- Transportation of supplies and goods.

Depending on the size of the firms, the nomenclature of the raw materials and supplies used, the nature and variety of the manufactured goods, the availability or lack of technological links between the production subdivisions (the enterprises) that are part of the firm, as well as other factors, the problem about the centralization/decentralization extent of the pointed out logistic functions is solved between the head office of the firm and the production units (factories, plants).

As a rule, the head office of the firm works out the development strategy, based on the objectives and assignments resulting from the state plan and the market demands. It follows an integrated production, technology, investment and market policy. In relation to this, the firm decides up on the channels for purchasing of raw materials, as well as for the distribution of the final products.

The real purchasing, storage and distribution process take place in the production units of the firms (factories, plants, etc.)

The transport firms are specialized by mode of transport: rail, road, water, air. Their units (enterprises) have subdivisions for transportation activities, for repair as well as for purchasing of the necessary raw materials and equipment.

The trade firms are divided into two major groups:

- Production goods trade firms; and
- Consumer goods trade firms.

The production goods trade firms are wholesale companies. In Bulgaria these are large economic formations, that depending on the nature of their activities are:

- Specialized in trade of specific goods, such as metals, chemicals, liquid fuels, building materials, spare parts and machines for agriculture, etc. These organizations purchase goods from manufacturers in the country, or import them, and sell them to the firms in all spheres of the economy. Each of these organizations has a developed network of warehouses in the country. They can deliver the goods directly from the manufacturers or the import stations to the production units of the user-firms or through their warehouses;

- Universal ones, that trade with almost all kinds of material goods (excluding liquid fuels).

These firms have a developed warehouse network, through which they supply relatively small users. The universal production goods trade firms purchase goods from domestic producers, from the specialized production goods trade firms or import them.

- Enterprises (subdivisions of firms) that perform the supply of a specific firm or a large economic formation;

- Enterprises (subdivisions of firms) that accomplish the distribution of the manufactured by the firm goods.

The consumer goods trade firms are three kinds:

- For wholesale trade. They have a very important participation in the flows of goods of a wide and complex assortment, such as shoes, clothing, household appliances, technical products (television sets, refrigerators, etc.). These firms study the consumer demand, purchase the goods from the manufacturing companies or import them, divide the great consignments into smaller ones, form consignments of different goods and deliver them to the retail enterprises (shops). They also export goods;

- For retail trade. These firms have a developed network of shops. They buy goods either directly from the manufacturing firms or from the wholesale firms. Some functions of the wholesale trade are also performed by these organizations (in the cases when they have their own warehouses, from which the goods are distributed to the shops);

- For public catering - restaurants, confectioneries, etc.

The new trends in the consumer goods trade are as follows:

- Expansion of the network of trade firms belonging to the goods producing firms;

- Expansion of the wholesale functions of retail firms. Development of direct links between the production firms and the retail trade firms;

- Performing retail trade by the wholesale trade firms.

Within the trade firms (both production goods and consumer goods ones) there exist units (departments, division, groups, etc.) that perform planning and coordination of the transportation activities. They are responsible for the interaction with the specialized transport organizations, as well as the control of their own transport fleet.

2.2 Economic Regulators of Logistics Activity

Planning has always been of paramount importance in the management of the Bulgarian economy. Various planning technologies were applied, however, in the different periods. For many decades the centralized directive planning has been the basic mean for managing the economy. Typical for this period is the dominant use of centralized administrative methods. These methods find an expression in a system of obligatory indicators, determined by the central planning bodies, and regulating almost the complete range of activities and development of separate economic systems. There were too thorough prescriptions concerning both the indicators for the type and volume of output as well as the supply wit raw materials. In connection with assigning the planning tasks and having a control over their execution, a hierarchic structure of state and economic bodies was strongly developed, which turned the economic activities management into a bureaucratic process.

The directive centralized planning determined to a great extend the functioning of the logistics system in Bulgarian economy at that time. The elements of this system and the mechanism of its functioning were regulated by the plan. The main tools of the state plan for influencing the logistics system in that period, were the material balances, the plans for distribution and sales, obligatory tasks for production of certain products, rationing, material consumption and inventory norms. Almost 90% of the production goods were an object of rationing by the state plan.

Changes took place in the mechanism for management of the economy, from the 60's to the middle of the 80's (1964-1985), directed to overcome the shortcomings of the centralized planning and creating conditions for applying economic regulators. The existence of shortages, however, as far as the basic raw materials, fuel, etc. were concerned, the monopoly in production, the insufficient skill shown in dealing with the economic regulators, the psychologic barriers, all these did not enable the application of a mechanism for management and functioning of the economy, corresponding to the requirements.

A dynamic process of radical changes in the organizational and managerial structures, in the mechanism for functioning of the economy, started in the middle of the 80's. It brought about the creating of prerequisites for further democratization of the economic life. Planning of economic activities will be of importance for the management of the economy in the future as well. On micro-level the state plan will determine the basic goals, rates, and proportions in the development of the national economy and the tendencies for participation in the international division of labour. The indicators of the state plan are submitted to the economic organizations (the firms) as information, which they can use when working their plans out. The economic conditions, rates and regulators, which the state has worked out together with the state plan are submitted to the firms, too.

The state orders will be of importance in realizing the contact between the state plan and the firm's plans, and they will be placed for certain field of tasks (in connection with the international obligations, with the purpose of realizing strategic, technological and market aims, etc.). What is typical for the state orders, and different from the state tasks, applied before, is, that they are placed by means of a contract (the so called state economic contract) between an authorized state body and a respective firm, and if certain conditions exist competition is applied for the assigning of the state order. In relation to the logistics activities this mechanism of planning provides considerable freedom of action, thereby creating conditions for using the elements of the market mechanism by the different firms.

Prices and the mechanism of their formation influence very much the development of the economy (and in particular the logistics activity). The shortcomings in the pricing system are one of the main reasons for underdevelopment of modern logistics as well as number of negative phenomena in the development of the country's economy.

The principles, on which the new price mechanism is based, are, as follows: a) the prices of goods and services are established in accordance with the prices at the international markets and the supply and demand, their concrete size being agreed upon between the firms; b) the state bodies should determine fixed or limit retail prices for the goods and the services of especially big importance for the population; c) for raw and other materials, transport services, the competent state bodies should determine limit wholesale prices.

The system of financial regulators (taxes, credits, rates of interests, etc.) creates, to e great extent, the economic environment for the functioning of the economic units (the firms). This system is also a very dynamic element of the management mechanism, which has undergone very significant changes. A wide variety of tax forms and concrete rates has been introduced, cancelled, restored, changed, and so on in the 1970-1989 period.

With the introduced in early 1989 mechanism of the relationship of the firms with the state budget, the following tax forms (payments) are established: value added tax (now tax on the turnover is applied instead); excises; rent tax, profit tax, tax on the means for wages and salaries; payments to the municipal councils. Firms get subsidies and premiums from the state budget under certain conditions. The production goods trade companies pay a profit tax on average 50% ranging - from 20% to 65%, their payments to the budgets of the municipal councils amount to 10% of their balance profit.

The bank credit and the interests rates, used in a suitable way, may act as some of the most efficient economic regulators of the economy. Throughout the period of economic reforms in the search for an economic mechanism, corresponding to the socialist way of production, bank credit has been considered as an alternative of the budget financing of the economic development. No essential results have been achieved, however, in that respect, mainly because of the insufficient flexibility and operating capacity of the credit system as a whole. Important structural changes have been introduced in the system recently, with the purpose of taking it out of this inactivate state. The monopoly of the Bulgarian National Bank was abolished, by the foundation of a big group (9) of trade banks, oriented towards different economic branches (these banks have the right to effect bank operations with any firms - without taking into consideration their belonging to different branches and their territorial location).

The credit and the rate of interests strongly affect the logistics system, mainly by the conditions for giving credits as well as the application of various rates of interests - normal, stimulating and sanctioning, depending on the type of inventories, their turnover rate, the terms for paying bank credits, etc.

A comparatively flexible interest rate policy was introduced which established higher interest rates for short term loans for the production enterprises and lower interest rates for the production goods trade companies. This is done with a view of reallocating the inventories and their concentration in the production goods trade companies.

2.3 Information Technologies and Logistics Activities

Bulgarian logistics activities are characterized by the implementation and the accelerated development of computer information technologies.

A network of computer centres was established in the country (until the middle of 70's), which included computer centres at industrial ministries, territorial computer centres for collective use, computer centres at functional ministries and departments (including the Ministry of Supply and State Reserves), as well as computer centres at some other big companies and enterprises. Special attention was paid in this period, to the establishment and development of computerized data systems for the logistics activities: material and technical supply, trade with production goods, transport, trade with consumer goods.

The dominating element in the established computerized data systems was the centralized processing of the information. The possibility for a wide use of personal computers in the country after the 80's, contributed to the transition to a considerable decentralization in the information processing, the establishment of information-computer network.

The development of the computerized data system in material and technical supply (the so called National Information and Managing System for Material Economy) is on comparatively high level, especially for metals, chemical products, technical articles - spare parts, bearing, instruments, etc. The impacts of these data systems on the entire process of movement of certain material resources is quite significant: the goods flows are speeded up; permanent control is exerted over the level of inventories and execution of contracts, the efficiency of the relevant logistics activities is enhanced, etc. Moreover, a possibility is created for the integration of the information processes, concerning the flow of goods, of all the elements of the logistics chain: the production goods trade companies; the respective foreign trade companies; the enterprises and other economic organizations-producers and consumers of material resources.

The main activities in National Information and Managing System for Material Economy are arranged in groups, according to the character and contents they have, forming three subsystems.

A. Resource balancing, requirements planning, and delivery contacts. Information about the resources and the requirements of certain material (by aggregate nomenclature and specifications) enters this subsystem and is processed therein to provide the necessary balance (in detailed specification) between requirements and resources. On the basis of the balances obtained, and the estimates of the possibilities for local production of the relevant material (by the specifications) a national specification is made, in which the input sources - local production and import are indicated. As the needs of the separate firms have entered the subsystem, the final product of the activity of this subsystem is the formation of the object of the contracts, which are concluded, on the one hand, between the production goods trade companies and the consumer firms, and on the other hand - between the production goods trade companies and the producers-firms and/or foreign trade companies.

B. Operative management of deliveries. On the basis of the requirements, specified by the delivery contracts the system distributes the material flows, entering the respective trade firms, as well as their inventories, to the receivers - enterprises and companies. Here a mechanism for issuing delivery orders is applied which takes into consideration the requirements of the buyers; as well as the established priorities of the buyer-enterprises.

Depending on the origin of the goods flows, the distribution and the issuing of delivery orders is made: a) every day - for the imported and locally produced goods, and b) periodically - for the inventories in the warehouses of the trade companies. The delivery orders are sent via communication network to the production goods trade companies (where terminals, or mini-computers are installed) which organize the delivery. The information about the delivered goods is sent from the warehouses of the trade enterprises via the communication network to the computer centre of the system.

C. Accounting and control. This subsystem processes information about the deliveries (sales made by the different enterprises (divisions, warehouses)) and the necessary operative, book-keeping and statistical accountancy is created; analytic and synthetic registers ; information about the execution of the delivery plans; reports about execution of the contracts; information about the available material resources in the production goods trade companies and their divisions, etc.

With the technical reconstruction of the system in 1986, conditions were created for considerable qualitative changes in the data processing technologies, which will result in providing better services for the logistics system.

As far as organization is concerned, the system is hierarchic. Technically and technologically it has four levels: a) central computer system (National Computer Centre); b) minicomputer centres, located in the head-offices of the production goods trade companies; c) minicomputer complexes, located in about 90 divisions of the big trade firms; d) computer means for data processing and for management of technological processes, located in the warehouses.

The dialogue mode of work enables the access to the data base in the central computer system from a great number of working places (terminals). This makes the system extraordinary flexible and renders it largely express by nature.

The organizational structure of the system, the technical means used, and the modern technological decisions, characterize it as an open system, i.e. conditions are created for the computer centres of departments, firms, etc., to directly contact it, and exchange information. The development of the system during the next 3-4 years is mainly oriented to the: expansion of its range (including new trade firms and goods), enriching its functions and tasks; integration of the subsystems for management of the material resources in the national economy, creation of an information exchange (market) for free material resources, building up of a national data base for trade information etc.

The National Information and Managing System for Material Economy is being built, developed and operated by a respective institutionalized body - National Centre for Research and Data Systems in the Material Economy.

C O N C L U S I O N S

Logistics and logistics concepts in management were not very well known in Bulgaria until recently. Therefore, the strategic decisions regarding the development of the separate elements of the logistics system (transport and containerization, distribution channels and patterns, inventories and warehousing, information technologies, etc.) were taken without full recognition of the interrelations and the mutual dependencies between them as well as their impact on the overall logistics performance.

The results of the analysis show that between the different logistics activities there exist relations and dependencies which have to be taken into account in developing the overall economic policy as well as the strategy of the firms. Such relations exist between the inventory level and structure, the transport modal split, the choice of distribution channels, the information technologies applied, etc. which influence the total logistics costs.

The state of development of the logistics system depends upon the technological level of the 'physical' elements of the system (transport, handling and storage technologies) as well as on the managerial strategies and institutional structures. Without underestimating the importance of the economic regulators and the organizational structures we consider that the technological level of the 'physical' elements have decisive importance for the development of the logistics system.

On the other hand, having a physicsl system on a high technological level without an adequate managerial system and economic enviorment is not sufficient for high logistics performance. The analysis show that in Bulgaria there are trands in development of both the physical logistics structure as well as the managerial system. The creation of a physical system on a high technological level, however, requires more efforts (in terms of costs) and longer period of time.

The investigation of the different elements of the physical logistics structures indicates that their state and trends of development are still lagging behind the contemporary reguirements for wider implementation of new logistics technologies.

The changes in the economic regulators and the institutional structures have been much more intensive than those of the real physical processes. The aplication of various managerial approaches, however, has not resulted in considerable changes in the country's logistics performance (inventory levels, logistics costs). The over centralized system of planning, the existance of shortages and underdevelopment of the economic regulators (prices, credit, interest rates, etc.), the restricted rights of the economic organizations (firms, enterprises) did not allow for considerable improvements of the logistics activities. The new pattern for socio-economic development which is being implemented recently is creating favourable conditions for radical changes of all economic activities and logistics in particular.

Along with the technological and managerial developments the radical improvement of the logistics system in Bulgaria requires education and training of new type of specialists for the needs of the state institutions and the firms, as well as intensive research, including participation in the international research projects.

R E F R E N C E S

1. Statistical Yearbook of the PR of Bulgaria, 1961 - 1987

2. Dimitrov, P. (1984) Tendencies of Inventory Formation in Bulgarian Economy. Scientific Works of "Karl Marks" Higher Institute of Economics, Sofia (in Bilgarian)

3. Dimitrov, P. (1988) Macroeconomic Aspects of Inventory Management in Bulgaria. In: Chickan, A. and Lovel, M. The Economics of Inventory Management. Elsvier Science Publishers, Amsterdam, pp.69-77

4. Dimitrov, P. Wandel St. (1988) An International Analysis of Differences in Logistics Performance. WP-88-71, International Institute for Aplied System Analysis, Laxenburg, Austria

5. Pantev, A. (ed.) (1987) Bulgarian State Institutions 1879-1986, Sofia (in Bulgarian)

6. Parvulov, B. (1984) Production-Economic Relations. System, Organization, Management. Sofia (in Bulgarian)

7. Shapkarev, P. (1987) The Circulation of the Gross National Product of the PR of Bulgaria. Economic Study, Sofia (in Bulgarian)

8. Velev, I. Dimitrov, P. (1982) Methodological Problems of Determining the Material Reguirements of the Natinal Economy. In: Material Reguirements of Production Goods Trade, Leipzig, pp.78-91 (in German)

9. Velev I. (1989) Input-Output Analysis and Inventories. Economics vol.2 (in Bulgarian)

Logistics in the ČSFR

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Introduction

The ČSFR is a federal republic with a territory covering 128,000 km^2 and in 1987 there was a population of some 15.6M. The country consists of two republics (the Czech Republic and the Slovak Republic. In 1987 some 7.8M people were active in the national economy, of whom 5.8M were in production sectors and 1.9M in non-production sectors. The state sector employed 88.5% of all working people, the quota of the cooperative sector amounting to 10.5%. The extent of the private sector was negligible.

Industrial production is distributed irregularly in the state sector with its structure characterized by certain disproportions, particularly concerning the oversized heavy industries. With regard to the elongated form of the state territory, transportation is concentrated in the East-West direction and, in recent years the environment has been deteriorating in major areas of the country.

The development of production is constrained by problems associated with accessibility of raw materials, material and energy inputs, etc. At the same time the raw materials and energy requirements of production are high.

The degree of utilization of fixed assets does not increase, and the value of production per 1000 Kčs of fixed assets dropped from 319 Kčs in 1980 and to 269 Kčs in 1985.

The market is characterized by greater demand than the ability to supply, particularly in the field of production goods and some groups of industrial consumer goods. The shortage of certain commodities (due to the imbalance in the planning of development of production capacities of industrial branches and enterprises) is accompanied by falling quality of products.

The development of the national economy is characterized by the Gross Domestic Product. This indicator is not yet recorded in national statistics, but it has been estimated in comparative prices in research work [Zeman, 1988]; in national statistics national income is recorded in current prices only. The estimated Gross Domestic Product, and the percentages of the principal sectors of the national economy in its formation are given in Table 1. The share of agriculture is gradually decreasing (due to the reduction of labour employed); also the share of industry is decreasing slightly. On the other hand, the share of the distribution sectors is increasing.

Under the conditions of the previous mechanism of management of the national economy, enterprises lacked sufficient motivation for the introduction of innovations aimed at improving flexibility of production, accelerating the circulation of commodities and satisfying customers' needs. Barriers which have so far prevented the assertion of the principal target of logistics – the prompt satisfaction of the customers' needs at acceptable costs are given as items 1-4 below.

1. Vast concentration and specialization of the production and wholesale trades, particularly in the fields of production goods. This resulted in monopoly positions of numerous enterprises on the market.

2. The assessment of the performance of the enterprises which was used as a basis for the remuneration of its employees was based on the degree of fulfillment of the tasks specified by the state plan. So far these tasks were oriented primarily on

Table 1: Estimated Gross Domestic Product in Comparable Prices of 1977; and Participation of Principal Sectors in its Formation (4)

Year	1970	1975	1980	1981	1982	1983	1984
GDP(1000M Kčs)	375.4	476.6	600.4	604.3	612.2	630.5	653.0
Percentage of Principle ISIC Sectors							
1	10.1	9.0	7.7	6.9	7.5	7.4	7.7
2	4.6	3.7	3.8	4.5	4.2	4.0	4.9
3	43.1	43.5	43.4	43.7	42.6	42.5	41.9
4	1.6	1.4	2.9	1.9	2.9	2.9	2.1
5	9.0	10.6	9.1	9.3	9.0	8.9	8.3
6	10.9	11.3	12.6	13.0	13.4	13.8	13.5
7	3.9	4.2	4.4	4.6	4.6	4.5	4.6
Others	16.8	16.4	16.2	16.1	16.7	16.8	16.8

production volume (in the case of production enterprises) or sales volume (in the case of commercial enterprises). Only as a secondary feature was emphasis placed on costs, quality of products and profit. The priority of production volume sometimes even resulted in the manufacture of products without ensured sales. The standard of customer services was not specified in the plan, therefore the enterprises did not pay any attention to it, in geneıal.

3. The progress of production was irregular. The dispatch of a considerable number of products was concentrated in the last third of the month in order to ensure fulfillment of the monthly plan. This worsens the performance conditions of public transport (particularly railway transport), the capacity of which is almost totally exhausted. The period between the demand for transport and the delivery of the consignment to the addressee varies considerably, particularly in the case of single railway cars or containers and individual package shipments.

4. The codified rules of buyer/seller relations are complicated and specify excessively long lead times (the period between the order being placed and its delivery) even for regularly produced and stored commodities (production goods and industrial consumer goods). The delivery contract specifies only a period of delivery (a particular quarter of the year, exceptionally the month), not its date. The decision concerning the date of delivery within this specified long period is left to the supplier's discretion. Sanctions for failure to fulfill the contract either in respect of quantity or delivery period are relatively slight.

   The above unfavourable situation should be gradually changed by the comprehensive restructuring of economic mechanisms which began in 1988. The program of restructuring accentuates independent entrepreneurship of production and wholesale enterprises, and a substantial limitation of indicators imposed by the state plan. The new criteria will orient the enterprises on economy and prompt satisfaction of the customers' needs by the provision of high quality products and services.

One of the prerequisites for improvement of efficiency in the Czechoslovak economy is its effective incorporation into product specialization and improved quality. In 1987 foreign trade turnover amounted to some 43% of the national income. However, the foreign trade balance has been negative for the past decade. A glance at Table 2 reveals that a certain physical volume of imports must be balanced with an ever increasing quantity of exports. This is due, on the one hand, to inadequate export structures, e.g. high levels of raw materials and components. On the other hand to the low competitiveness of the industrial sector (primarily engineering), whose products have lagged on the world market due to low product innovation, a fall in quality, and the poor responsiveness of suppliers.

Table 2: Import and Export Volumes (free the frontier of exporter country, current prices) (2)

Year	1970	1975	1980	1985	1986
Import, total (1000m USD)	3.7	9.1	15.1	17.6	21.1
Index of physical import volume (1975=100)[a]	73	100	115	118	121
Export, total (1000m USD)	3.8	8.4	14.9	17.5	20.5
Index of physical export volume (1975=100)[a]	74	100	136	172	174

a) Index based on 1975 stationary prices derived from the US $ value; UNO index

The structure of import and export according to commodity types and groups of countries is given in Table 3.

Table 3: Structure of Czechoslovak Imports and Exports in 1986 by Principal Regions (as A% import form/export to the given region) (3)

Import/Export:	Total	USSR	Other CMEA count.	Other socialist countries	Developed count.	Developing count.
Machine, equipment	36/57	19/68	62/64	23/45	44/14	1/71
Fuel, materials, raw materials	52/24	79/12	20/23	39/46	42/53	60/18
Foodstuffs (raw materials & goods)	6/3	1/1	8/2	13/1	7/9	35/3
Industrial consumer goods	6/16	1/19	10/11	25/8	7/24	4/8

1 Physical Logistics Structures

1.1 Inventories in National Economy

The holding of large inventories has been one of the major problems of the Czechoslovak national economy. Table 4 below provides a time series of national income, and the value of inventories. The national income is used to approximate the value added, which is not reported in national statistics.

Table 4: Comparison of Development of National Income and Inventories at the End of the Year (in 1000m Kčs of current prices) (1)

Year	1975	1980	1981	1982	1983	1984	1985	1986	1987
National income formed	408	486	473	496	508	541	556	570	587
Inventories total	397	534	540	584	601	634	635	652	670
of which:									
in agriculture	47	81	83	87	91	96	99	102	104
in industry	150	194	204	226	234	264	246	251	254
in construction	82	115	111	123	123	131	126	131	138
Inventories/national income ratio	0.97	1.10	1.14	1.17	1.18	1.17	1.14	1.14	1.14

The table shows that inventories are steadily increasing. Their reduction in industry and construction in 1985 was brought about by Government measures concerned with inventory control, however it was not of a permanent character.

The inventories/national income ratio increased steadily until 1983 and has stabilized at approximately 1.14 in recent years. The increase of inventories absorbs a considerable proportion of the means which should be used for extended reproduction. In spite of several interventions by central authorities (Government and Planning Commissions) involving inventory control in the past decade, it was impossible to reverse negative developments in this field.

The development of the structure of inventories in production sectors is illustrated in Table 5.

The structure of inventories is stable. For example, materials remain solid at 26% of total inventories, unfinished production at 23% and finished production at 33 to 35%.

The value of unfinished production is influenced chiefly by construction (over 52% in 1987). The commodity inventories in trade (ISIC 6) amounted to 125B Kčs (1B = 1000M); the remaining 106B Kčs is the amount of finished production inventories in other sectors. In comparison with this amount the material inventories (174B Kčs) is rather high.

The amount of financial assets frozen in inventories manifests itself "inter alia" in the solvency level of production enterprises. At present the value of inventories without unbilled works and supplies amounts to some 520B Kčs, of which some 230B Kčs fall to industry. At the end of 1987 some 70B Kčs of this amount were covered by the single-purpose stock credit, 90% of which was afforded for permanent stocks and 10% for

Table 5: Structure of Inventories in Economic Organizations of Production Sectors (in 1000m Kčs at current prices) (1)

Year		1975	1980	1985	1986	1987
Inventories, total		390	526	627	643	661
of which:	materials	103	135	166	171	174
	unfinished production	93	122	142	147	154
	finished production	131	165	220	225	231

*) Total inventories shown in Table 5 are slightly lower than those shown in Table 4; the difference represents the inventories in non-production sectors.

seasonal stocks. All other inventories (in agriculture, trade, etc.) are credited in the form of current account credit together with other working assets. In these sectors some 90B Kčs of this credit is used for inventories purposes [5].

In a number of production goods demand prevails over supply. In many cases the customer has only small supplier selection to choose from. In the assortment of production goods, production and wholesale enterprises are rather strictly specialized in narrow fields.

Inventory management is based on relatively simple mathematical models with fixed ordering dates, such models corresponding with legal rules valid for buyer/seller relations between enterprises. The decision-making process includes the decision, whether every possible date should be used for replenishment order, and the decision about the ordered quantity.

Because of long lead times and the need to place a single order per quarter, as a general rule, the calculation of the requirements forces a forecast of future demands for materials and components covering a considerable time period. This circumstance gives rise to low reliability of demand forecasting which, together with customer's uncertainty about the delivery date – sometimes even about the delivered quantity – results in the formation of considerable stocks of materials and components to act as a "shock-absorber" in production enterprises. In the majority of cases enterprises are capable of fulfilling the production volume prescribed by the plan only with the full use of production capacities, therefore they cannot afford too many idle times in production due to momentary unavailability of materials or components.

Excessive stocks on the input side of production enterprises exert a negative influence on the performance of the whole national economy. Unnecessarily blocked materials are often needed in other enterprises. On the other hand, the market stocks maintained on the output side of producers or by wholesalers could satisfy the needs of numerous customers.

As noted earlier, in past years several attempts were made at reducing the inventories in the national economy. The measures of central authorities were not very successful, as they had short-term targets, concerned with the volume of inventories (i.e., symptom) rather than with the principal causes of the formation of large stocks in enterprises.

One such measure included the inventory norms. It has come to light that the consideration of uncertainties in demand forecasting and delivery dates results in high safety stocks computed by the respective mathematical model, sometimes even higher than the existing inventory, which is already generally considered excessive.

It can be expected that the comprehensive restructuring of economic mechanisms will gradually eliminate the causes of the formation of such heavy stocks, and thus improve this dismal situation.

1.2 Transportation Systems

All modes of public transport form parts of an integral transportation system of the country. Rail transport is performed by the Czech and Slovak State Railways (ČSD) and in 1987 the total overall length of trackways was over 13,000 km – of which nearly 3,000 km were double-track lines. Electric traction was used on over 3,700 km of railway lines. The principal railway lines are heavily loaded, and their capacity can be increased to a rather limited extent without measures involving very high investment costs. Therefore, measures are being adopted to reduce transportation requirements.

Public road transport is carried out by Czech and Slovak State Road Transport (ČSAD) enterprises, with each region having its independent enterprise. The road network of the Czech and Slovak Federal Republic has a relatively high density. In 1987 it comprised 489 km of motorways (the motorway network is continuously extended), and over 73,000 km of highways of national importance. Almost every major production and trade enterprise operates its own enterprise road transport, covering a certain quota of its transportation needs.

Table 6 gives time series of outputs of the principal modes of freight transport. The quota of air transport is negligible. Pipeline transport was not included in this analysis because of its specific character and restriction to a few substrates. The extent of Czech and Slovak freight transport is considerable. In 1987 its per capita quota amounted, on average, to 101 tons and 6,530 tkm.

The volume of railway transport has changed relatively little in the course of recent years, with the mean transport distance practically constant. The increase of the output of this mode of transport, advantageous with regard to power requirements, is impossible without an increased capacity of main lines.

The output of public road transport has been continuously increasing, as has the mean transport distance. This increase has been brought about by the heavy loading of railway transport and the ensuing low operative availability of its services.

The output of enterprise transport in the seventies was slightly higher than that of the public road transport; in the eighties this relation was reversed. The drop of output at the beginning of the eighties and its slow rise in the years to follow, was due to the pressure of central authorities for improvement of the level of efficiency of enterprise transport, and the introduction of limits of fuel consumption for individual enterprises.

The following four transportation systems are considered progressive ones in the ČSFR:

1. *Container Transportation System*, which is operated by an independent enterprise known as ČSKD-INTRANS. Type ISO 1C containers are mostly used. In 1985 18 container terminals of various sizes were in operation; the terminal network is

Table 6: Selected Transport Indicators (2)

Year		1970	1975	1980	1985	1986	1987
Freight transport volume (m t):							
Total		945	1274	1532	1544	1585	1570
of wich:	rail	237	271	286	293	297	291
	road, public	226	302	337	339	346	338
	road, enterprise	477	695	898	898	928	924
	river	5	6	10	13	14	14
Freight transport output (m tkm):							
Total		73.5	86.9	97.6	99.5	102.3	101.6
of which:	rail	61.0	69.3	72.6	73.6	75.2	73.5
	road, public	4.8	7.3	10.8	11.7	12.2	12.5
	road, enterprise	5.3	7.7	10.5	9.8	10.1	10.4
	river	2.4	2.6	3.6	4.4	4.8	5.1
Average transport distance (km):							
Rail		257	255	254	251	253	253
Road, public		21	24	32	35	35	40
Road, enterprise		11	11	12	11	11	11
River		545	456	344	326	339	345

continuously extended (to attain 41 by 2000). Combined transport is absolutely prevalent, the quota of direct road transport of containers being less than 10%. On rail the containers are transported mostly on regular goods trains. International transport (import, export, transit) represents almost one half of the whole transport volume. In recent years the volume of container transport has changed only slightly exceeding 1% of railway transportation volume.

2. *Pallet Pool*, which has been functioning for a number of years. Flat, size 800 x 1200 mm wooden pool pallets are used. At present 71 pallet exchange stations are in operation. In 1985 the pallet pool had a membership of 146 shippers. The transportation volume of palletized goods is relatively stable and is only slightly lower than that of container transportation. Considerable volumes of goods are also transported on pallets of various types outside the Pallet Pool framework. This amounts to about 4% of all piece goods transported by rail.

3. *Concentrated Loading and Unloading Stations*, which originated in the sixties in connection with the abolishment of inefficient works sidings. This is operated by the ČSD. Its principal function is the performance of loading and unloading operations on behalf of shippers in selected railway stations provided with the necessary handling equipment. At present 105 such stations are in operation. In the future a slight reduction of the number of stations and the improvement of their equipment is envisaged. The volume of handling in this system amounts to about 4% of railway transportation volume. The carrier to development of this system consists in the shortage of the necessary handling equipment.

4. *Collecting Service of the ČSAD*, which has been the only system of small-quantity shipments transportation since the end of the seventies. This is operated by a special division of the ČSAD. At present the system has 116 collection districts. Every district has one or two trans-shipment centers (road and/or railway in the same town, as a rule). It ensures the collection of shipments from the shippers and their deliveries to the addressees by road. The system organizes the bulk transportation of between the individual centers (about 70% by road and 30% by rail). The use of ISO 1C containers has not proved to be efficient and is being abandoned.

   In recent years the number of regular road and railway routes has been increasing, particularly for transportation between the regions. In 1985 some 3.5M tons of small-quantity shipments were put forward for delivery by this system. A substantial increase of transportation volume of the system is hindered by the shortage of storage space, and of the means of handling in some centers.

For the future, the following principal measures to increase transport efficiency are envisaged:

(a) An increase of capacity of the most important rail transport routes, in the first phase without major investment requirements.

(b) Modernization of rolling stock and change of its structure to promote container transportation.

(c) Completion and upgrading of international highways.

(d) Innovation of motor vehicles, on the one hand by an increase of home production of lorries conforming to world standards, on the other hand by the importing of further types and special-purpose vehicles.

In the framework of the prognosis the Integrated Public Circulation System was drafted, envisaging a system of transportation units and packaging enabling the transportation of large volumes of goods required little loading and unloading on the way; the remaining loading and unloading will be mechanized or automated to a considerable extent.

The Integrated Public Circulation System should afford extensive logistic services to shippers. Its fundamental functional link consists in the network of transportation centers (terminals) of various sizes. The first phase considers 20 basic and 60 secondary terminals. The network should be gradually extended to include some 250 terminals. The implementation of the system would be connected with very heavy investment costs, though as yet no decision concerning it has been made.

1.3 Distribution Channels and Patterns

There are four circulation sectors in the ČSFR:

1. *Foreign trade*, wholesale trade of production and consumer goods carried out (together with other services) by foreign trade organizations. These organizations, specialized in accordance with commodities, had a foreign trade monopoly until 1988. Other enterprises can now also establish direct business relations with partners abroad.

2. *Material and Technical Supplies*, wholesale trade mostly of production goods carried out by sales and supply organizations. The majority of these organizations are of a sales character, delivering certain assortments of commodities to customers either in the territory of the respective republic or nationally. Several organizations supply a relatively wide assortment of services to a defined circle of customers. The sales and supply organizations provide their services mostly to enterprises, although they also have a small number of salesrooms selling directly to the public. The volume of their retail trade is, however, negligible. An exception to this rule are four organizations which have a dense retail trade network for sales to the population

   (a) motorcars and their spare parts

   (b) building materials

   (c) fuels and

   (d) lubricants.

3. *Purchase of Agricultural Products*, wholesale trade with agricultural produce. The production and distribution of fodder mixes, partly also the supplies of fertilizers. There are two enterprises only, one in each republic.

4. *Home Trade*, intended almost exclusively for supplies to the public. This comprises four branches:

(a) wholesale trade with consumer goods

(b) retail trade with consumer goods

(c) public catering (restaurants)

(d) works catering.

The prevailing volume of sales of *production goods* is affected by direct deliveries from the producer's works to the customer. They include practically all products made to order or intended for a narrow circle of customers. Materials and products for wide use, produced in major series for stock, are delivered only to major customers (in carloads or containers as a rule, exceptionally on individual pallets). The quotas of direct and indirect deliveries vary considerably in the individual industrial branches. For example, the quotas of the value of direct deliveries from the total sales for various products are as follows:

Wool products	40%
Wood products	60%
Basic metallurgical products	59%
Building engineering products and light-weight prefabricated building components	90%
Cables and conductors	76%
Electrical installation materials	26%
Agricultural machines	3%

The sales and supply organizations handle some 13% of the total sales of production goods. The task of these organizations is to ensure deliveries of small and medium quantities (too small for direct deliveries from the producer's works) to a wide circle of customers with regular or sporadic demand. Guaranteed supplies have so far been applied to a very limited extent, as they can be ensured only by means of high safety stocks. The majority of deliveries effected by the sales and supply organizations passes through their warehouses. Only about 9% are direct deliveries from the producer's works.

The sales and supply organizations have a one-level network of warehouses, which are broken up on the basis of territorial principles into regional divisions. Every division operates one or several warehouses. In the case of several warehouses they specialize according to commodities, with every commodity stored in a single warehouse of the given regional division. The division supplies all customers of the given territory (region) and exceptionally it delivers also to the regions covered by other divisions. Selected commodities are partly or fully centralized and are distributed in the whole territory of the republic by certain regional divisions only. The replenishment orders are sent to the producers (suppliers) either directly by the individual divisions or through the head office of the organization. In both cases the commodities are delivered – with few exceptions – directly to the respective warehouses.

The sales channels of *consumer goods* are varied. The home trade organizations comprise state organizations and cooperative organizations. The state trade organizations are organized in the individual regions and specialize according to commodities; they supply mostly the towns. Cooperative trade organizations are organized on district principles, ensuring supplies of a wide variety of goods to rural areas. Both types of trade organizations carry out both wholesale and retail trade; the shops of their own retail trade networks and also other customers (restaurants, works and school canteens, etc.) are supplied from the wholesale trade warehouses. Apart from that there are a few specialized sales rooms at individual enterprises, supplied directly from their production works.

Perishable foodstuffs – meat, milk, bread, beer, soft drinks, eggs, poultry, deep-frozen goods, some fruits and vegetables – are supplied by the producers directly to the retail trade. The wholesale trade warehouses handle about 40% – 50% of foodstuffs of a non-perishable nature.

In the case of other commodities practically all goods are handled by wholesale trade warehouses, with the exception of solid fuel, building materials and furniture, which are delivered by the producers directly to the retail trade. Footwear distribution can also be considered as direct supplies since there are only two wholesale trade warehouses – situated in the proximity of the producer's works.

The deliveries from wholesale trade warehouses to retail trade sales rooms (or to other customers) are ensured by the road transport of the trade enterprises. The delivery rate depends on the assortment of commodities and size of sales rooms.

Foreign trade organizations have storage facilities of their own to a very limited extent. *Export deliveries* are completed and loaded directly in the producer's works according to the instructions of the respective foreign trade organization. *Import deliveries* are usually directed straight to the customer, i.e. to a producer's works or a wholesale trade warehouse.

1.4 Warehousing, Materials Handling and Packaging

Warehousing

The state and structure of the warehouse network in the ČSFR reflects the previous extensive development of the national economy. The storage areas are widespread with a great number of small-capacity buildings. There are 108,000 warehouses dispersed in 37,300 localities with the mean storage area of a warehouse only some 520 m^2. The number of unsatisfactory and obsolete buildings is high (in the case of closed, roofed warehouses 27.5%). A number of the warehouses are also inconveniently located.

The level of mechanization of warehouse processes is also inadequate. Warehouse fixed assets show a high degree of wear, relatively few new, modern warehouses are built. The greatest shortcomings can be observed in the warehouses of the distribution sectors.

To intensify goods distribution it is necessary to gradually eliminate the lag between what exists and what is needed by the national economy. For this purpose the following approaches are envisaged:

(a) rationalization, modernization and reconstruction of selected warehouses;

(b) centralized construction of new warehouses;

(c) the elimination of small/temporary warehouses;

(d) the construction of warehouse districts and public warehouses in settlement agglomerations and industrial centers;

(e) preference for the renewal and development of warehouses of both sales and supply organizations, and of wholesale warehouses of home trade organizations.

The following targets are considered to be of particular importance for further warehouse development:

(a) A gradual reduction of inventory level in the national economy (and the ensuing reduction of warehouse requirements) by a consistent application of direct and indirect management instruments, and a change of stock structure to the benefit of market stocks;

(b) significant improvement of warehouse standards by the application of progressive technological systems in the inward/outward delivery areas, and of storage methods;

(c) computer application both in the management of warehouse operation and in technological processes;

(d) gradual optimization of the warehouse network and its territorial distribution, and the elimination of scattered storage facilities in settlement and industrial agglomerations;

(e) improvement of stock protection and reduction of use-value damage done by inadequate storage.

Materials Handling

The gap between the needs for materials handling equipment and machines, and the possibilities of their manufacture has existed for a number of years in the ČSFR. The shortage of mechanical handling mechanisms is due to non-uniform organization, and the dispersal and insufficient capacity of producers. Such production is carried out in a number of enterprises none of which considers materials handling machinery as its main production output.

The satisfaction of these needs by imports from socialist countries also meets with difficulties, because the capacity of foreign producers does not fully cover the demand; there are also gaps in the variety of products.

The development of materials handling should follow the following directions:

(a) A rationalization of transport and handling operations involving the production process and material flows;

(b) a radical reduction of the amount of manual handling;

(c) development of progressive materials handling systems with the application of microelectronics;

(d) an extension of the production base for the manufacture of machines and equipment for works transport, materials handling and warehousing;

(e) computer application to the management and control of transport and materials handling systems.

Packaging

In conditions of current demand for goods exceeding their supply, the enterprises are not sufficiently motivated to improve the packaging of their products. For a number of years the central authorities gave little attention to the development of packaging processes and materials, as well as packaging machines and equipment. Production capacity is low and widely dispersed over a number of enterprises, in several industrial branches. Their number also includes relatively small cooperative and communal enterprises.

The low volume of production of packaging machinery, together with their variety and the quality of products, exerts unfavourable influences on the economics of packaging processes. This is particularly true with regards to the efficiency of automatic packaging machines and lines. From time to time it happens that momentary shortages of packaging of certain types disrupts the whole production process. Short-term production plans are often conditioned by the availability of the individual types of packing.

The development of packaging machinery and technology necessitates:

(a) the solution of imbalances between the supply and the demand of packaging materials, packings and machines by both home production and imports;

(b) the elimination of the dispersal of production and development capacities;

(c) the introduction of progressive packaging methods enabling the minimization of losses in distribution and the preservation of the use-value of packaged goods.

2 Managerial Structures and Strategies

2.1 Organizational and Institutional Structures

Planning Systems

The Czech and Slovak Federal Repulic belongs to the list of countries who had central planning of the national economy. Central authorities influenced and – to a certain extent determined – conditions in the field of distribution. On the one hand this was done by state plans, on the other hand by a system of instruments of the state price, financial, credit and income policies. According to relevant periods of time three types of *state plan* existed:

(a) the long-term, outlook;

(b) the medium-term (five years') state plan;

(c) the executive (one year) state plan.

The five years' and one year's state plans, which also determine the tasks of the distribution sectors, comprise, inter alia:

(a) material measures prepared for groups of products of basic importance for economic considerations on the scale of the national economy;

(b) distribution plans prepared in accordance with the same nomenclature as the material balances;

(c) calculation of the consumption of selected raw materials, materials, energy and products.

The *Economic plans* of central authorities governing the individual sectors of the national economy; the authorities on the middle management level (the production economic units and the trade economic units); and at the enterprise level, are prepared for identical periods and according to the same methodology as the respective state plans. These plans transform the tasks of the state plans gradually into such details as are necessary for the execution of the supply chain.

The restructuring of economic mechanisms in the ČSFR will result in qualitative changes in the concept of state plans and enterprise plans. The transition to two level management will eliminate the economic plans of central authorities in charge of the individual sectors of the national economy, with the middle management level being eliminated. Enterprises will become relatively independent entrepreneurial operators, and the central economic authorities will acquire new functions in new conditions.

State plans will have structures for the overall conception of development of the national economy. They will define the conditions for the activities of enterprises and determine their binding tasks only to a very limited extent.

The plans for enterprises will express their entrepreneurial intentions. While respecting the obligatory outputs of the state plans, they will have to be based consistently on the needs and requirements of the users.

Institutions in Circulation Management

The State Planning Commission and the planning commissions of both republics are responsible for the creation of balanced economic planning and for ensuing the basic material relations. They prepare levels, distribution plans and calculations of consumption of those selected materials, energy and products which are of decisive importance for the formation of main requirements.

The State Planning Commission has been also entrusted with the methodological control of the whole distribution system, and the regulation of the development of its material and technical base.

The Administration of Federal Material Reserves prepared the conceptual data on the development of the warehouse network for the State Planning Commission, ensured the construction of public warehouses, and organized the construction of warehouse districts. Since 1989 it has been entrusted with the analysis of distribution processes as well as the regulation and coordination of development of warehousing, materials handling and packaging in the whole economy.

The Central Authorities of the individual sectors of the national economy are responsible for the control of distribution, and for the organization of buyer/seller relations. They ensure the fulfillment of tasks of the state plan by their transfer at the enterprise level, and coordinate the fulfillment of these tasks by bringing together the suppliers and the buyers. At the same time they control the development of the material and technical base. Distribution at the level of the individual sector is ensured by the departments of marketing and supplies of the respective central authorities.

The *National Committees* (Local Government authorities, i.e. territorial organs of state administration) ensure the tasks in the field of distribution for the organizations under their control. These activities are ensured by their planning departments.

Regional National Committees perform the function of central authority in the system. National Committees of lower levels limit their activities in the field to the regulation of supply and sales activities in the enterprises under their control.

The organs of middle management level have been considered until recently, the decisive element of distribution management, and the regulation of buyer/seller relations at enterprise level. The degree of integration of marketing and supply activities, their extent and content, depended on the type of enterprise integration (trust, branch corporation, concern). At present, however, this management level is being gradually eliminated as a separate function.

The enterprises are direct executors of the tasks of the state and economic plans. They directly ensure the distribution processes, they negotiate the buyer/seller relations and conclude contracts regarding deliveries. Problems are dealt with by their marketing and supply departments, the organizational structure of which differs according to set conditions and the individual sectors of the national economy.

2.2 Economic Regulation of Logistic Activity

The foreign trade rates of exchange are determined by the State Bank of the ČSFR. The prices have been based on cost calculations up to now, and were approved by a central authority. The comprehensive restructuring of the national economy envisages that the prices of certain products and services will be determined by an agreement between the buyer and the seller. The prices of certain groups of products (e.g. foodstuffs) are subsidized by the State.

The freight transport tariffs are determined by the respective central authority. In road transport there is a uniform tariff valid for both public transport and enterprise transport. If, in the latter case, work is carried out for another enterprise, though this is infrequent, it usually involves the use of return drives of vehicles over longer rather than short journeys.

The tariff for railway carloads, valid from 1984, includes a major fixed rate component and is only to a limited extent distance related. This tariff raised the limit of equal costs of road and rail transport to the level of 80 - 120 km. The rail transport tariff promotes the use of whole trainloads or groups of carloads by cost reductions.

The attempt to regulate the volume and structure of inventories, discussed earlier, resulted in the differentiation of credits for stocks. So far the rate of interest for current account credit amounts to 6%. The credit for stocks of trade, sales and supply organizations is at the rate of 3%, that for the ready market stocks at the rate of about 1.5%. The lowest rate of interest (for seasonal stocks and stocks of some fuel) is 1%.

Increased pressure upon the national economy, results also in the re-structuring of credit policy for future years. It is envisaged that stocks will be credited by short-term credits (up to one year) at the rate of 5%; and medium-term credits (up to three years) at the rate of 6%. Long-term credits, which have been given to cover permanent stocks so far, will not be allowed at all in the future [5].

In the attempt to promote a more rapid development of mechanization and automation, and thus increase the productivity of labour, the returns of enterprises to the state connected with the volume of wages will be considerably increased. This measure became valid in 1989 in established state enterprises and will be applicable to the whole national economy from 1990. This will have a considerable impact on the distribution sectors, in which the share of manual labour is considerable.

2.3 Information Technologies

At present the central authorities and the enterprises do not have sufficiently detailed and reliable data for the system management and the global optimization of logistic processes. The existing macroeconomic information systems (for sectors and national statistics) comprise of only very aggregated data on material processes. The costs of logistic processes are not recorded separately. These information systems were developed at a time when information on logistic systems were not yet considered important.

Information systems of enterprises are mostly centralized and use mainframe computers. They form part of automated enterprise management systems using batch data processing in the majority of cases. Detailed data on logistic costs and performance are not recorded separately in these systems. A number of logistic cost items are calculated together with many other costs, in overhead costs.

The development of logistic information and management systems in enterprises is only now beginning. It is limited by the shortage of decentralized computer technology (minicomputers, personal computers, mobile terminals) and their system connection. The selection of types of imported minicomputers and personal computers is insufficiently coordinated. Thus there arises incompatibility in hardware which limits the possibility of wide applications of software created in individual organizations. This also creates difficulties for future data interchange among information systems of different organizations and enterprises.

Uniform commodity distribution management projects based on computer applications have been implemented in the Czech and Slovak Federal Republic only in the home trade. The system records wholesale inventories, processes the orders of retail trade units and other customers, prints out the accompanying documents and invoices and prepares the data for the control of enterprise transport. These services are carried out for the home trade organizations by the enterprise Computing and Organizational Service (PORS) which has 23 divisions.

Electronic data interchange is relatively rare in the ČSFR. For remote data transfer only, the public analogue telephone network is available. The development of a digital telecommunication system is currently undergoing consideration in feasibility studies.

2.4 Human Resources and Education

In 1987 the distribution sectors (ISIC 6) employed some 825,000 people – which represents 10.6% of the overall number of people working in national economy. The majority of these people (708,000) were employed in the home trade, which includes both retail trade and wholesale trade with consumer goods. The remainder of the employees were employed in three branches of a wholesale nature:

(a) foreign trade – 24,000

(b) material and technical supplies – 62,000 and

(c) purchase of agricultural produce – 31,000.

Freight transportation employed some 243,000 people.

It is assumed that the overall labour requirements of circulation and transport will decrease in the years to come as a result of the application of:

(a) mechanization and automation of processes

(b) rationalization of workplaces

(c) large-scale use of pallets and containers

(d) rationalization of packaging and introduction of code marking of goods

(e) marked improvement of the organization of labour

(f) the development of computer application to process management and administrative operations.

The qualifications of workers and administrative staff in materials handling and warehousing is generally satisfactory at present. The rationalization of logistic processes, particularly large-scale automation and computerization will however impose higher levels of qualifications for the majority of employees and the system of their education in future years.

There is a shortage of specialists for logistics management in all sectors of the national economy presently, particularly at higher management levels. There is no Logistics Management course in the ČSFR educational system which would afford specialized training to the extent and depth of training required.

Several technical universities have traditional courses on the Design of Machines and Equipment for Materials Handling and Storage. The economic universities have courses with a certain relation to logistics (Economy of Industry, Economy of Home Trade, Economy of Foreign Trade, Informatics), however, their students attend only a limited number of lecturers involving logistic disciplines. The Economic University of Prague is preparing a new course on Marketing and Supplies to be launched within a few years. Currently the numbers of students taking courses bordering on logistics, in both types of universities, are relatively low - 20 to 45 students graduating every year.

A number of universities are already organizing or preparing post-graduate courses on subjects concerning logistics, e.g. automation and robotization, robot control systems, technology of materials handling, packaging technology, information systems of engineering production enterprises, marketing and supplies. The purpose of these courses is to deepen the knowledge of the graduates of the respective specializations.

2.5 Research Projects

In the past, research in the ČSFR was concerned mostly with the physical aspect of logistic processes, e.g. with the transportation, materials handling, warehousing and packaging processes - which included the necessary machines and equipment. This category also includes the state target-oriented research program "Rationalization and Modernization of Warehousing" the resolution of which has involved a number of research organizations together with selected producers of materials handling equipment, since 1986.

It is only recently that the systems aspect of logistics, i.e., integrated systems of material and information flow and its overall optimization, has become the object of research. The term "logistics" itself is only now beginning to become significant, mostly in the field of research.

The character of logistics and the possibilities of application of its principles, methods and technologies in the national economy were analyzed for the first time in 1986 in the Transport Research Institute in Žilina. That study was concerned with transportation.

The IMADOS Project completed in 1988, is a far reaching study intended to characterize the principles of the system concept of rationalization of product circulation, to make a survey of foreign approaches, to classify and describe adequate logistic technologies for rational circulation management, and to present examples of logistic systems used abroad.

This study will be continued in the period 1989 - 1990 with detailed research on two problems:

(a) methods of recording logistic costs and performance (on enterprise or works level and for national statistics);

(b) technical, technological, economic, organizational and legislative barriers hindering the wide application of logistic principles and technologies in the ČSFR, and the proposal of measures for their elimination.

After 1990 the pilot verification of logistic projects in the enterprises of production and distribution spheres is also envisaged.

Since 1988 a large state research program "Intensification of Circulation and Transportation Processes" has been in progress. A number of research institutions participate in this. The IMADOS group is preparing, in this framework, a prognosis of distribution processes in the ČSFR for the period ending 2010.

Conclusions

In the past the national economy developed extensively. Demand prevailed over supply in the market, particularly in the field of production goods and for some types of industrial consumer goods.

In the distribution sectors and in transport, the material and technical base is relatively obsolete. For a number of years there has been a continual shortage of machines and equipment for materials handling, warehousing and packaging.

The national economy is also not sufficiently provided with decentralized computer technology, which gives rise to a low standard of management of logistic processes. So far enterprises have not been motivated sufficiently to accelerate the distribution of goods and prompt satisfaction of consumers' requirements.

To radically change this unsatisfactory situation the Government decided in 1988 to carry out a comprehensive restructuring of the economic mechanisms. In the process of improving the economy, logistics will increasingly occupy a place of importance. The introduction of new logistic technologies will be promoted by the new economic mechanism which begins to assert itself and which will be deepened in the future.

The main prerequisite for the improvement of efficiency of logistic activities consists in the gradual elimination of the prevalence of demand over supply on the market. Only then will it be possible to develop logistic systems based on the possibility of easy and speedy provision of the necessary commodities (e.g. guaranteed supplies, Just-in-Time systems in production, etc.).

For the modernization of the material and technical base of distribution it will be necessary to ensure, on one hand, the necessary investment; on the other hand the manufacture or import of materials handling, warehousing and computer technology in sufficient quantities.

Transport also requires modernization and an increase in capacity, with simultaneous reduction of transportation pressures in the national economy.

Efficient and promptly functioning distribution and transport sectors are a necessary prerequisite for the development of the whole economy.

In the near future it will also be necessary to pay increased attention to the education and training of logistics workers and staff. This trend includes the introduction of new apprentice specializations connected with the servicing of automated equipment, and the operation of information systems. It will also require the establishment of university courses intended to educate logistics managers. The new logistic technologies impose high requirements on employees at all levels in both production and distribution sectors.

The principal measures needed for the improvement of the existing situation in various field of logistics have been outlined in the individual sections of this chapter.

REFERENCES[1]

(1) Statistical Yearbook of the Czechoslovak Socialist Republic. Prague, Federal Bureau of Statistics, 1971-1988.

(2) Database of Internationally Comparable Data. Center of Scientific, Technical and Economic Information (ÚVTEI), Prague.

(3) Qualitative Changes of the Reproduction Process of Czechoslovak National Economy and Deepening of the Intensive Character of Its Development. Prague, ÚÚNV+VÚROM, 1988.

(4) Zeman, K. (1988). Estimate of the Formation of Gross Domestic Product. Prague, ÚÚNV, (manuscript).

(5) Information of the staff of the Head Office of the State Bank of the ČSFR.

(6) Unified Classification of Sectors of National Economy (1986) (2nd ed.). Prague, Federal Bureau of Statistics.

(7) IMADOS (1988), Prague. National Report on Logistic Structures, Strategies and Prospects Presented on Behalf of the Czechoslovak Socialist Republic (Draft version).

(8) Jindra, J. (1986). Distribution of Foodstuff Commodities in the ČSFR. Prague, Research Institute of Trade (VÚO), (manuscript).

(9) IMADOS (1988), Prague. Logistic Courses in Higher Education in Europe. Initial Data for Joint ELA Project.

[1]Note: All sources used are in Czech; their titles are given in English.

Logistics in Hungary

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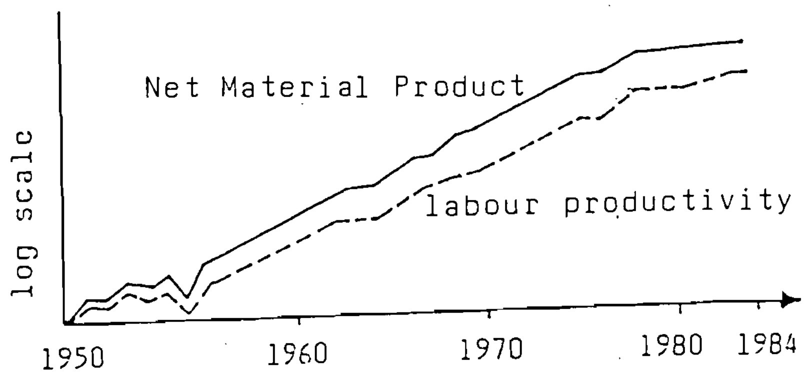
INTRODUCTION

Hungary is located in the middle of Europe, at the crossroads of international transport and communications. The area of the country is 93.036 sq km, the population is about 10.5 million, with a population density of 115.0 per sq km.

From 1950/52 to 1982/84, the average annual growth rates in the Hungarian economy were as follows: national income 5.0%, per capita national income 4.6%, labour productivity 4.4%, total factor productivity (national income per labour and capital) 2.9% per annum.

Figure 1 shows the growth of Net Material Product+ and labour productivity in the years 1950-1984. It indicates the fluctuations at the beginning of this period, the impact of the political and military events of 1956, the subsequent lasting growth and then, after 1978, the decline of the previous trend line.

FIGURE 1



The fast increase of industrial production, amounting to a yearly average of 7%, was the engine of growth. The national income produced by agriculture hardly increased, the productivity indicators of agricultural activity, reckoning with net output, show only a moderate growth in spite of a considerable decrease of employment.

(Table 1 reflects how the most dramatic changes in branch structure by material sectors of the economy happened in the industry and trade.)

+ Expressing the National Income, Hungarian (and other socialist) statistics used the term Net Material Product. Recently Hungarian staticstics contain GDP and Gross Value Added as well. Both will be shown, but we prefer to use GDP.

TABLE 1

GDP by Source in Current Prices (percentage)

	1960	1970	1980	1985
Industry	50,0	37,1	33,8	34,0
Construction	7,0	8,1	7,4	6,9
Agriculture and Forestry	19,8	18,2	17,1	15,9
Transport, Post and Telecommunication	6,4	8,5	8,1	7,4
Trade and Other Material Sectors	2,4	12,5	10,8	11,5
Non Material Sectors	11,6	11,5	12,3	13,5
Customs Duties, Valuation	2,9	4,0	10,5	10,9
Total	100,0	100,0	100,0	100,0

The Hungarian economy is rather open (although, in the true sense of the word, by far not completely). In 1985, the Export/GDP ratio was 41.2 percent as a consequence of a great opening towards foreign trade. In 1960, the same figure was only 20.5 percent. Various markets play an important role.
The CMEA (Comecon) market is not simply one of the markets of the Hungarian economy, but has traditionally played a fundamental role in the formulation of growth targets, economic structure and control mechanism. The development of the economy depended to a great extent on CMEA cooperation. Up till now more than 50 percent of Hungary's foreign trade turnover is connected to socialist countries.

Hungary has vital connections with market economies, too, partly because of the geographic location and historical tradition and the "open" policy. The import of know-how, the keeping abreast with global technical progress, and also the expansion of exports in this direction encouraged economic growth.

Amidst the extreme fluctuations, however, and under the pressure of balance-of-payments problems, the average annual increase of imports from the West slowed to less than two-fifths of the rate of the preceding ten years. However, since 1973 (the oil crisis) the non-roubles import, always exceeded the rouble imports except in one year.

Under Hungarian conditions, the exchange-rate level is fundamentally determinded by the average cost of earning a unit of foreign exchange through exports. Since 1981, when the dualty of the so-called commercial and non-commercial exchange rates for convertible currencies were abolished, a uniform exchange rate was introduced for these currencies. It is worth mentioning that during the last two years the Hungarian forint was devalued several times.

Interest rates in the past used to depend on government policy preferences, but nowadays through the emergence of money market the signs of a nascent credit market can also be seen. In the last few years there was a remarkable change in the financial institutional system: the monopoly on the money market of the National Bank of Hungary has ended. Five commercial banks andd twelve venture capital banks have been established.

As a result of strict price control and extensive price subsidies the consumption prices historically do not have a close connection with world market prices. The impact of the two oil price explosions were belated and depressed and that is why a great inflation press were accumulated in the economy, which are being felt in these years.

I. PHYSICAL LOGISTICS STRUCTURE

I.1. Inventories in the national economy

I.1.1. General characteristics of aggregate inventories (1960-1986)

In various branches of the national economy, the volume of assets tied up in inventories has increased significantly during the last quarter of the century. Its growth rate was higher than that of the Gross Domestic Product (GDP). In 1960, in order to produce 1 unit of GDP, 0.764 unit of inventory was held. In 1985, this ratio was 0.781 calculating with end of the year data.+ (See Table 2)

TABLE 2

Inventory/GDP ratio in the National Economy

	1960	1970	1975	1980	1985
GDP (Billion Ft)	175,4	333,7	483,2	720,6	1033,7
Inventories (Billion Ft)	134,0				807,4
Inventory/GDP ratio	0,764				0,781

The same figures for the manufacturing industry (0.930), agriculture (1.022), trade (1,72), transportation, post and telecommunications (0.297) in 1986 show that there are major differences among branches.

Other assets followed the same direction during the period

+ In the course of the analyses, we disregard the possible deforming effects of statistical evaluation methods and we don't examine that how much are real and frozen or fictive inventory - existing only on paper - behind the statistically revealed inventories. But we must add, that real market--evaluation of stocks would be badly needed. The real market-value of inventories is probably much smaller than the statistically published figure.

under survey. The ratio of the volume of total inventories and of unfinished fixed capital formation (incomplete investments) within the gross volume of real assets has increased from 16.2 percent in 1960 to 20.4 percent in 1986. All this reveals that on the aggregate level there has been a slow-down (See details in Table 3). It must be emphasized that the increase in the ratio of inventories and unfinished investments to total assets was almost continuous.

TABLE 3

Composition of Physical Assets

(current prices)	1960 Billion Forints	1960 %	1985 Billion Forints	1985 %
Gross fixed assets	785.4	83.8	3965.7	79.6
Unfinished fixed capital formation	18.2	1.9	207.5	4.2
Inventories	134.0	14.3	807.4	16.2
Total gross value of assets	937.6	100.0	4980.6	100.0
GDP	175.2	-	1033.7	-

Between 1960 and 1982 the average value of the inventory-accumulation rate was 4.06 in Hungary, which is much higher than that of the developed countries (their rates are between 0.65 and 1.7), and it also exceeds the rates of a number of developing countries. Concerning the socialist countries Hungary's rate is in the middle range, but it is to be noted that this comparison should be viewed with reservation because of the dissimilar and insufficient systems of statistical evaluation.

The different levels of inventories in various countries can't be explained by the differencies in development. Previous research definitely rejected that economic development could be the major determinant of the amount of stocks needed for the normal functioning of the economy. The inventory situation is influenced by a number of factors simultaneously. Research so far confirmed the assumption that from among the factors permanently influencing inventories, the state of equilibrium and structure of market play the main role.

The Hungarian economic history after World War II has been dogged by an overdemand which was characteristic of the markets of both consumer goods and capital goods.

The overdemand on the market creates an unequal bargaining position for buyers and sellers. The connection between suppliers and buyers is based not on mutual advantages and interests but on the conditions dictated by the supplier.

However, the greater potential power of supplier is created not only by overdemand but also by the concentration of market, which is also characteristic of our economy. Similar behavioural patterns in inventory management can be found in those markets, too, where the seller is in a monopolistic position and the buyer has no choice in selecting the supplier.+

The buyers, who are accustomed to the seller's greater potential, try to protect themselves against uncertain supply with high material stocks. They are prepared to keep such high level of material stocks which ensures the continuity of production in the light of the possibly long and uncertain supply-time.

The structure of stocks in the Hungarian industry was almost unchanged in the seventies, while the value of inventories has increased nearly threefold. (See Table 4)

TABLE 4
Structure of Inventories in the Industry (without Food Industry), December 31, Current prices (Percentage)

	1971	1975	1980	1986	1986 in % of 1970
Materials	70,9	71,5	71,9	72,8	293,4
Semifinished goods and work-in-process	17,2	17,3	16,0	15,2	251,0
Finished goods	11,9	11,2	12,1	12,0	288,6
Total:	100,0	100,0	100,0	100,0	285,2

Source: Report on Inventories, Hungarian National Bank, annually

The little change that occured - the slight increase of the rate of material supply to the detriment of the unfinished and semi-finished products - is totally diverse from the tendency in the developed countries, where these two components of inventores are increasing. (In the USA, the ratios of the three elements of stocks was 40-20-40 in the forties, while today they are 1/3-1/3-1/3; in Japan these ratios are 26-42-32.)

The sectorial structure of stocks is also unchanged. (See Table 5) The two percent increase of the ratio of food industry and a similar decrease in the construction industry is not a really significant change during 20 years with such a growth.

+ Despite the decentralizations, domestic markets can be still characterized by basically monopolistic mechanisms: "Despite the decentralization, examining 460 main group of products of the Hungarian industry, there is no one where the share of the greatest supplier would be smaller than 51 percent and there are only some where the share of the two greatest ones doesn't exceed 75 percent." Changing Demand - Unchanging Supply. Figyelő, 20th February, 1986

TABLE 5

Structure of inventories by sectors, end of the year

Companies and cooperatives	Inventory of 1985 in % of 1968	Structure by sectors 1968 in %	Structure by sectors 1985 in %
I. Productive sectors			
Industry	340	35	35
Food industry	384	9	11
Construction industry	233	7	5
Agriculture	334	20	20
Transportation and telecommunication	383	3	3
Total of productive sectors	335	74	74
II. Trading sectors			
Production goods	335	8	8
Agricultural goods	320	3	2
Consumption goods	379	12	13
Foreign trade	500	3	3
Total of trading sectors	370	26	26
Total	344	100	100

Source: Saving materials through decrease of inventory investments
National Board for Technical Development, 1987

I.1.2. Connections of inventories to other main processes in the national economy

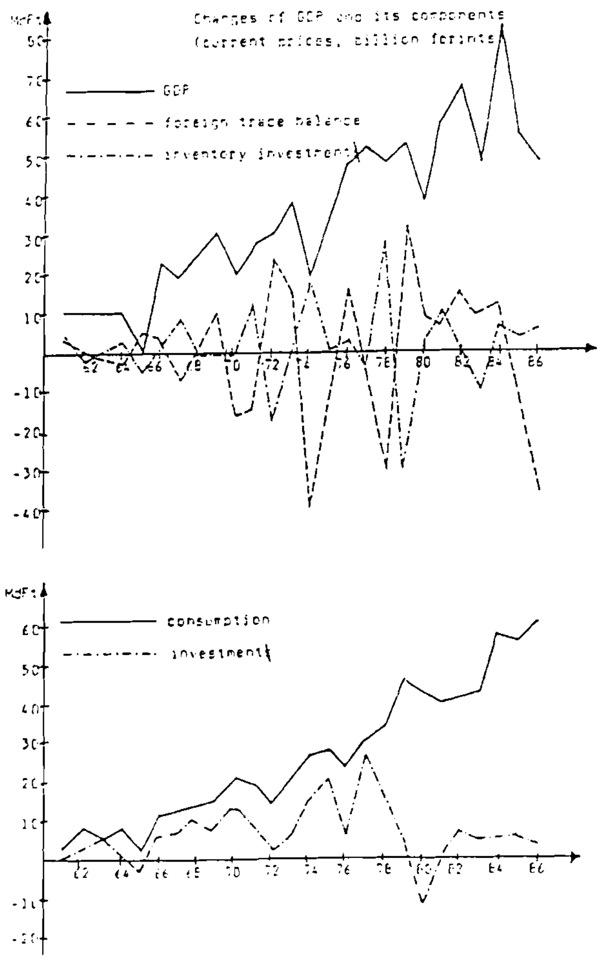
I.1.2.1. Inventories and economic growth - the fluctuations of stocks (cycles)

Decentralized storage system and high ratio of material stocks create a high level of aggregate inventories contributing to significant resource waste. A significant part of the increment of national income is used for inventory accumulation year-by-year. In the period under survey there were a few years (1961, 1964, 1971, 1974, 1978) when (almost) the total growth of GDP was used for investments and growth of consumption would have been impossible without utilizing foreign resources.

In the close future the consolidation of foreign trade balance will absorb a greater part of the national income. High rate of inventory accumulation is a considerable restriction on our development.

Taking account of the changes in the main macroeconomic processes of the period under survey, among the elements of GDP inventory accumulation fluctuated with the greatest amplitude (See Figure 2)

FIGURE 2



Significant declines follow each other by mostly 6 or 7 years, (1965, 1972, 1973, 1979, 1980) which are always preceded by relatively high peaks in stockpiling (1964, 1971, 1978). But the periods between significant troughs do not show steady growth either; smaller declines can occur after two or three years of increase (1962, 1969-70, 1977, 1983).

The fluctuations of stocks are produced primarily not by the fluctuations of production as it usually happens in the industrialized countries, but by the disproportions occuring in the use-structure of GDP.

I.1.2.2. Stocks and foreign trade

Comparing the regularities of inventory accumulation with those of other components of gross domestic product and their changes, we can observe that the closest relation is with the foreign trade balance and its complement - the domestic use of GDP. Inventory accumulation and the foreign-trade balance are almost mirror-reflections of each other: the high inventory accumulation is accompanied by the deterioration of balance and vica-verse. This "mirror-reflection" nature is confirmed by the fact that the magnitudes of numbers are nearly the same. This is especially striking between 1970 and 1974, in 1978 and 1986. The larger the inventory accumulation the more likely is it accompanied by the deterioration of the foreign-trade balance. There are similar relationships between the changes of investments and foreign-trade balance as well.

I.1.2.3. Inventories and investments

Inventories and investments are competing components of gross investment. With respect to accumulation intentions, and the limits of their realisation, inventory accumulation and fixed investments have to be analysed jointly.

In a shortage economy investment eagerness applies to fixed-capital investment as well as to inventory accumulation. Firms, adapting themselves to excess demand in a "shortage economy", try to avoid market uncertainty and ensure production continuity by holding excess input stocks.

In order to guarantee growth, firms tend to accumulate fixed capital goods, but their willingness to save money is relatively low. Firms try to put their income into real means, because their cash balance can be taken by central authorities at any time. Authorities tend to influence investments and inventory changes by way of fiscal restrictions.

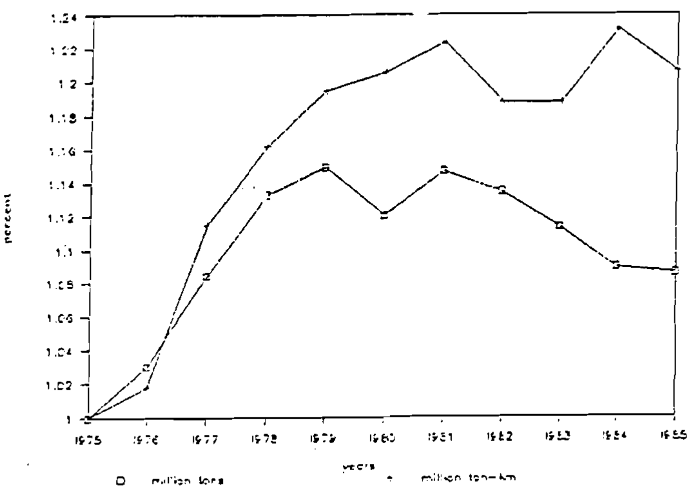
I.2. Transportation systems

According to international comparisons the per capita weight transport in Hungary is relatively high (66.4 ton/capita or 4518 ton-km/capita in 1985). The high transport-intensity of the economy is due to the:
- high proportion of material-intensive industries (fuels, ores and other raw materials, building materials, etc.)
- importance of export-import trade
- centralized structure of company distribution.

The above mentioned figures increased continuously in the last few decades; a turning-point came only in recent years. Unfortunately this was not mainly a consequence of changes in the causes given above, but rather due to the economic recession which appeared in the eighties in Hungary.

FIGURE 3

Freight Transport by Public Companies



As far as the distribution of national income (net material product) by activities is concerned, the proportion of transport decreased from 8.2 percent in 1975 to 7.4 percent in 1985. It shows that transportation for public use lost somewhat in importance, as did almost all other material activities except for industry, which is still the engine of the economy.

The proportion of transport performances of public transport companies versus companies using their own vehicles 52.5 percent in terms of tons in 1985, and 87.1 percent in terms of ton-kilometres - has hardly changed in the last 15 years. The structure of transport modes was modified substantinally at the expense of rail transport. (Tables 6 and

7) By international standards, this relatively great change still doesn't prove sufficient. Although there are discussions about the ideal share of railway transport even among economic policy makers, it seems evident that the "marketing myopia" which characterized the railway sphere of developed market economies earlier, is a recent problem in Hungary. It should also be noted that the railway transport per capita is in all socialist countries (except for Yugoslavia) usually higher than in other countries of Europe.

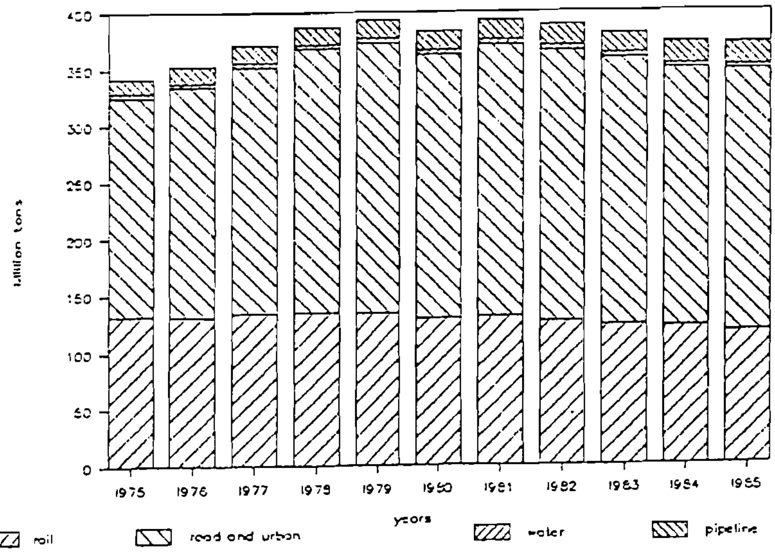
TABLE 6.

Structure of Inland Freight Transport by Modes (percentage)

	1970	1985	1970	1985
	By Volume		By Freight ton-kms	
Rail transport	34,1	22,7	78,3	63,8
Road and urban transport	64,0	73,9	18,2	28,7
Water transport	0,6	0,7	0,8	0,6
Transport by pipelines	1,3	2,7	2,7	6,9
Total:	100,0	100,0	100,0	100,0

FIGURE 4.

Modal Split of Transport



I.2.1. The Transport Infrastructure

The transport infrastructure needs development as well. Much of the destruction suffered by Hungary in World War II, during which the country lost some 40 per cent of its national wealth, was concentrated on communications and transportation systems. Yet investments in infrastructure have lagged behind other areas, for in the traditional socialist economy the production sphere develops to a greater extent than the so-called service sector. In the seventies one could register more ambitious goals which resulted in the relative development of transport and other physical distribution fields like materials handling and warehousing. In light of the economic growth objectives envisaged in the reform packages of the eighties it seems to be foreseeable that this decade is leading to the deterioration of the transport sector again.

The road network will be developed to a less extent than it was planned in the seventies. The national public road structure is almost unchanged concerning the share of highway, motorway and main roads. Roads paved with asphalt and bitumen grew from 15,085 kms in 1970 to 26,309 kms in 1985, which is a substantial improvement and amounts to 89 per cent of the total. The road density is 318 kms per 1000 km^2.

As far as the rail network is concerned, the density is 83 kms per 1000 km^2, somewhat higher than the European average. According to the utilization figures of the railway infrastructure this sector is overutilized, that is, its higher productivity is only illusory. The average age of waggons is continuously growing. The number of wagons purchased by the Hungarian State Railways decreased from 12,917 in the period of 1976-1980 to 1985 wagons between 1981-1985. Nonetheless the sales of rail freight transport amounted to 26.6 billion forints, i.e., about 48 per cent of total freight transport sales in 1985.

From a logistics point of view, special attention should be devoted to the average length of haul, which increased in case of railway freight transport for public use from 169 kms to 190 kms between 1970-1985. The same figures for road and urban transport of goods are 19 km and 29 km. The longer distances are due to the higher proportion of international transport. This latter is illustrated by percentage figures of inland, import, export and transit traffic for public use (Table 6). The average inland transportation distance became shorter regarding water transport. Between 1975 and 1985, it decreased from 63 km to 44 km. Meanwhile the average inland transportation distance by road and urban transport stagnated at about 20 km but a slight increase occured in railway transport from 137 km to 144 km. Nonetheless, this small change couldn't be explained by more sophisticated logistics efforts, but rather by the stronger competitive era of transport modes. But these trends will, hopefully, meet in the future.

TABLE 7

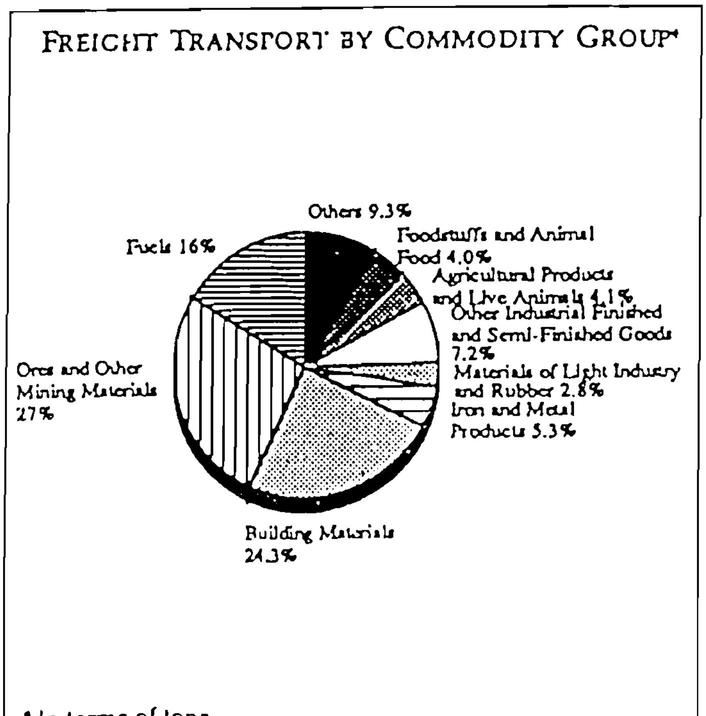
The Share of Traffic Relations (percentage of freight ton-kms)

	Railway freight-transport 1970	Railway freight-transport 1985	Road and urban transport 1970	Road and urban transport 1985
Inland traffic	54,3	44,5	87,1	66,9
Import traffic	20,0	20,8	5,3	11,8
Export traffic	6,8	13,3	5,7	15,8
Transit traffic	18,9	21,4	1,9	5,5
Total:	100,0	100,0	100,0	100,0

Summing up the current trends in freight transport the following conclusions can be drawn:

- The transportation industry came to a turning point regarding transport intensity. The foreseeable and expectable change of industrial structure to the benefit of less material intensive branches requires a more competitive (i.e. more logistics oriented) reaction from the transport sector. Freight transport by commodity groups shows that those are the most important which are connected to economic prosperity (e.g. mining materials, building materials, etc.). (Figure 3)
- The lower level of investments in the infrastructure in the eighties shows that the government's priority is rather to maintain things than to alter its thinking and hence it ranks freight transport unfavourable.
- To compensate for the lack of central efforts in the interest of industry, the government must/will give more room for micro-initiatives, i.e., for company level actitivites. The logistics concept can help improve the relative competitiveness of individual firms and, hopefully, the whole area in the future.

FIGURE 5



I.2.2. Containerization in Goods Transport

The first steps towards containerization in Hungary were taken in the first half of the 50s. Small containers were widely used until the 70s, when they were replaced by the bigger and more modern medium-size containers. The appearence of the latter dates back to the second half of the 60s, but their regular use started in 1970-71.

The first large containers appeared in Hungary at the beginning of 1969, Hungarofruct and Monimpex being the pioneers. The national transcontainer traffic started in 1973-74 between the cities Budapest, Miskolc and Debrecen. It gradually expanded and in 1987 there were seventeen container operating places.

Structurally, containerization is based on MÁV (Hungarian Railway Company), whose transportation office represents and directs it nationally and internationally. MÁV is a founding member of Intercontainer, and represents Hungary in the SZPK, the container aggreement of COMECON countries.

In general, we can state that at short distances the container is not competitive with traditional road transport. The transportation of containers exclusively on road is in most cases not economical because of the overweight. The longest national transport route in Hungary, either road or rail, does not exceed 700 km. Assessing the distances between various cooperating economic areas we have seen that the average transport distance by rail, depending on type of wagons, is between 130-160 km. Considering that the volume of a truck and a container is approximately the same, at such a distance container transportation will most probably prove inferior to trucking on the transportation market. Within this distance there are no geographic obstacles to hinder road traffic. This way geographic factors in Hungary help to relegate containerization toward the field of international transportation. Nevertheless, among the local peculiarities it should be mentioned that in the case of shipments to the West container transport is chosen partly not on economic grounds, but because it is stipulated in the contract.

Although it was declared already in 1968 that the introduction of containerization meets the interests of our national economy, its wide use was hindered by several factors.
- In principle, the greatest motivation to use containers comes through the requirement of profitability. In the short run, however, it is not surprising that such savings are not

significant.

- In order to adopt containerization, a relatively high one-time investment is required on the user's part. Let us recall that the whole loading system must be developed to suit its purpose. Even though at the national economy level the savings in labour and other costs are huge, the conflicting interests of the companies do not always make its realization possible.
- Modern transportation technology was encouraged by state subsidies in all European countries except Hungary. Containerization is a "venture" supported in principle by Hungary's economic policy and financed by MÁV.
- In Hungary, the traditional transport technology is also encouraged by the regulation of prices. As an alternative it would be possible to redistribute the income of the railway among other kinds of transport, thus encouraging transporters to adopt containerization.

In 1986, altogether 133,907 TEU loaded containers were transpsorted by MÁV as part of the international transportation of large containers, only 13,522 TEU (10,1%) of which were transit traffic. Due to our geographical situation, the transit figure could be higher.

I.3. Distribution Channels and Patterns

I.3.1. The Principal Scheme and Realization of the Distribution System

The flow of goods and materials is presented in Figure 6. The different sections of this process will be analyzed below.

The logistics tasks of the country are carried out mainly by state companies; the role of small private enterprises is sharply increasing but still very limited.

Inputs of the national economy come either from extracting industries (mining) or from foreign trade (import) - mining and importing organizations carry out the task of primary logistics.

Hungary is rather poor in natural resources, and therefore mining is a small but important branch of our industry. This branch consists mainly of large companies: eight (regionally organized) companies in coal mining, one large trust for oil extraction (manufacturing of oil products also belong to this trust), one trust for bauxit (also vertically integrated with aluminium manufacturing capacities), one large company for other ores. These companies are heavily controlled by the state.

As for imports, they come either through specialized trade companies or by direct imports by manufacturing companies themselves. There were about 40 foreign trade companies in 1987 (all of which deals also with exports), most of them specialized in some branch of industry (e.g. chemicals, steel & iron, wood, paper & pulp, etc.), while a few have general profile. The right to import of manufacturing companies and also the specialized supply companies is directly the development of the eighties; before that the state monopoly of foreign trade was fully carried out by specialized companies, and by a limited number of licensed industrial firms.

(FIGURE 6)

As for the internal supply of the manufacturing sector, it takes place mainly through direct contacts between manufacturing companies. However, specialized supply companies of production goods also play an important role - these companies buy goods from other manufacturers or import and serve mainly those companies which have sporadic or small volume demand for the particular goods (e.g., those which do not reach the lower limit of production lot of the manufacturer).

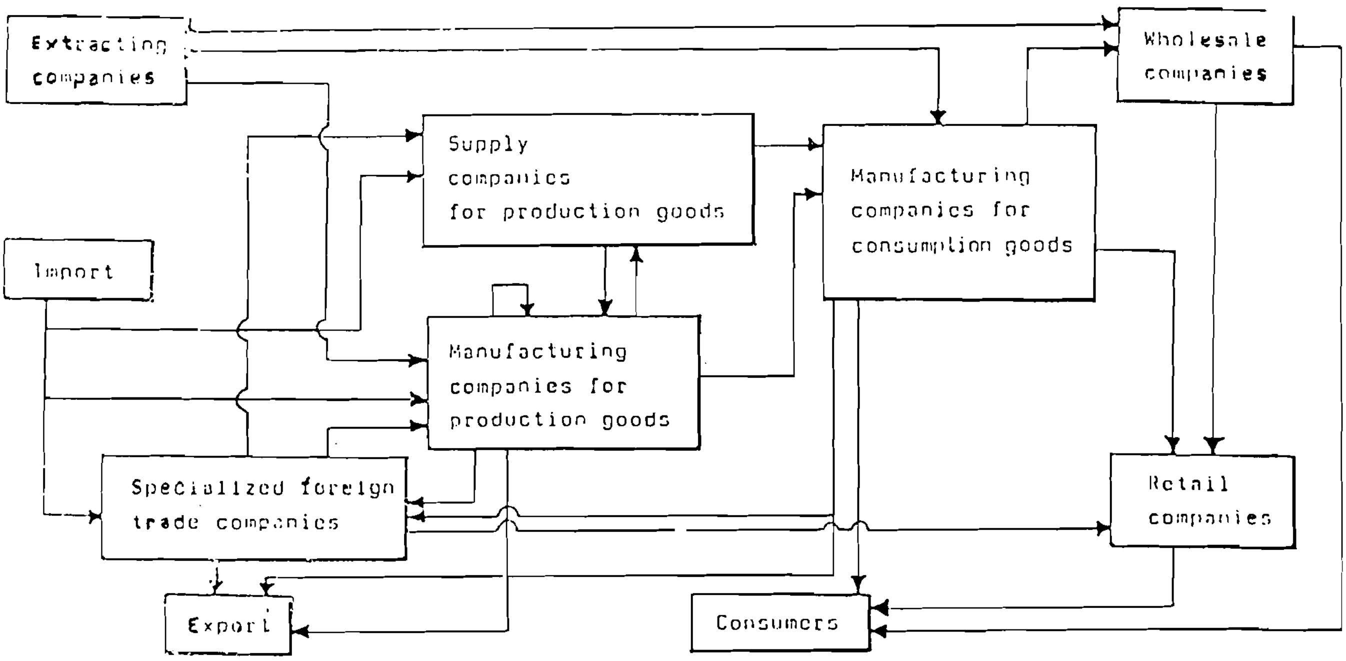
TABLE 8

The Sales Relations of Industrial Companies and Cooperatives (Curent prices, percentage)

Sales relations (sectors)	1975	1980	1987
Industrial companies	34,8	34,9	38,4
Supply companies for production goods	10,4	13,4	10,3
Final output	52,8	49,3	50,3
of which: Consumption	25,7	23,8	23,4
Investments	3,2	2,9	2,8
Foreign trade	23,9	22,6	24,1
Others	2,0	2,4	1,0
Total	100,0	100,0	100,0

FIGURE 6

Principle scheme of the distribution channels in Hungary



As it can be seen from Table 7, half of the industrial production will be used and processed by industrial companies and only 20 percent of this turnover is organized by specialized wholesale companies. This ratio seems very stable although some fluctuations happened during the last decade.

Final consumption has two directions: export and consumers. Export can be direct from manufacturers or can go through the specialized foreign trade companies. Consumers can buy either from manufacturers or from retail (or demigross) companies; wholesalers are usually organized on a territorial basis. Table 9 gives an overview and comparison of total sales and inventories of the various organizations.

TABLE 9

Weight of various branches in the Hungarian logistics system

Branches	Total sales		Total Inventories	
	Billion Fts	%	Billion Fts	%
Industry (wihtout food)	971.4	28.1	260.9	39.9
Food industry	217.8	6.3	68.5	10.5
Agriculture	242.1	7.0	133.1	20.3
Internal trade	980.6	28.3		
Supply companies	327.6		70.1	10.7
Wholesale	163.5		78.3	12.0
Demigross	77.6		78.3	
Retail	412.0			
Foreign trade			9.3	1.4
Imports	390.5			
Exports	414.5	12.0		
Other branches	630.6	18.3	34.3	5.2
Total:	3.457.0	100.0	654.5	100.0

I.3.2. Some Characteristics of Trade Channels

Distribution structure in Hungary can be characterized first of all by the existence of a very limited number of wholesale companies. From the three main groups of wholesale firms, which are specialized in foreign trade, consumer goods and production goods, we are dealing only with the latter two because they have a decisive importance from the internal logistics point of view.

Since 1968 the companies have had the opportunity to choose freely their partners in the domestic market. (After step by step legal amendments, this is the general rule from 1988 in foreign trade as well.) In spite of these legal possibilities the current specialization by type of products of wholesale companies served as a barrier against real freedom to choose partners. This means that in almost all of the production goods wholesalers preserved their original product profile. In addition to this the high degree of monopolization changed only very slowly in the last decades. Hence the number of companies remained practically unchanged. (Table 10)

TABLE 10

Number of Trade Companies
(Without trading and catering service companies)

	1975	1980	1985
Wholesale trade of production goods	85	80	81
Wholesale trade of consumer goods	48	47	50
Retail Trade	665	447	427

It must be admitted that beneath of this rigid organizational structure the real activities of these firms show a better situation.

- First, because the demarcation between wholesale and retail activities are not strictly established: retail companies sell for other retail firms. The so-called demigross trade accounts for about 22 per cent of retail net sales.

- Second, the wholesalers of consumer goods started to establish their own retail shops. To a lesser extent the same can be mentioned about the wholesalers of production goods (production supply companies).

TABLE 11

Size Distribution of Internal Trade Companies According to Number of Employees in 1985

Size groups of employees	Number of companies		Number of employees	
	unit	%	person	%
- 100	61	9.4	2446	0.6
101 - 300	148	23.8	28649	6.9
301 - 500	105	16.9	41021	9.8
501 - 750	113	18.3	70800	17.0
751 -1000	83	13.3	70300	16.8
1001 -1500	66	10.6	77572	18.6
1501 -2500	29	4.7	52096	12.5
2501 -	16	2.6	74329	17.8
Total	621	100.0	418213	100.0

According to Table 11, 20 per cent of biggest inland trade companies accounts for about 50 per cent of employees. The above figure doesn't contain the data of private retail trade.

The private sector still cannot engage in wholesale activity by law. The strong concentration of size distribution is mainly due to this.

From the logistics point of view it is worth mentioning that the number of shops and catering units increased from 65,675 to 80,731 in the last decade due to the growth of the private sector.

Although the private sector became relatively great regarding the number of retail outlets, their share in retailing sales are still low. According to expert judgements it could be below 10 percent of total sales. (Data are not available in Hungarian statistics.)

Inventories play an important role in the physical assets of internal trade. (Table 11) Production goods distribution needs more than twice as much inventories than gross fixed assets. It could be explained by the higher level of the so-called "transit" operation which means that the product itself will not touch the warehousing depot of the supplier company. Another reason is that production goods and consumer goods are different concerning their needs for storing, displaying, etc. facilities: the latter need more expensive real estate.

TABLE 12

Composition of Physical Assets in Internal Trade (current prices) /1987/

	Gross fixed areas		Inventories		Total	
	Billion Fts	%	Billion Fts	%	Bill.Fts	%
Production goods distribution	31,4	28,8	76,8	45,6	108,2	39,0
Consumer goods distribution	77,7	71,2	91,6	54,4	169,3	61,0
Total	109,1	100,0	168,4	100,0	277,5	100,0

Earlier we have seen that about one-fourth of industrial sales go for final consumption. (Table 12) Now we can have a look at the opposite side. Who are the main suppliers of consumer goods wholesale and retail companies? (Table 1)

TABLE 13

Purchasing Sources of Consumer Goods Trade (Current Consumer Prices, 1987)

Sources	Food beverages		Clothing		Other industrial goods		Total	
	Billion Ft	%	Bill.Ft	%	Bill.Ft	%	Bill.Ft	%
Industry	213,7	78,5	51,9	78,1	155,2	46,9	420,8	61,9
Agriculture	11,9	4,4	-	-	7,2	2,2	19,1	2,8
Foreign tr.	10,4	3,8	19,8	25,5	63,6	19,3	93,8	13,8
Production goods suppliers	8,0	2,9	1,9	2,5	77,4	23,4	87,3	12,8
Others	28,2	10,4	3,8	4,9	27,2	8,2	59,2	8,7
Total:	272,2	100,0	77,4	100,0	330,6	100,0	680,2	100,0

Of course, industry with its total 61.9 percent share is the most important source. But in the second place is imports, especially in clothing articles and other industrial goods. There are many goods which in the same form can be both industrial and consumer products. As the earlier boundaries regarding marketing channels of production goods' suppliers collapsed they strengthened their efforts to get a market share of consumer goods turnover as well. They show some progress in this respect.

Inventories have a higher proportion of capital tied up in distribution. As a result, inventory turnover determines the efficiency of this area to a great extent. According to the trends, the consumer goods sector needs less and less inventories compared to sales. (Table 14) The economic reform at the end of the sixties emphasized capital efficiency for companies. Hence the inventory turnover speeded up in the seventies. In the eighties, this trend slowed down because of the recession in the whole economy and it is getting closer to the natural limits of speed (inventory turnover).

TABLE 14

Inventory and Inventory Turnover of Consumer Goods Trade (Current consumer prices)

Year	Retailing		Wholesaling		Total	
	Inventory Bill.Fts	Inventory Turnover days	Inventory Bill.Fts	Inventory Turno.days	Inventory Bill.Fts.	Inventory Turno.days
1970	16,5	47	15,7	38	32,2	85
1975	20,3	39	19,5	33	39,8	72
1980	32,3	37	25,0	26	57,3	63
1985	46,1	36	41,3	28	87,4	64
1987	44,0	33	44,8	26	88,8	59

As in the whole economy, in the distribution channels as well an immense change began in 1989. A new association law is in force and new forms of trade companies are emerging. According to these recent developments at the end of March 1989, 1051 internal trade companies and 125 foreign trade companies existed of a total of 1176 trading companies. Most of the new firms chose the Limited Liability Corporation form (240 of the total). The dramatic changes in the number of companies will influence trade relations (turnover) only later.

I.4. Warehousing, materials handling and packaging

I.4.1. Warehousing

During the extensive period of Hungary's economic development storage was considered an unproductive activity on the grounds that storage does not add to use value but considerably adds to costs.

In the field of technological development the emphasis was on basic technological activities, while the development of storage - like that of other infrastructural elements - was relegated to the background. This conception is well reflected by the fact that during the fifties, although more than one-third of the storage capacity was destroyed during World War II, hardly any new warehouses were built and today less than 7% of storage capacity originates from that period.

According to data on warehouse capacity compiled in 1950, storage capacity of Hungary amounted to 560,000 wagons, and in 1960 to 860,000 wagons. In ten years the capacity increased only by 53% while in the same ten years industrial production increased by 167%, construction activity by 118%, retail-trade turnover by 95%, foreign-trade turnover by 187%, and freight ton/kilometre performance by 156%.

Larger storage-construction projects were started in the sixties, and more considerable development came with the investment policy of the seventies. In Hungary, 24% of the total storage area was established between 1960 and 1969 and more than 35% during the years 1970-1979.

The share of storage space built after 1980 is also not insignificant, amounting to a 12% share. In the last two years, storage construction showed a decreasing tendency: storage area growth was only 0.5% in 1985.

The following table illustrates the development of storage capacity between 1950 and 1985.

TABLE 15

Development of Storage Capacity in Hungary

Year	Thousand wagons	Storage area (thousand sq.meters)
1950	560	5,600
1960	860	8,600
1970	1,230	11,900
1975	1,800	14,229
1980	2,300	16,761
1985	2,800	19,000

Nowadays, the average internal height of the storage area is 4.3 m while 35 years ago it hardly reached 3.2 m. In 1950, in 83% of the warehouses materials handling was performed entirely manually, in 15.8% partly mechanization and only 1.2% was fully mechanized. Now the share of manual materials handling is 18%, partially mechanized 19.2%, 61% fully mechanized and 1.5% has automated materials handling. Although the proportions have become reversed during the last 35 years, there is still much to do.

Despite the easing of the warehouse shortage, 14% of businesses (enterprises, cooperatives) reported a permanent shortage throughout the year while 35% complained of a temporary lack of storage capacity. At the same time, 12% of the enterprises and cooperatives have excess storage capacities periodically.

The area of the closed-and-covered warehouses is nearly 19 million sq.m. and their volume is approx. 79 million cu.m. In 1985, this area and volume represented 36,000 warehouses. An average Hungarian enterprise has 10 warehouses, with an average area of 520 sq-m. each. Storing activity is performed at 22,500 sites, of which 7,130 are exclusively storage sites. Mechanization is impeded by the fact that warehouses are widely scattered as well as by the territorial composition involved. Sixty per cent of the total closed-and-covered warehouses is of 50-300 sq.m floor area which is definitely small. One-third of the warehouses with over 300 sq.m. of floor area have 300-500 sq.m; that of a further 36% is in the 500-1000 sq.m category. It cannot be considered favourable at all that more than two-thirds of the closed-and-covered warehouses have floor areas less than 1000 sq.m. which limits the feasibility and efficiency of intensive mechanization.

The total area (450,000 sq.m.) of emergency storages, which in absolute forms has decreased by hardly 10% since 1970, is still very high. (Today, 2.4% of the closed-and-covered warehouse area can be qualified as emergency storage.)

Storage space in cellars unsuitable for mechanization amounts to 2.5-3% of the total.

Factors impeding mechanization are the low (28%) level of unit packaging, handling and transport, the low number of unit packing machines (seven-thousandths of warehouse machines, found in only every 40th warehouse with one 300 sq.m floor area), as well as the lack of machines to measure unit loads.

The utilization of storage capacity also depends on the level of organization of the management. The summarizing data on administration verify that in this area vast reserves still exist. At present in 78% of the closed-and-covered warehouses of over 300 sq.m. floor area accounts are kept by hand. The proportion of administration aided by small machines is 13.6%, and only in 8.6% is the work aided by computer.

Even in this latter group the machines usually only assist but not actually perform control functions and in most cases are used only for accounting and registration purposes.

A major criterion of linking the warehouses into a logistic chain is their physical accessibility. Twenty percent of the closed-and-covered warehouses with over 300 sq.m. floor area is provided with industrial railway, representing 30% in respect of area. This relatively low ratio also contributes to the decreasing freight-ton performance of railway cargo transportation.

In the course of the last decade no great changes have occured in warehouse distribution, but certain tendencies are becoming outlined. While in 1975 the industrial warehouses represented a 40% share, today it is 38%. An opposite trend is observable in agriculture where the share increased from 36% to 38%. The decreasing tendency in this regard in the commercial network is unfavourable, down to 28%.

While the area of closed-and-covered warehouses has increased by 32% in ten years, the retail branch's storage area grew by only 24%.

The same adverse phenomenon is reflected in the reduction of the role of the special supplying companies of production goods played in stockpiling which is also reflected in the proportions of the stock. While in 1980, the WCPM+ storage stock represented 8.5% of total stocks, nowadays this is only 7.5%, less than it was in 1975. The closed-and-covered WCPM storage area represents only 3.9% of the total storage area in the economy, which is rather low.

TABLE 16

Distribution of warehouses by economic branches

Economic branch	1975		1980		1985		1985/1975 %
	m^2	%	m^2	%	m^2	%	
Industry	5,750,450	40	6,544,420	39	7,108,084	38	124
Construction industry	277,840	2	384,280	2	563,412	3	203
Agriculture	5,067,410	36	6,104,210	37	7,179,794	38	142
Domestic trade and commerce	2,789,170	20	3,233,380	19	3,463,736	18	124
Other sectors total	344,160	2	414,450	3	447,785	3	130
Total	14,229,030	100	16,760,740	100	18,762,811	100	132

+ WCPM: Wholesale Company of Production Means

I.4.2. Materials handling

By materials handling we mean the complex shifting of different (basic and auxiliary) materials, machine parts, semi-finished and finished products in order to achieve production goals and their use; and this is executed manually or with the help of materials handling machines, storage machines, machines for forming unit loads and breakers and of transport vehicles.

The number of those employed in materials handling was reduced by about ten percent between 1977 and 1985, somewhat more rapidly than the total number of people employed in the productive branches of economy. This annual 1.3 percent reduction is moderate and shows a strong deviation according to branches.

The most considerable change took place in the construction and the home trade branches whereas in the other industrial branches reductions were minimal. It confirms the finding that companies consider the mechanization of their basic activities a primary goal as opposed to auxiliary activities or to infrastructural functional areas.

The mechanization level of materials handling can be characterized by the share of mechanized and manual work. It can be stated that the mechanization level has been improved to a certain extent (manual work has been reduced from 58.2% to 56.7%). Within this, the share of manual work is considerable in areas connected with logistics (communications and home trade). In building and construction an essential reduction has taken place in connection with the developments described above. In manufacturing industry the situation has deterioriated where the number of employees carrying out manual handling has been increased because of the insufficient level of mechanization.

In the productive branches of the national economy the gross value of fixed assets connected with materials handling approximated 260 billion Fts on 31st December, 1985 and their share within the total fixed assets stock amounted to 22% with a wide scattering according to the special conditions of the branch.

The overwhelming majority of materials handling machines and equipment and of transporting vehicles was at the disposal of the manufacturing industry (61.1%) and of the transportation postal services and telecommunication branches (67.2%) according to the special conditions and relative importance of these economic branches.

During the period studied the following changes may be experienced within the composition of fixed assets stock of the productive branches (without transportation, postal services and telecommunications) divided into fixed asset groups:
- the share of landed properties (with the exception of the manufacturing industry) increased in every economic branch,
- the share of machines and equipment increased in every material economic branch (the highest in the industry),
- the share of transporting vehicles fell back in every economic branch (especially in building and construction).

The determining factors of the future development of materials handling technologies used in different sectors of the economy are as follows:
- Mechanization and automation of materials handling will be continued. In the first place it will be carried out through the rational replacement of labour and through the creation of similar technological levels in all the phases of production and distribution, and further, in case of emergency (e.g., in workplaces dangerous to health, in handling toxic materials) the task is to eliminate the loading and transporting operations previously carried out manually.
- In spite of the fact that the quantity of raw materials processed during manufacturing will not be increased in the long run, in accordance with the efforts directed towards material savings, the tasks of materials handling will be enlarged nevertheless parallel with the increase of degree of co-operation within shops and between the different shops.
- As a result of the increase of co-operation within production and greater consumption the quantity of goods flowing in the logistic system will be increased, involving also an increase of the tasks of materials handling (storage and loading tasks).

I.4.3. Packaging

In Hungary, the per capita usage of packaging-materials and means is relatively low when compared with the developed countries. As the final destinations of large part of the Hungarian products are the markets of the developed countries, the higher packaging requirements of these markets should be satisfied, even if the domestic packaging level is not as demanding.

The production of packaging implements increased by some 14.5% on the annual average between 1970 and 1986.

The production value increased from 7.8 billion Fts in 1970 to 31.3 billion Fts. This is an achievement of great importance even if inflation is taken into account. Steady development rate was characteristic of the production of packaging means.

In the production and use of packaging means paper represents the largest value. During ten years the paper packaging means kept their first place and leading share within total production. Regarding usage shares, paper packaging means were followed by metal ones. The use of metal packaging means was characterized by a development rate smaller than average, though a steady one.

The production of plastic packaging means - in quantity and value as well - sky-rocketed between 1975 and 1986 and in respect to rate of increase, plastics take first place. Production has increased from 796 million Fts to 5.6 billion Fts.

TABLE 17

Composition of Packaging Materials Used in Hungary in 1986

Packaging material	Usages (Bill.Fts)	Share (%)
Paper	12.3	39.8
Metal	7.0	22.6
Plastic	5.4	17.5
Glass	4.7	15.3
Wood	1.1	3.6
Textile	0.4	1.2
Total:	30.9	100.0

In 1986, the value of packaging means was 1.3% of the gross national product, and 3.6% of the national income; these rates varied just slightly during the period under survey. The relatively dynamic development of use and its result, however, does not show a favourable picture when comparing it with international data. In Hungary, the packaging means-use per capita was around 66 USD in 1986, which is 30-40% of the West European, 25% of the Japanese and 20% of the North American use. But comparing it to the per capita gross national product, Hungary is in around the average level. To sum up: the packaging industry - within its national scope - is at a similar level as the other branches of the national economy.

I.5. Information Technologies

The second half of this century is already the age of information technology. More and more people are engaged in this area in all of the developed countries. Unfortunately, Hungary is not among them and the underdeveloped mass communication systems seem to impede general economic progress as well. The diffusion of information technology into the economy, society and consumption slowed during the last two decades. The shortage of telephone became a sore point of everyday life. Table 20 shows a few parameteres of this situation.

TABLE 18

Telephone and Telex Network	1970	1980	1985	1987
Number of telephone main stations, thousand	399	617	739	813
Telephone stations per hundred population, unit	8,0	11,8	13,9	15,2
Number of those who are waiting for telephone-station to be equipped in dwellings (thousands)	122	242	478	498
Number of telex subscribers	2 794	8 132	11 345	11 960

The Hungarian government realized that in this way the reconstruction of the economy into a market driven mixed economy is not possible. According to plans, five years from now the number of telephone stations must be doubled and the shortage overcome. This program will be feasible only if new western operating capital will appear in this sector. The process could be accelerated if the COCOM list released is abolished. The physical distribution and logistics sphere could gain a lot.

In the field of computerization the situation is somewhat better. The diffusion of mainframe systems was not very successful in seventies. The batch-type data processing did not stir users' enthusiasm to develop new systems. Logistics, especially inventory control, always played a great role in application. The appeance of micro computers (see Table 19) in the eighties has just started to change the acceptance of computers in the whole economy. In the private -sector and in the households a new culture towards computers is appearing. There are only about a dozen retail outlets where a fully computerized system is used. Many new and old management consulting companies offer distribution software packages for stock control, transport management, order processing, warehousing operations, etc. The market is growing. The sales of computer service companies doubled between 1984 and 1987. This trend promises to continue at the beginning of the next decade as well.

TABLE 19

Trends of Computerization in Hungarian Public Sector

	1970	1975	1980	1985	1987
Number of persons engaged in sphere of computer techique	4765	10 925	18040	21662	23716
Microcomputers, number	-	61	300	16587	62893
Computers (small, medium, high capacity), number	n.a.	487	972	3209	2090

I.6. Measuring of logistic costs and logistic efficiency

The total logistic costs consist of costs related to inventory control, transport, materials handling, warehousing, packaging, etc. Due to the research and statistical shortcomings of this area, one could hardly find relevant data at the macroeconomic level.

According to surveys of western developed countries, logistics costs increase as the customer-service level plays an increasing role as a market factor. The result of this is that the proportion of logistics costs shows an increasing trend within the total costs of enterprises. But those countries which have developed logistics systems (USA, Japan, etc.) seem to increase their logistics costs at macro level.

Consequently, there are arguments both for and against both increasing and decreasing these costs in a less developed country like Hungary. If these higher costs are used for developing the general technical standards it is good. But if the lower level of costs show that the advanced technology is unable to come to this area - as we can see in Hungary - it is not good.

Based on financial statements and other documents of companies a given area of logistics costs were examined in 1985 by the National Committee of Technical Development. The survey was a repetition of one made in 1977 and for some industries in 1980. Table 20 shows the data of some industries.

TABLE 20

Logistics Costs of Some Industries in 1985 (Billion forints)

	Internal materials handling	Ware-housing	Transport	Total costs	As a percentage of total production costs
Industry	17,8	13,5	30,2	61,5	5,2
Construction	3,1	1,1	7,5	11,7	11,7
Agriculture	13,8	1,5	6,6	21,9	7,7
Internal trade	1,6	5,4	11,0	18,0	16,4

These figures are based on many methodological simplifications because of the lack of some data, or of different accounting principles used in different industries. Nevertheless, they can illustrate some differences among industries and show the structure of partial logistics costs. It must be admitted that taking into account other elements of logistics costs (e.g. inventory control, ordering, information technology used in this field, etc.) the relations could be modified. According to rough expert judgements the total logistics costs could be doubled compared to figures given in Table 20 . Nevertheless, this fraction of logistics costs and their changes in time offers an opportunity for analysis.

It is worth mentioning that without exception the proportion of above logistics costs in total production costs decreased during the last decade. In industry only from 5.8 to 5.2, but in domestic trade from 18.3 percent to 16.4 percent. The components of logistics costs hardly changed in trade.

TABLE 21

Components of Logistics Costs in Internal Trade

	1981		1985	
	Million Fts	%	Million Fts	%
Internal materials handling	1 208	8,3	1 645	9,1
Warehousing	4 634	32,0	5 380	29,9
Transport	8 628	59,7	10 006	61,0
Total:	14 470	100,0	18 006	100,0

Transportation costs are the highest in all branches, but there are methodological differences in how they were accounted in different branches. For example the internal materials handling costs in trade consisted only of labor costs involved in materials hadling. However, the materials handling costs of industry consists of fixed capital costs and labor costs, too. That is why this component is relatively high in this sector. (Table 22)

TABLE 22

Components of Logistics Costs in Industry

Components	1977 Million Fts	%	1985 Million Fts	%
Internal materials handling	14 096	38,1	17 797	28,9
Warehousing	6 946	18,7	13 540	22,0
Transport	15 998	43,2	30 203	49,1
Total:	37 040	100,0	61 541	100,0

These limitations notwithstanding, one can make some relevant statements:

- logistics costs increased to a lesser extent than production costs;
- transport costs amounted to a higher proportion at the expense of internal materials handling.

Much of these costs, which occur as a result of logistics shortcomings (e.g. less flexible service, low competitiveness, physical damages, losses, etc.) can't be measured directly, but probably amounts to quite a lot.

II. Organizational Structures and Government Regulation

II.1. Micro-level organization of logistics tasks

In the vast majority of Hungarian companies there is no organizational unit which is responsible for all or even the majority of logistics tasks. The logistics function is performed by several, generally loosely connected units and one can hardly see any integration attempt.

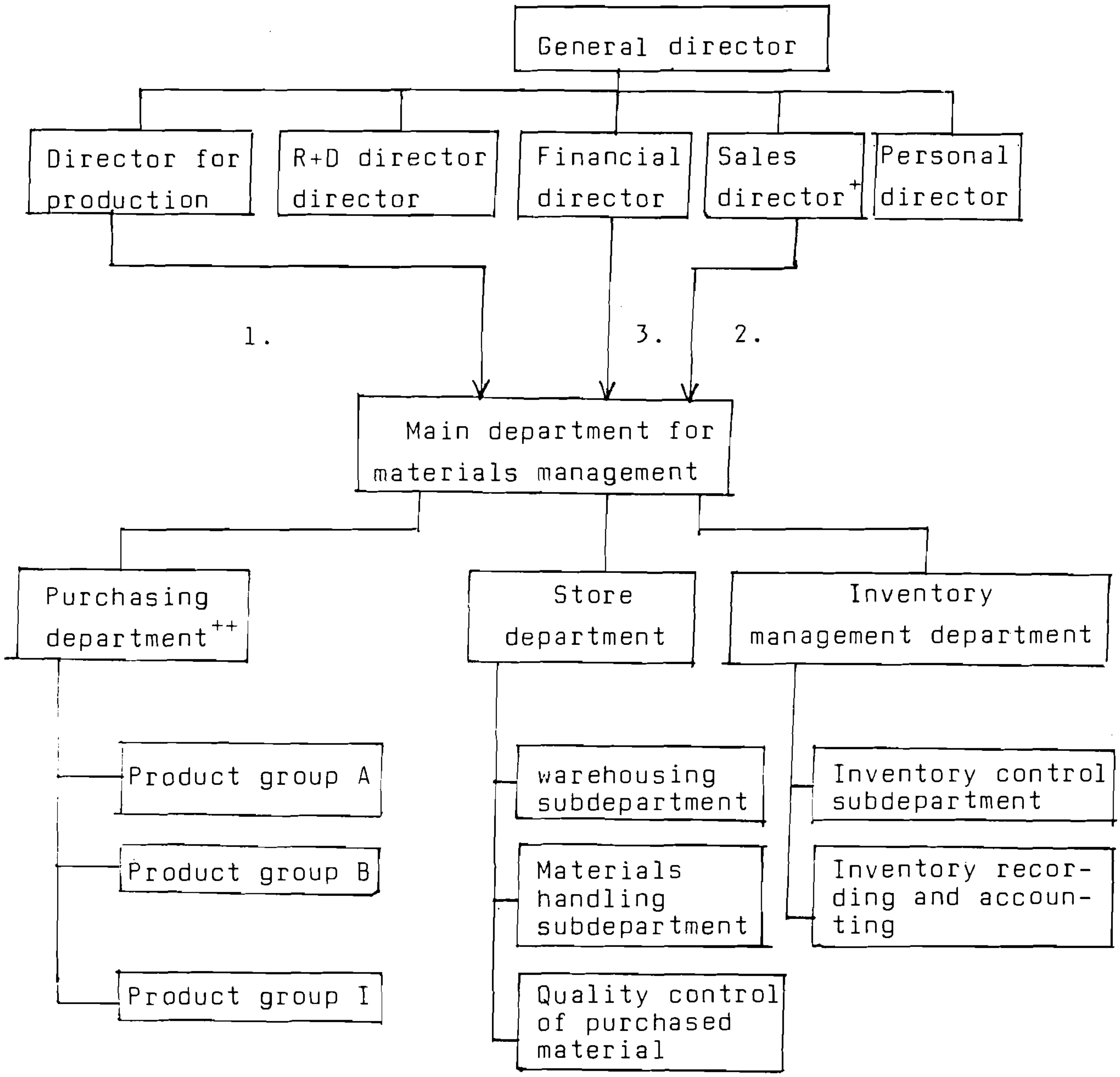
The dominating role in logistics is played by materials management, which is usually organized as a main department (with its head at the third level of the hierarchy). Under the title "materials management" usually the following activities are found: purchasing, store management and internal materials handling, quality control of incoming products; raw material and puchased parts inventory control. The internal structure of the materials management section of a typical manufacturing company is shown in Figure 7.

The special role of materials management comes from the fact that in a shortage economy purchasing can face considerable difficulties: deliveries are uncertain in timing, quantity and quality. In knowledge of that it's even more surprising that the head of purchasing and materials management is comparatively low in the hierarchy: onlv rarely can one find a materials management director (second level of hierarchy), which is quite common in the industrialized countries.

Materials management in general is not integrated organizationally to production: there is usually a separate main department for production (though in a considerable part of the cases they both belong to the same director). The production department is generally responsible for the work-in-progress and in-process inventories and semi-finished goods.

FIGURE 7

A typical organizational structure of the materials management function in a Hungarian company



1., 2., and 3. means alternative solutions

+ In case 2. it is Purchasing and Sales director

++ Subdepartments are usually specialized by product groups

Deliveries to consumers and the control of finished-goods inventories are usually under the responsibility of the sales department, which has a quite different role in the Hungarian companies than in the Western countries. Due to the shortage economy, companies usually produce for order and can (or even have to) in many cases actually make a choice on the priority given the consumer order consequently, finished goods are kept at a very low level (actually at a level necessary for the technical performance of the shipment preparation) and finished goods are dispatched usually directly to consumers.

In a number of cases there is a separate unit in the company for transportation and internal handling of materials, which is a step toward an integrated logistics system. However, decisions of this unit are generally limited to technical questions.

II.2.. Labour Resources in Logistics

There are neither standard statistics nor surveys about the number of blue and white collar workers employed in logistics. In the productive sectors the manual workers amount to 75 percent of the total work force. One can suppose that a similar ratio is valid for the logistics area as well. According to the logistics cost survey earlier mentioned (done by OMFB) 352,251 manual workers were engaged in logistics. (Table 19) Because the survey did not cover all of the logistics activities the correct figure should be only bigger. This means that at least 15 but rather 20 percent of the Hungarian work force is engaged in logistics.

There are many other correction factors which could be taken into account. For example, according to some studies 20 percent of each manual worker's work time will be devoted to materials handling in factories. This is also for believing that the above given figures must have been underestimated.

TABLE 23

Number and proportion of manual workers engaged in logistics by industries in 1985

	The number of persons	as proportion of total manual workers(percentage)
Industry (state owned)	133206	13,3
Construction	19304	9,6
Agriculture and Forestry	93718	14,1
Water works and supply	4429	7,3
Transport, post and telecommunication	83219	32,2
Trade	18375	6,5
Total:	352251	14,3

Traditionally, the labour involved in logistics is not highly educated. Only 30 percent of above mentioned 352,000 persons were skilled workers. In the transport and telecommunications industry the situation is worse because only 12 percent are skilled workers, and most of them are semi-skilled.

The status of manual workers can be characterized by their average wages. In the manufacturing industry, e.g., the manual workers who are active in materials handling could get 93.4 per cent of the average wage of all manual workers, but there are many differences, e.g., according to hard or easy manual work. Unskilled workers in the transport area get 32 per cent more on the average than total unskilled workers.

There is a need for education at all levels of logistical professions. There are a few institutes and organizations which offer courses in sub-areas of logistics (transport, warehousing, etc.) but there is not any which trains real logisticians.

II.3. Economic Policy Trends

Since the introduction of the New Economic Mechanism in 1968, Hungary's economic policy and development can be divided into several phases. The first phase from 1968 to 1973 is characterised by economic success due to favourable worldwide conditions. Between 1973 and 1978, the economic policy pursued was contrary to the spirit of reform and, in addition to this, the economic situation deteriorated as a result of the international recession caused by the first oil price hike. Since 1979, Hungarian economic policy has been attempting to pursue the intentions of the 1968 reform in an intensified manner. From 1980 to 1982, the critical international situation (Afghanistan) and the crisis in Poland (1981) led to a strained liquidity situation in Hungary which forced economic policy to implement considerable import restrictions up until 1984. In 1985, reform steps were again undertaken, which exceeded the aims set in 1968. Since 1988, even more profound changes have happened both in politics and in the economy.

II.4. The Nature of Government Regulation of Inventories and Other Logistical Areas

As a rule, regulation is in response to significant changes in inventory accumulation. The increasing amount of capital tied-up in inventories at the macro-level gives rise to a restrictive period, while the decreasing level of inventory accumulation tends to diminish the urgent need for a severe inventory control system.

In order to reduce overdemand for assets, not only net incomes but also assets and investment activities are taxed in Hungary. In 1987 a firm had to pay a 3% asset-tax on the average value of its fixed assets and inventories and a 18-25% so-called investment tax after its investment expenditures. The mandatory rules of financing inventories also play important roles in regulation. Companies are required to finance the different activities through special funds.

The credit policy has a limited effect on the firms' behaviour, partly because of the low sensitivity to costs and partly because credits represent only a small fraction of the sources of a firm's financing and a growing number of firms are operating without bank credits.

As for transport regulation, the most liberalized system was developed in road traffic. As the preconditions of establishing private companies both in passenger and freight transport were created, a stronger competition emerged among public transport organizations as well. Since 1989, the road and urban transport is feed of carrier and freight pricing obligations. It is forecasted nat the companies will make higher efforts to use their own fleet of trucks more efficiently. Regarding the Hungarian Railway Company (MÁV) there are still in force a few obligations concerning pricing, supplying customers, etc. But the freight transport division is not subsidized by the government, unlike passenger transport. New movements fighting against environment pollution have started to defend rail versus road traffic. In the near future one must count on their lobbying at the government level, too.

III. Research Agenda

Logistics research has a long history in Hungary: it has been constantly on the agenda, but with a very limited budget. This fact has been (and is) one of the problems, the other being the lack of organic connection among the various institutions dealing with logistics research. Especially the separation of economic-managerial and engineering approaches is painful. However, at least in the short run, we have to live with this situation.

As for research into the economic and managerial aspects of logistics, a long-term research project is under way. It is coordinated by the Department of Business Economics of the University of Economics in Budapest. The project consists of the following parts:
(i) international comparison of inventory investments;
(ii) company inventory behavior and the formation of aggregate inventories;
(iii) new logistics technologies (MRP, JIT, FMS) and their application in Hungarian industry;
(iv) integration of specific functions (purchasing, materials management, production, sales) into the logistics system.

The project will last until at least 1992.

There is no national research program on the technical aspects of logistics in Hungary. But there are sectorial research institutes established by government agencies which are responsible for logistics subfunctions as transport, materials handling, packaging, warehousing and inventory control. Developing their own research programs they include some broader logistical approaches as well. As a part of the last five year research plan of Transport Ministry the flow of special goods were studied. The Scientific Institute of Transport, the National Committee of Technical Development and Institute of Mateials Handling and Packaging carried out research financed by government and to some extent by the Hungarian Academy of Sciences. Universities and other research institutes have research projects on computerisation, freight model split, packaging materials, etc.

References

1. Berács J. - Chikán A.(eds.) (1988): Logistics in Hungary, Budapest, pp. 224

2. Chikán, A. (1984): Inventory Fluctuations (Cycles?) in the Hungarian Economy, In Chikán, A (ed.): New Results in Inventory Research, Elsevier Scientific Publishing Co, Amsterdam

3. Chikán, A. (1981): Market Disequilibrium and the Volume of Stocks, in Chikán, A (ed.): The Economics and Management of Inventories, Elsevier Scientific Publishing Co, Amsterdam

4. Nagy, M. - Vígh, K. (1986): On the Central Warehousing Information System in Hungary, in Chikán, A. (ed.): Inventory in Theory and Practive, Elsevier Scientific Publishing Co, Amsterdam

5. Ábel, I. - Székely, I. (1987): The Role of Inventories in Adjusment, IIASA-ISIR Workshop, Bük, Hungary

6. Hunyadi, Cs. (1989): Inventory Cycles in Market and Planned Economies in Chikán, A. (ed.): Progress in Inventory Research, Elsevier Scientific Publishing Co., Amsterdam

7. Az anyagmozgatás színvonala és fejlődése hazai és nemzetközi összehasonlításban. OMFB tanulmány 21-8601-EA, Budapest, 1987, pp. 152 (= Development of Materials Handling - National and International Comparison; Survey made by National Committee of Technical Development)

The following studies were prepared as a background material for this volume under the contract between IIASA and ISIR (titles are given in English, though all papers were written in Hungarian):

Ábel, I:: Analysis of the Hungarian economic performance (with special reference to logistics)
Ábel, I. - Székely, I.: A simple inventory adjustment model
Baráti, I.: Logistics study of the wood panels and board market in Hungary
Brandl, P.: Logistical analysis of SZIM (Machine Tool Works)
Chikán, A. - Hunyadi, Cs.: Main tendencies of inventory investment and its factors in Hungary, 1960-1986
Farkas, A. - Koltai, T.: Principles and practice of multidimensional integrated logistics
Kata, J.: Logistics study of the household hardware market
Kupor, L.: Containerization as part of logistics
Lotz, K.: The role of packaging in the logistics process
Lotz, K. - Vándorffy, I.: Logistical evaluation of materials handling in Hungary
Török, S.: Survey of logistics activities at the "Magyar Acélárugyár" (Hungarian Steel Works)

Logistics in Poland

by

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Introduction

Poland is situated in the centre of Europe. The country is almost circular in shape and consists mainly of a lowland area where up to 91% of the country's surface is over 300 meters above sea level. The mountainous regions are heavily concentrated along the southern border.

Poland's geographical position in the middle of Europe as well as the favourable configuration of the country's surface should help promote economic relations with foreign countries, transport connections, etc. Generally, these factors have a significant importance from a logistics point of view.

Industry is the main sector of the Polish economy. About 97% of the total industrial output is produced by socially-owned industry, i.e., state-owned industry and co-operatives. Priority has always been given to the manufacturing branches of industry and their share in the total value of gross production amounted to 65.3% in 1985 [Yearbook 1986].

Central planning and priority systems did not succeed in promoting harmonious growth. Errors in economic and planning policies brought about such negative phenomena, such as: deficit of raw materials and semi-products, increase in inflation, shortage of consumer items, etc.[1] Several high-technology industries have not been developed (e.g. electronics, informatics) which actually forms a deep technological gap between Poland and other highly industrialised countries. The living standard of the average citizen is relatively lower in comparison to West European criteria.

Location and spatial policies also appear to be at fault since they have resulted in an excessive concentration of industry in the area of Upper Silesia, Warsaw, Lódz, Krakóv, etc. This has caused an enormous deterioration of living conditions as a result of environmental pollution. Other negative effects come as a result of the overcharged infrastructure system, and especially the transport and communication systems.

In 1982 economic reform in Poland effectively started and has been continued. Its aim was a withdrawal of the directive–distributive system, and the creation of state-owned companies as self-reliant, autonomous and self-financing units. Direct interference and control by the state administrative bodies has finally been limited to an absolute minimum. Companies cover expenses by their revenues and they sell their products at the prices mutually agreed upon between seller and buyer.[2]

Some independent banks have been established and these have started granting credits according to the policy of "difficult access to money". The central plan currently impacts only on the main strategy of state economic policy and fixes such economic parameters as, rates of interests of the central bank, rates of taxes, indexes of maximum price rises, etc. Rationing of goods is still exercised but its scope is constantly diminishing.

Some laws have been passed that enhance the establishment of private companies, facilitates changes in the traditional organization of state-owned companies, encourages

[1]This phenomenon, known as "structural shortages", occur when the rates of growth in certain branches or sectors are not adjusted to these observed in other branches. A detailed analysis of shortage phenomena is presented in [Kornai, 1980].

[2]Prices for goods – with a few exceptions for basic strategic materials and foodstuffs – are exempted from administrative control.

the inflow of foreign capital into the country, demonopolizes the export and import of goods, etc.

Generally, since the end of 1988, there has been a tendency to demonopolize the economy, to increase the degree of competition between companies and to develop an economy which functions according to market rules. This tendency is expressed by the growing numbers of small private manufacturing, transport, trade or service companies. Co-operatives have also become more active in many fields of economic activities. State-owned companies, however, have remained the most conservative units, hardly responding to changes in the market. Some of them have adapted themselves to a new economic situation and made a spectacular success with their products and services, which has been recognized by a wide range of consumers.

Those general circumstances briefly describe the background of logistics in Poland. It suggests that great changes in many logistic activities may take place as a parallel to shifts in economic circumstances and modified ways of management resulting from the real necessity for enterpreneurship. Hence one must realize that all basic trends presented in this report may undergo substantial changes within the next few years, and it is still too early to foresee the real and final scenario for them.

1 Physical Logistic Structures

1.1 Inventories in the national economy

The general economic situation of the economy; limited role of the market, tight rules of procurement, rationing of production means and finally, limited transport capacities – all result in high inventory levels and a specific inventory structure in the whole economy, and its particular sectors.

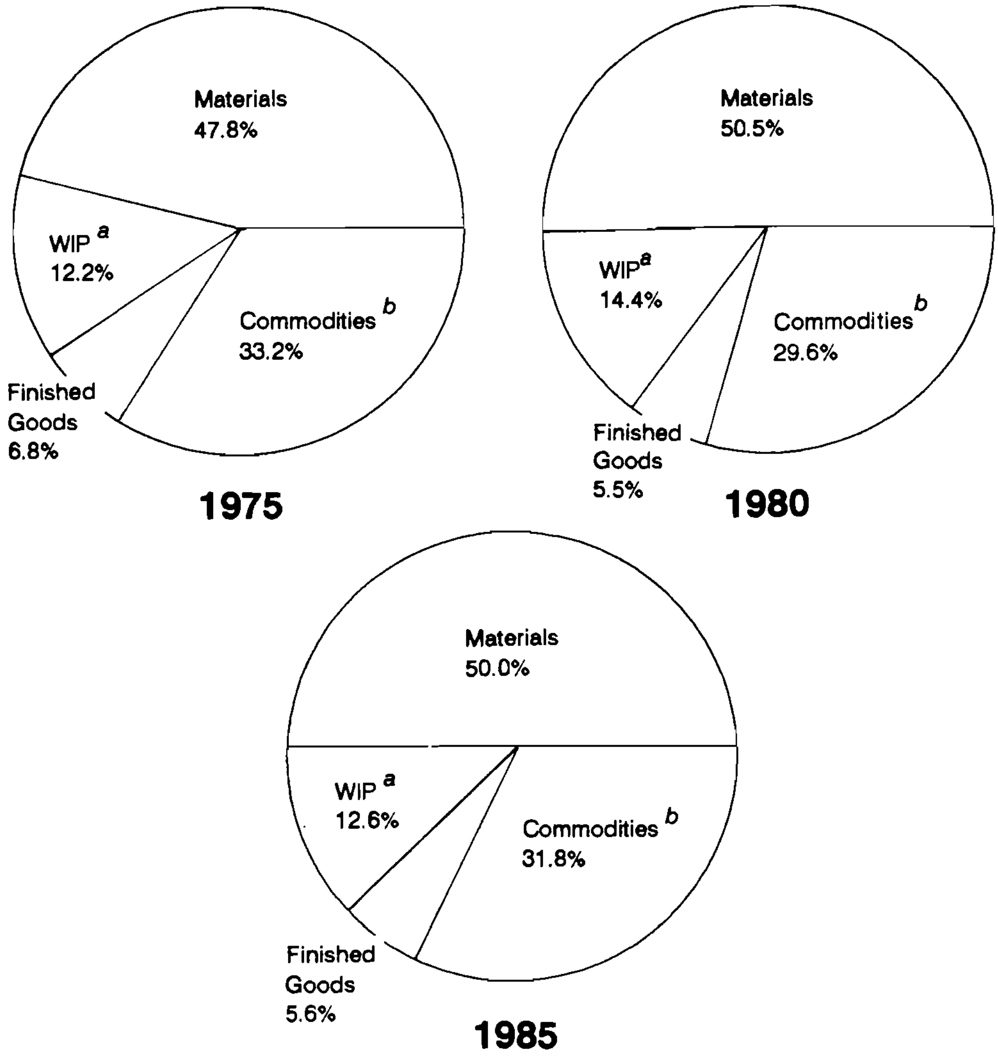
The level of inventories was constantly growing during the period 1975-1985. It rose from 857 Polish zloties per 1,000 zloties of national income in 1975, to 1,080 zloties per 1,000 zloties of national income in 1981 (i.e., a growth of 26%) [Statistical Yearbook 1982].[3] After 1981 a slow but noticeable improvement of inventory level appeared as a result of moving out of a socio-economic crisis in 1980-1981. However, post the first half of 1985 inventory ratios are again slowly rising, mainly due to reduced dynamics of production.[4]

The structure of inventories by their types is presented in Figure 1. It shows that the least disposable part of inventories, i.e., materials, is constantly increasing while the share of work-in-process inventories remains comparatively stable.

The inappropriate allocation of inventories results from a growth of the share of inventories for production purposes in the total value of inventories. That share rose from 72.1% in 1975 up to 76.1% in 1985 [Statistical Yearbook 1985] and [Matwiejczuk, 1986]. The internal structure of inventories for production purposes is similar to the general structure of inventories in the whole economy.

[3]Only inventories in the socialized sector have been considered here because inventories in the private sector – due to its small share in the economy – are not yet of significant value.

[4]The yearly rate of growth of gross production dropped from 6.4% in 1983 to 4.5% in 1985.



a) Data does not comprise WIP in construction or the inventories of socialized companies in agriculture.

b) Commodities – goods in the sector of trade and the sector of construction.

Figure 1: Structure of inventories in the socialized sector. Source: Report on New Logistic Technologies in Poland (1988).

The availability of goods is greatly reduced due to a large concentration of stocks at the ultimate users of different products. This is typical for raw materials and materials, since less than 13% of these stocks are kept by trade companies. It results mainly from imbalance in the market, and from comparatively higher costs and losses in the case of "stockouts" (costs of standstill or reduction of produced quantity) than in the situation of excess inventories (costs of maintenance of stocks and their crediting).

Another unfavourable phenomenon is connected with the low speed of stock rotation at customers. Some simple materials, such as, zinc, aluminium are stocked for 8–14 days on average, while stocks of groups of products with wider range of assortments (e.g. rolled steel products, steel pipes, cold-rolled steel sheets) are stockpiled from 50 to 157 days [Duszek, 1986].

Simultaneously with the phenomena described above, inventories in the procurement trade[5] decreased and the level of stocks is insufficient to maintain performance under current economic conditions, i.e., in an unbalanced market with many shortages, with given distribution channels and patterns, with rationing of goods, in a strong seller's and producer's market, etc.

Stocks of commodities in the procurement trade[6] constituted 8.6% of total inventories in 1975 and only 7.3% in 1985. Despite the reduced ratio of inventories stock rotation did not improve since the average level of inventories rose from 55 days in 1975 to 82 days in 1985 [Wojciechowski, 1988].

The long-term policy of transfering stocks from buyers–users to a trade network did not bring significant results. For that reason trade companies that should serve as a logistic link aiming at reducing disproportions of inventory levels between manufacturing companies – and at the same time limit disturbances occuring in production process – do not play their role as expected. This is also partly due to errors in the organization of the wholesale trade as well as being due to wrong decisions regarding the assortment of stocks.

All changes that would be required for the improvement of inventory structures and allocation, as well as for the reduction of levels, greatly depend on better general regulation of the economy. However, one should realize that the Polish economy – being a socialist shortage economy – cannot function with "zero-stocks". Stocks are likely to be somewhat higher than in market economies but still many decisions might be made in the area of distribution, transportation and managerial structures that would help to speed the flow of goods in the whole economy. Thus the level of inventories might serve as a particularly sensitive "barometer" for performance of the economy.

1.2 Transportation System

The efficient distribution of goods must be supported by a proper system of various transport modes.

Transportation needs in Poland have been growing constantly due to the specific structure of production and foreign trade, i.e.:

[5]Procurement trade includes nationalized units selling goods destined mainly for material supply of socialized economy units.

[6]These stocks consist mainly of materials, tools and spare parts as the basis of wholesaling.

- A large output of bulk products like hard and brown coal, sulphur, copper and other mineral resources destined for domestic use as well as for export;
- the import of iron ore, which is constantly increasing.

The requirements for transport services were also increased as a result of economic misconceptions such as:

- transport was viewed as a sector of little importance within the planning process that located new investments;
- there was excessive concentration of production and specialization of companies;
- the inappropriate location of stores and bad distribution organization which brought about multiple shipments of the same products, etc.

Estimates presented in [Fronczak, 1988] indicate that the share of non-rational movements totals between 20-30% of all activities of the whole transport system.

For many years the transport sector has been under-invested both in terms of the network and the means of transportation. The share of investment outlays in transport decreased in the period 1960-1975 compared with other sectors. Also many investment projects that started in the second half of the seventies and that were aiming at adjusting transport capacity to the requirements of the economy, were reduced due to the economic crises in the country. Capital outlays, especially for inland waterways, were stopped as well as projects for the construction of high technical standard roads.

Some theoretical scenarios [Report of Economic Consulting Council, 1986] suggest that capital outlays for transport will remain low until the mid 1990's. Hence the hopes for balancing the capacity of transport system with needs for transport services are still poor, and thus all logistic flows and logistic channels have to function within these tight constraints.

The Polish system of transportation is considered to be rather a traditional one with the following modes operating: railway, automobile transport, airway, inland water navigation, sea transport, horse transport and pipelines. The general structure of shipments by different modes of transport is presented in Table 1.

The decisive role in domestic freight has been played by rail and automobile transport. The share of sea transport has also been important but only from the point of view of foreign cargo freight. The role of the remaining transport modes such as air transport, pipelines and horse transport has been relatively insignificant.[7]

One can notice a specific substitution of rail transport by automobile transport in domestic shipments. It means that the majority of cargo (according to weight) is transported by trucks (road transport) for comparatively short distances, i.e., on average 26

[7]Horse transport is used mainly for very small cargo for local purposes (short distances) and usually is performed to satisfy the needs of individual customers. About 77% of freight of Polish Airlines were carried out on international lines in regular traffic. Piping is used for crude oil (mainly imported) and for final petroleum products. There are no pipelines for bulk cargo and there are no plans to build such pipelines.

Table 1: Structure of socialized[a] cargo transport.

A. Including transit, receipts from abroad and foreign shipments

Modes of transport	% for cargo measured by metric tons		% for cargo measured by ton – kilometers	
	1975	1985	1975	1985
Railway	20.3	22.1	33.8	34.3
Automobile	76.3	73.4	8.5	10.4
Airway	0.0[b]	0.0[b]	0.0[b]	0.0 [b]
Pipelines	1.3	2.0	3.3	4.8
Horse transport	0.1	0.0 [b]	0.0 [b]	0.0 [b]
Inland water transport	0.7	0.8	0.5	0.4
Sea transport	1.3	1.7	53.9	50.1
Total	100.0	100.0	100.0	100.0

B. Only for domestic shipments[c]

Modes of transport	% for cargo measured by metric tons		% for cargo measured by ton – kilometers	
	1975	1985	1975	1985
Railway	16.5	18.4	70.4	67.5
Automobile	82.8[d]	80.8	28.4[d]	31.7
Airway	0.0[b]	0.0[b]	0.0[b]	0.0 [b]
Horse transport	0.1	0.0 [b]	0.0 [b]	0.0 [b]
Inland water transport	0.7	0.8	1.2	0.8
Sea transport	0.0[b]	-[e]	0.0[b]	-[e]
Total	100.0	100.0	100.0	100.0

[a] Socialized transport comprises the whole transport in Poland excluding private transport, having a small share in the total volume of cargo carriages.

[b] Dimensions of cargo transported by that mode are not significant for the total structure of transport.

[c] Excluding pipelines since data on domestic transport by pipelines is not available.

[d] Estimated upon the basis of the Yearbook of Transport Statistics 1981 as accurate data is not available.

[e] Non-existant carriages.

Source: Yearbooks of Transport Statistics (annually), the Main Statistic Office, Warsaw.

km, whereas rail transport conveys smaller amounts of cargo per year (mainly bulk cargo) but for longer distances.[8]

Rail transport has been totally monopolized by the Polish State Railways Company. However, road transport is more diversified and is of three main forms:

- public transport – consisting of state-owned and cooperative companies who deal exclusively with transport services for any customer;
- branch transport – specialized transport units or companies servicing only a particular group of trade or manufacturing companies;
- transport of own manufactures performed by non-transport companies.

The average distances covered were longer for public transport (82 km) than for branch transport (only 22 km) and for transport performed on own account it was even shorter. Conversely, 58% of the total weight of cargo transported was by transport of own manufactures, 33% by branch transport and only 8% by public transport companies.

Failures of the transportation system are often reported and a substantial number of these failures originate for the following reasons.

A. Road network and railway network

Despite a very high density public roads network[9] (about 380 km per 100 square km) only 60% of all roads are covered with a proper firm surface, so road standards partly influence the quality of transport services. There is also a shortage of freeways, expressways, highways, etc. which exerts some negative impact.

The railway network has been decreasing since 1980 due to the reduction of narrow-gauge lines. The network is also poorly adjusted to the spatial structure of Poland.

B. Technical standard of vehicles

The proportion of older vehicles is growing both in road and rail transport. For example, the share of trucks operating for 8-10 years doubled in the period 1980-1984 and of those operating for more than 11 years tripled. The share of wagons operating for 11–20 years accounts for 33% of all wagons and of those used for 21–30 years 25.2%. The increased volume of older vehicles is primarily caused by insufficient deliveries of trucks and wagons, in spite of the fact that railway cars, for instance, are one of Poland's export specialities.

[8]The following classes of loads had the greatest average distances of carriage within the country: potatoes 365 km, artificial fertilizers 325 km, other chemical products 338 km, hard coal 336 km and ores 336 km.

[9]Public roads are accessible for all users and constitute three quarters of all roads in Poland. Besides public roads there is a network of country roads where access is limited.

Many of the trucks in operation have a very small capacity, i.e., almost 40% of them take loads of only 2 tons or less and only 11% of trucks have capacity of 6.1–7 tons. In railway transport the share of electric diesel locomotives is growing but the number of cars is decreasing (by about 22% compared with the years 1975–1985). Coal wagons dominate in the structure of goods wagons (53%) since bulk products constitute about 40% of the total cargo shipped by rail.

C. Limits on supplies of liquid fuels

These limits are imposed on all companies but they affect the specialized transport companies particularly badly. It also accounts for the comparatively short distance of cargo transfer performed by transport of own manufactures by non-transport companies.

All transportation needs significantly exceed the capacity of all of the types of transport available, but still insufficient attention has been paid to the correct organization of combined transport and its operation. Transport has been performed regularly by one state-owned forwarding company for domestic shipments of goods which coordinates freight within Poland.[10] The company also has a very important task in organizing regular truck communications. This means that drivers of all trucks with no cargo destined for them are obliged to contact the appropriate regional agencies in order to obtain a load. This limits empty truck journeys.

Several small forwarding companies also function and these are transport and forwarding co-operatives and branch specialized forwarding companies. Forwarding companies for domestic freight mainly combine rail and road transport.

Due to the unfavourable circumstances described above, the majority of which could not be overcome easily at least in a short run, attempts should be made to replace the shortage of transport capacity by more efficient utilization of the current transport facilities. The scale of potential improvements in the logistic chain in the field of transport might be expressed by the following indicators:

- The share of idle runs of rail wagons as a percentage of total runs amounts to some 30.7%; in road transport it is some 31.2%.
- The comparison of the average transfer speed of 1 ton of cargo in 1985 (i.e., about 78 km per day) with the average technical speed of a goods train in the same year (i.e., about 40 km per hour) shows poor utilization of a wagon runs and long stop-overs in places of loading, unloading and reloading, as well as at intermediate railway stations.

The level of mechanization of loading activities computed as a ratio of loading activities performed by mechanized equipment for cargo handling to the total volume of loading activities rose from 80.1% in 1975 to 91.5% in 1985 excluding sea ports where the level reached 100% in 1982. The full mechanization of reloading activities is not possible at all in rail transport due to the traditional system of conveying goods. Freight in containers

[10]There are five forwarding companies for foreign goods. They cooperate closely with the forwarding companies for domestic shipments.

constituted only 0.3% of the total amount of freight in 1975, in 1980 - 0.2% and in 1985 - 0.5%. The share for shipments by sea is 5.5%.

This survey on transport systems in Poland allows us to conclude that transportation still does not properly support the supply and distribution of goods. However, one must admit that a portion of demand for transport services is exaggerated and results from certain anomalies within distribution patterns. Hence the problems of poor quality transport services seems not to be solved merely within that sector.

1.3 Distribution Channels and Patterns

The system of distribution of production in Poland has a significant feature: the share of raw materials, materials and energy prevails in the total value of turnover of production. The share of turnover value of machinery and equipment dropped from 11% in 1975 to 5% in 1985.[11]

The limits put on the flows of products is presented in Figure 2.

In Poland there are the following forms of physical flow of goods from their producers (or from foreign trade companies importing goods) to consumers/users:

A.) A direct flow of goods when there is no intermediary between a producer and a consumer/user.

B.) Indirect flow of goods occurring in the form of:

- organized transit when an intermediary company is involved between producer and consumer/user. The intermediary takes the order from a customer and places it with a producer but the contact is made and deliveries are accomplished directly between producer and customer;
- accounted transit when between producer and consumer/user, the intermediary appears who enters in his own name into separate contracts with the producer and the consumer, but deliveries are shipped directly from producer to consumer;
- warehousing, when a consumer buys goods at a trade company (i.e., warehouses, shops or other vending locations).

The structure of different forms of flows of production in Poland is presented in Figure 3.

A significant difference in the structure of the flow of products results from two main reasons. One of these is not directly connected to the logistic problems but concerns the changing structure of prices rather than physical structures of flow. The second reason is that more and more companies try to avoid any trade intermediating agency, especially in cases where so called "obligatory intermediation" (major form of rationing) has been reduced, and also when producers and trade companies are not bound by fixed agreements on the exclusivity of representation on the market.[12]

[11]Partly this was due, apart from changing prices, to considerable limits placed on capital investment.

[12]Still the range of these phenomena is not known though one can presume that it might be quite wide. The reasons for such company's behavior is described in section 1.5.

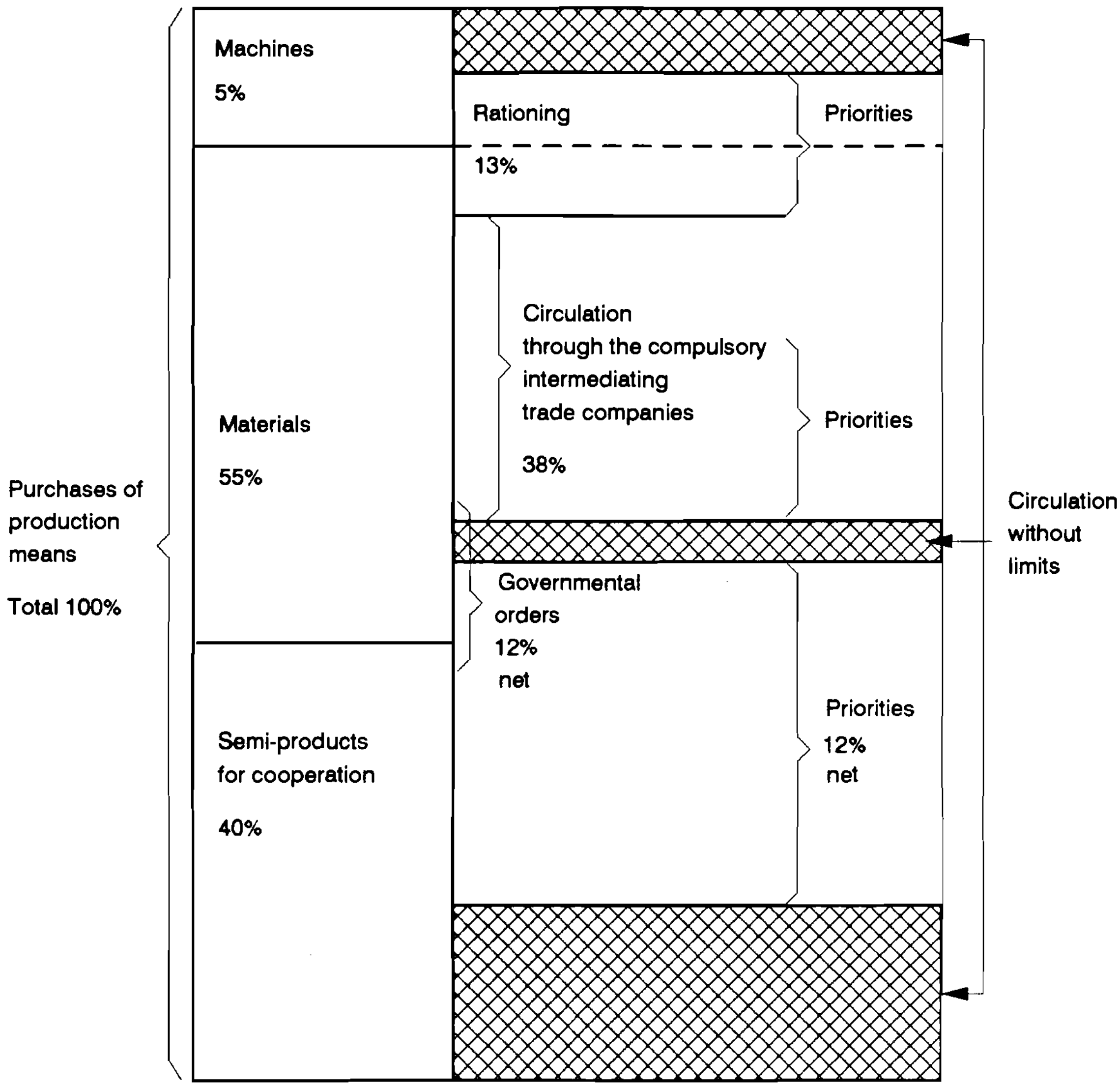
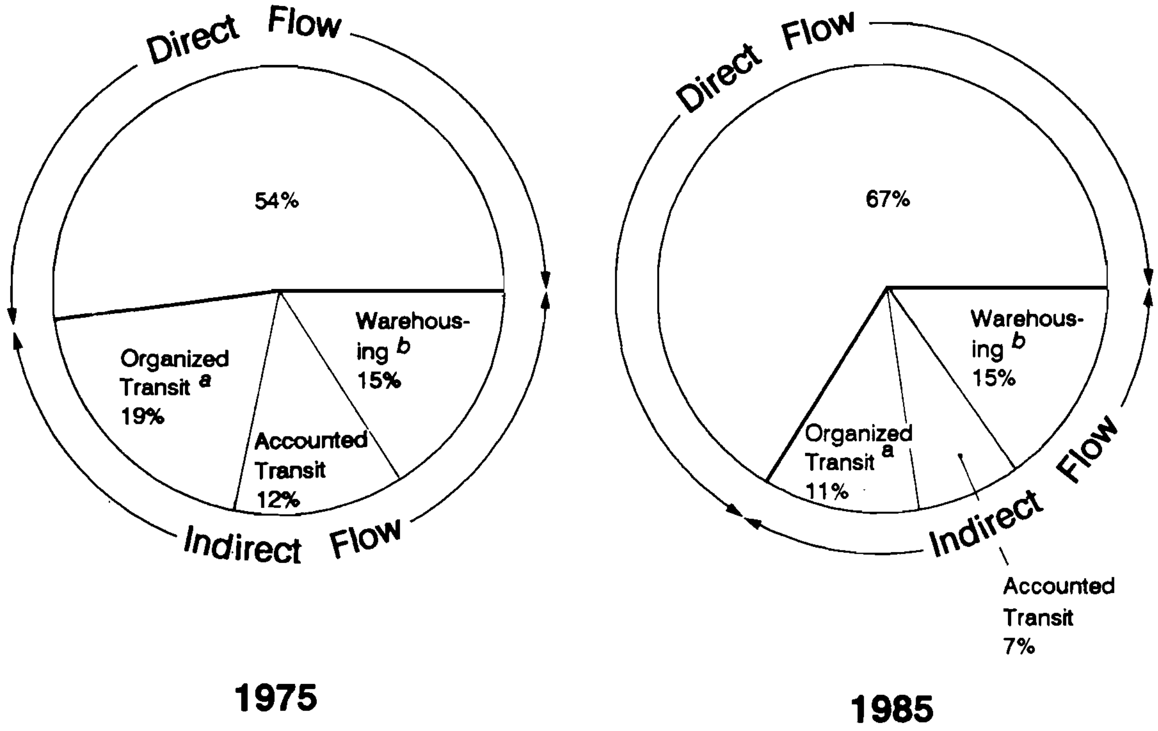


Figure 2: Scheme of limitations of free circulation of production means in Poland (1985-1986).

(Source: Wojciechowski, 1986)



a) Organized transit estimated by the Main Statistic Office on the basis of reports delivered by companies. However, its turnover value is always underestimated and is difficult to verify.

b) Warehousing includes wholesale and retail.

Figure 3: Structure of turnover value by different forms of flow of production means.

(Source: Wojchiechowski, 1988)

Still the range of the "obligatory intermediation" is significant and sometimes several "stages" of such intermediation occur. The typical features of such flows of products are as follows:

- when many intermediaries exist the circulation of documents i.e., ratios of materials, order forms, etc. is quite detached from the physical flow of goods;
- many storage stages may be gone through before products from a manufacturer reach ultimate users;
- long lead times occur, e.g. these amount to 65-95 days or sometimes even 125 days before the quarter of the year when the delivery is supposed to be accomplished; these lead times are fixed by intermediary companies and they are extremely tough;
- complicated distribution systems lead to many additional transport activities.

The question arises, will the future reduction (or even abolishment) of obligatory intermediation in trade bring about quantitative changes in the structure of flows of production? In other words – will it cause a further drop of the share of indirect turnover? It is difficult to answer this question.

Intermediating companies generally safeguard their interests very well and they make many efforts to maintain their monopoly of intermediation, even when there is no formal obligation.[13] Such processes are enforced by the lack of real competition in the field of trade intermediaries, as well as the lack of action on the part of procurement staff of the buying companies. These existing staff are used to being served by intermediary companies and are not able to take any immediate steps to arrange for other ways of supply. Many companies do not feel like changing the present status-quo based on long-lasting formal and informal contacts since this is rather convenient for them.

Economic necessity and soft budget constraints have not been strong enough to force companies to avoid additional payments for intermediation. Many managers and executives still prefer the feeling of comfort in the old system rather than face the sometimes difficult and time-consuming direct relations with the producers.

Another specific phenomenon occurring in procurement in Poland is the so called "re-circulation" of materials.[14] This means that companies re-sell materials which they bought earlier for their own processing. These multiple sales of a part of materials held are estimated [Warzecha, 1986] to raise the total value of turnover of production in Poland by 20%. The process also results in a tremendous increase in different costs items, and particularly in transportation costs. Finally, these costs raise the effective prices for manufactured goods and it is the customer who pays for this "re-circulation".

[13]Some efficient anti-monopolistic laws are expected to be passed in Poland. They aim at the liquidation of monopolies both in the production and trade spheres.

[14]Generally the reasons for "re-circulation" of goods originate from the incorrect distribution, rationing and scarcity of goods. Procurement staff of companies are thus well-accustomed with the search for necessary materials not only at producers or at proper trade companies, but first in the stores of other companies who might have bought those materials earlier for themselves but for many reasons would like to re-sell them.

1.4 Warehousing, Materials Handling and Packaging

Spatial location of warehouses and stores is quite essential from a logistics point of view since it shapes the inter-regional and intra-regional flows of goods. In Poland there is a directly proportional dependence of the location of intermediary companies (and their storage areas) upon the location of the places where goods are produced.

Many unfavourable phenomena occur in this field of spatial location, usually involving negative results for the transportation process [Academy of Economics Katowice, 1988].

Storage areas are often scattered over different districts of a single town. Such dispersion of stores in towns increases the number of idle runs of delivery cars on the routes between stores and production or trade companies. It also results in crowded streets, especially during working hours and influences the average technical speed of trucks which amounted to 33.3 kmh in 1985 [Academy of Economics Katowice, 1988]. Multiple shipments of the same goods is also an unfavourable practice.[15]

Stores located in residential areas and in the outskirts of towns often do not have any railway sidings. This causes difficult access to these stores and involves higher costs. Location of stores within residential districts is also very inconvenient for their inhabitants due to air pollution, noise, increased probability of accidents, etc.

The most numerous group consists of trade companies having at their disposal an average storage area of 10,000 square meters, an average turnover of 20 Million tons, and the average number of stocked items amounts to 6,000. The average ratio of production sold by socialized industrial companies to the overall storage area amounted to 6.9 Billion zloties per square meter in 1986 though in many regions of the country, e.g., in southern and central regions, ratio ranged from 2.0 to 14.1 Billion zloties per square meter. In those regions the largest demand for new storage space exists [Academy of Economics Katowice, 1988].

The technical level of warehouses of trade companies is far from being satisfactory. On average, in the majority of warehouses open air storage areas prevail, exceeding 60% of the total storage area [Mrozek & Glod, 1984]. Open air storage yards are most commonly situated at sea ports, construction sites, mines, railway stations and wholesale stores.

Within the stores located in buildings the share of high-storage rooms is very small. In 1985 there were only 34 high-rack storage rooms in the country and only 7 of these belonged to trade companies [Piwonii, 1985]. The capacity of these stores is varied and ranges from 1500 to 35,360 shelve seats. Industrial stores have an average height of 12.5 m and only 2 stores are higher than 20 m. The majority of high-storage rooms operate: for car producing factories and trade companies selling cars and spare parts for these; the engineering industry; electronic industry; and chemical industries.

Also few high-rack stores, two or even three times higher than high-storage rooms, could be met [(2) Fijalkowski, 1983]. High-storage and high-racking show several shortcomings in Polish conditions.

[15]For instance, lack of properly located large storage areas leads to the situation when corn is sent out of certain country regions during the time of its purchase while the same corn is brought back during wintertime.

First of all traditional packaging prevails. The use of pallets during the period 1975-1985 is very small and has not changed significantly since. In 1975 only 0.2% of goods were carried on pallets. That share did not change greatly and in 1980 amounted to 0.3% and to 0.4% in 1985 [(15) Academy of Economics Katowice, 1988].

Due to the extremely low level of loading units in warehousing there are no possibilities of full automation of materials handling. Besides these problems high-racking problems also exist, such as:

- comparatively high rates of failure of equipment for materials handling;
- high exploitation costs connected mainly with the purchase of imported spare parts, since there is no domestic production of front and side-loading forklifts;
- difficulties with the heating system for storage areas.

Altogether advanced automation and mechanization of storage processes is still a far distant hope, and therefore warehousing of goods may add significant troubles to the logistics chain. Storage space is not likely to grow rapidly neither through better utilization of existing stores nor through construction of new storage sites. Estimations [(4) Golembska, 1986] show that new investments could cover only a quarter of all requirements for increased storage areas.

In these circumstances the role of organizational change is quite essential since these changes might be a self-reinforcing source of increased efficiency of storage processes. Most of these changes should provide for better links with the transportation system in order to create smooth flows.

1.5 Logistics Costs and Efficiency

Total logistic expenditure has not been estimated precisely in Poland as yet. This has been mainly due to the lack of information and little general interest in the logistics concept. Moreover, the difficulties connected with such an estimation are multiplied by lack of adequate data on the subject.

Nevertheless, some calculations will be presented below which are rough estimates of total logistical costs broken down between inventory, storage and materials handling as well as transport. The calculation excludes the costs of packaging and data processing which means that the total logistical expenditure might be under-estimated.

The value of particular elements of logistic costs and their share in GDP is presented in Table 2, this indicates that the share of logistic costs in GDP is quite significant. The fall of that cost by 2.5 points between 1980 and 1985 could not be considered as a sign of any tendency. Still one can see that a considerable effort must be made in order to distribute goods within the economy. However, companies themselves did not estimate their logistic costs and moreover they were not even very interested in the exact efficiency of different types of procurement. Also, the constraints put on the distribution system did not encourage companies to obtain such information.

Preliminary research undertaken in 1984 [(7) Haus, 1985] has shown some interesting results indicating how – within limited possibilities of choice – manufacturers choose a

Table 2: Share of logistic costs in GDP in Poland[a] (current prices.)

Main logistic costs	Billion zloties	
	1980	1985
1. Inventories in economy[b]	215. 643	713. 782
2. Storage and materials handling[c]	120. 760	322. 353
3. Costs of transport and communication[d]	327. 008	937. 596
4. Total logistic cost	663. 411	1,973. 731
5. Value of GDP	5,657. 000	21,219. 500
6. Share of logistic costs (1 + 2 + 3) : 5	11. 8%	9. 3%

[a]) All data estimated on the basis of Yearbooks of Statistics edited by the Main Statistic Office in Warsaw.

[b]) Cost of inventories was estimated as a cost resulting from interests on bank credits for maintaining inventories plus the rate of the profits lost due to the capital tied up by inventories. In 1980 on average 40% of total inventories were financed by credit with the rate of interest amounting to 8% and in 1985 that share dropped to about 20% and the basic rate of interest rose to 12%. The rate of lost profits was estimated on the basis of the level of average rentability in a socialized industrial company which rose from 9.3% in 1980 to 13.1% in 1985.

[c]) Costs of storage and materials handling were estimated according to indicators presented by Cz. Skowronek [Skowronek, 1977]. He estimates that costs of storage and handling amount to 4% of the value of stocks and additional costs of inventory depreciation (lowering quality, costs of dislocation, etc.) constitute about 3% of their value.

[d]) These are the material and non-material costs of transport and communication companies.

Source: Author's estimations.

particular logistic channel for procurement. This is an example of at least a simple partial evaluation of logistic efficiency (presented in Table 3).

Structures of procurement are listed according to the value of their share in the total turnover of production in 1985 in Poland. Specified criteria of evaluation are not subject to any hierarchical ranking since their significance varies between different companies. The criteria include cost elements such as prices, purchasing and transportation costs, as well as elements of customer satisfaction with performed services.

The analysis of different types of procurement indicates that their logistic efficiency varies considerably. The evaluation of that efficiency is in accord with the real tendencies in the structure of the flow of production discussed in section 1.3.

2 Managerial Structures and Strategies

2.1 Organizational and Institutional Structures

Logistic functions in the economy are performed essentially on two levels, i.e.:

- by "central" bodies of state administration;
- by economic organizations (companies and their associations).

The structure is presented in Figure 4.

General functions of the "central" bodies consist of decision making on economic and legal conditions for the circulation of goods. They set the economic instruments for procurement control and prepare balances of materials. Sector and branch ministries assist the supervised companies with their procurement of materials or sales of manufactured products. In practice those ministries try to exercise administrative control over companies. These ministries are:

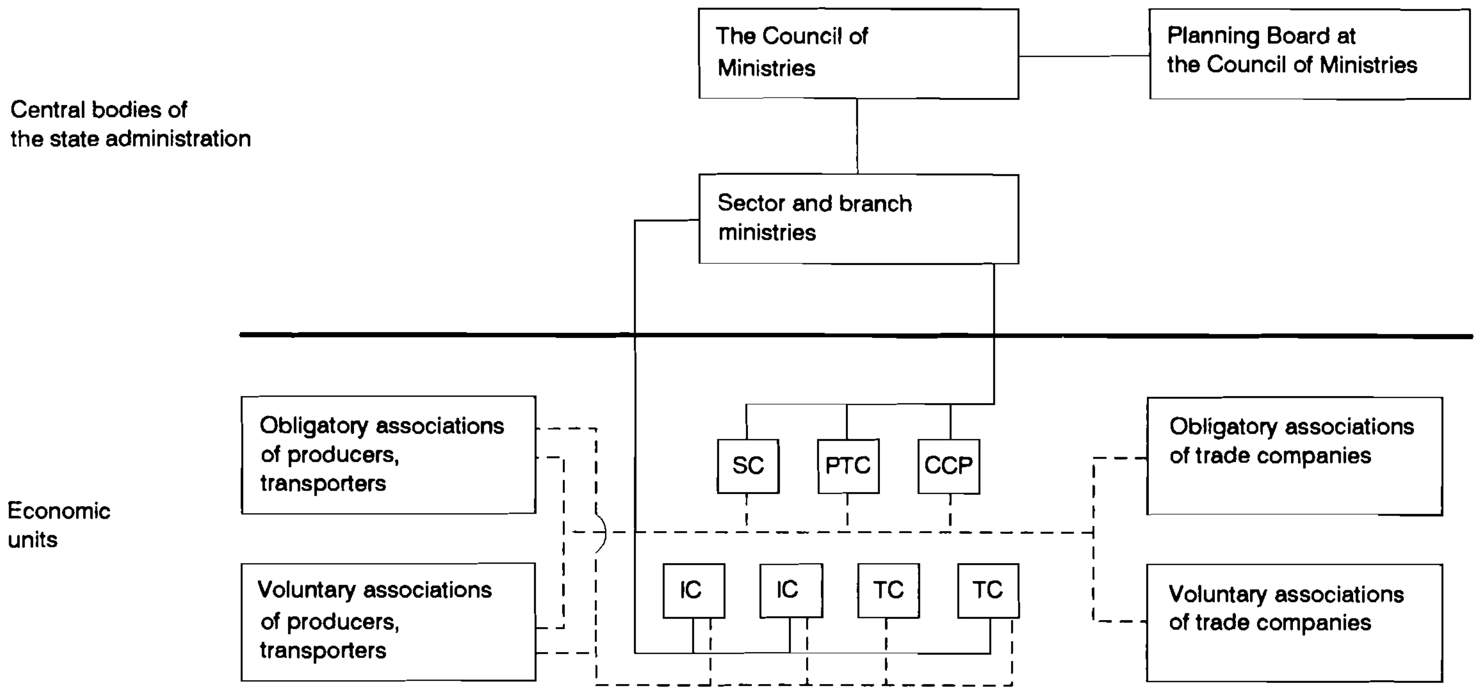
- Ministry of Domestic Trade
- Ministry of Industry
- Ministry of Spatial Economy and Construction
- Ministry of Transport, Water Navigation and Communication
- Ministry of Agriculture, Forestry and Food
- Ministry of Foreign Markets and Sea Navigation.

The financial system for companies, tax system, rules of price setting, etc. have been established by the Ministry of Finance and their decisions greatly influence logistic operations of all companies. The impact of the central and other functioning banks is exerted by credit policies and control of financial conditions of companies.

Table 3: The effects of different forms of procurement for costumers

Form of Procurement	Price+purchasing costs	Transport costs	Safety of quantity in deliveries	Cost of single deliveries	Promptnes of deliveries	Lead times	Safety of emergency deliveries	Quality of deliveries	Total effects
1. Direct purchases from producers	low +	average 0	high +	low +	high +	short +	high +	high +	high +7
2. Purchases by own company of centralized procurement	average 0	high -	high +	low +	high +	short +	high +	average 0	high +4
3. Warehousing	average 0	high -	average 0	low +	average 0	short +	average 0	average 0	average +1
4. Organized transit	average 0	average 0	low -	high -	low -	average 0	low -	low -	low -5
5. Accounted transit	high -	average 0	low -	high -	low -	long -	low -	low -	low -7

(Source: [7])



SC = Sales companies
PTC = Procurement trade companies
CCP = Companies of centralized procurement
IE = Industrial companies
TE = Transport companies
—— = Organizational links
- - - = Links with associations

Figure 4: Structure of organizations participating in circulation of production means.

Participation of so many institutions for decision making in logistics means that the process is decentralized. None of those institutions could actually coordinate logistic activities unless it is specially authorized to do so.

The second level of organizational structure for goods distribution consists of:

- industrial companies and their associations;
- transport companies and their associations, functioning as independent specialized units dealing with cargo freights;
- separate trade companies and organizations supervising these companies.

Trade companies occupy a special position as they influence logistic flows. One can divide them into three essential groups:

- sales companies (e.g. sales offices, central sales offices, selling companies, etc.) whose main function is to organize sales of products manufactured by domestic producers;
- wholesale trade companies whose main function is to play the role of wholesaler, selling production to a wide range of customers;
- companies of centralized procurement whose main function is to organize the procurement process of strictly limited groups of customers.

This classification is to some extent theoretical as many trade companies perform in practice more than one type of functions. The reason is that many companies were forced to offer new services for customers in order to maintain the same share of the market. Hence one can meet companies dealing with sales of certain goods and simultaneously organizing procurement for the producers of these goods. Some companies try to organize both wholesale and retail sales.

In practice trade companies commit errors in their operation:

- detailed market analysis is limited and sometimes completely forgotten, since it is comparatively easy to sell products in an economy which is dominated by shortage of supply.
- commercial and technical services performed by these companies has undergone some reduction and their range is very limited.

The organizational structure in trade of products changed in the period 1975-1985, mainly due to changes in management resulting from the economic reform (see Table 4).

One can observe the following phenomena:

- the transformation of central unions of wholesale trade companies into associations of companies with greater autonomy.

Table 4: Changes of the structure of trade companies dealing with the means of production

Types of companies	Number of companies in the years	
	1980-1981	1985-1986
1. Intermediaries - organizing sales	35	31
2. Wholesaling companies	146	154
3. Intermediaries - organizing procurement	106	145

(Source: [19] and [9])

- a tendency for increasing the number of intermediary companies and especially companies organizing procurement for certain groups of buyers.

Logistic flows also include the basic links of the Polish economy, i.e., industrial companies. In the majority of Polish companies different logistic functions are performed by separate sections or departments. Hence, their structure is the traditional one with materials management playing the dominant role. However, the type of organization and place of materials management in the whole structure of a company are quite varied. Thus it is very difficult to find even two completely identical companies.

Materials management is usually divided into two essential functional departments:

- purchasing (or procurement) department which is an extremely important unit in a supply shortage economy, though its role is often underestimated;
- materials economy department, existing only in some companies and dealing with efficient utilization of materials, control of technical standards for materials consumption in production, levels of inventories, etc.

The purchasing department usually consists of several sections dealing with different groups of purchased products. The department too often manages storage processes. Purchasing is usually supervised by a sales and purchasing director (also called "trade" director) in larger companies. In smaller firms where such roles do not exist, that department is usually within the scope of activities of the director responsible for economic efficiency of a company. That director as a rule supervises also a department for materials economy, where they exist.

The organization of materials management is formally and strictly separated from:

- a sector of technical activities (technical documentation for production, management of fixed assets, energy department, tooling department, etc.);
- production activities (manufacturing, quality control, etc.).

That separation occurs in spite of the fact that all these activities are closely interconnected with one another. Particularly strong ties between materials management (especially procurement staff) and departments for design of products and production technology are desirable.

Materials management do not normally have close ties with sales departments since the latter usually perform formal and administrative services for sales, using marketing rather seldomly, with limited market research, etc. This is due to the fact that usually there is a queue of buyers waiting for products and the department of sales faces only the problem which customer should be served first.

Work-in-progress inventories and flows of materials during manufacturing are the responsibilities of the production department and director (technical director).

In many companies separate transport divisions have been organized, which are responsible for internal and external transport. They may operate with own transportation means or they may also hire services from specialized transport companies. Those transport divisions face all the major problems discussed in section 1.2. on transportation systems.

As formal organization structures are not adjusted to integrated logistic functions, frequently many informal links appear. No one calls them "logistic links" but they have this character. There is a considerable need for integration of the whole sphere of the flow of material through a company where, for example, it emerges that in large companies thousands of parts materials, and components enter and flow through the plant.

More profound organization structural analysis focused on relations between materials management, sales and transportation can hardly ever be met either in research reports or in practical surveys.[16]

2.2 Economic Regulation of Logistics Activity

Various activities connected to logistics are primarily regulated by different methods of stock and procurement control. These methods are aimed at:

- improvement of stock levels
- adjustment of the structure of inventories to meet real production requirements
- reduction of excessive stocks
- maintaining smooth procurement according to the current needs of different companies.

[16]The same concerns the analysis of staff at different departments of companies or sectors of the economy involved in logistics. Some very dated research performed by the State Board of Materials Management in 1974 showed that the staff for materials management (without storage) amounted to 4.5% of the total number of employees in the 15 branches of industry subject to examination.

Regulation on the macro-level

Direct control has been based on the following instruments:

a) balances of materials prepared by:

   - the "Central Bodies"; these do not impose any obligations and rather they serve the purpose of current information on the terms of supplies and desired directions of utilization of materials;
   - trade companies; these balances become operative tools of trade companies functioning. They balance and fix strict commitments only in cases prepared by an obligatory intermediatory company and serve the purpose of rationing or allocating supplies:

b) different forms of materials rationing such as: administrative distribution of products, limits of fuels and energy consumption, obligatory trade intermediation;

c) stock planning mainly in the form of macro-economic standards indicating the highest possible level of stocks of materials quarterly at all customers in the socialized economy;

d) procurement priorities such as: guaranteed procurement, priority deliveries, priority of orders, etc.

These instruments have been used for many years, however, the details of the system were not stable. It appeared quite soon that such direct control was not efficient at all and it could not completely replace the market. As a matter of fact all those direct instruments were to a greater or lesser degree, the hidden forms of administrative rationing of products. However, imbalanced markets and shortages appeared to be more influencial regulators of inventories and procurement, while obligatory intermediation, stock standards, etc added only extreme formality and a bureaucratic style to managerial strategies.[17]

During recent years more attention has been paid to *indirect* procurement and stock control based on regulations and parameters influencing companies behaviour. In other words—certain impulses for companies must exist which would stream all performance of companies in a proper direction including materials management. These impulses could concern motivation (through incentives) or supplies (connected e.g. with stock financing).

The general tendency of the present government is to base the economy on market forces. It means a withdrawal of all types of rationing of goods, systems of priorities, special grants, etc. Therefore the role of central control also becomes different. Instead of rationing and the allocation of means of production the "Central" bodies will concentrate on problems of overall strategy, identification of development priorities and on creation of conditions suitable for efficient operation of all companies. Economic regulations will be identicalal for all sectors and branches of the economy (also for private and socialized sectors). Thus the main role of a company is to "earn money" and a good director should ensure a proper level of rentability, efficient performance not only in the short run but

[17]The achievement of full consistency between granted ratios and requirements for products is impossible even from a theoretic point of view. There are no ideal methods for efficient rationing and always lesser or greater errors will occur.

primarily over a longer time period. At the same time all economic regulations must be strictly observed.[18]

Still the process of the abolition of rationing is at its initial stage. It seems that the central level and the companies are fully prepared for these, but there are trade companies and central offices of company associations who defend the traditional system. For them it is much easier "to administrate" the circulation of goods than "to manage" the flow of goods.

Regulation on the micro-level

The most important elements of logistic regulation at the company level, consists of internal stock control.

A variety of stock control methods can be used but *statistical methods* are the most frequent ones. Mainly the simplicity of these methods establishes their common use since they fix certain stock standards on the basis of delivery lead time, delivery lot, rate of consumption and a certain level of safety stock. Methods of control based on *optimal stock levels* (i.e., inventory models) are used very rarely. Presently there are only few verified examples of its utilization in Poland.

Dynamic (operative) stock control means such restrictions of deliveries that they could cover current material requirements of production and at the same time minimum stock levels would be maintained. These methods are also rarely used in Poland.

MRP-systems are being installed in a few companies but the process is at the very initial stage and there is no body experience in this area. At this early stage, the majority of recognized difficulties concerns unrealistic production plans, planning horizon, planning periods and the scope of implementation of MRP. As the lead-times for almost all materials are very long (half a year or more) usually all materials purchased must be excluded from MRP, therefore it can very seldom be used as a tool for control of materials inventory.

Still the knowledge about MRP among the staff of manufacturing or trade companies is extremely limited. Those few people who know about it usually do not see any necessity nor possibility to use MRP in their own factories.

The activities connected to operating stock control are thus based mainly on traditional methods. One reason for this may be that difficult conditions of procurement do not enhance companies to use advanced methods of stock control based on computer networks and enabling to plan "just-in-time" deliveries.

2.3 Information Technologies

Increased efficiency of the material flow requires a proper system of information which is an integral part of the logistic system.

[18]Opinions presented by members of the Polish government at the meeting with numerous representative groups of general managers and reported by [(11) Misiak, 1989].

In 1975 there were 391 systems of automated materials management[19] in Poland. In 1977 the number of these systems increased to 624 and there was a tendency for further growth (present numbers of automated materials management systems cannot be specified because there is no central record of them).

The most numerous group consists of information systems for materials management, while industrial companies are the main users of these systems. The applications of Electronic Data Processing (EDP) in the area of materials management constitutes about 80% of all applications for management in industry. For instance in 1984 all ironworks and steel plants had operating informatic systems for materials management.

The majority of information systems in industrial companies were based on the batch technology of data processing. Such systems that use data bases are still fairly rare and they are used essentially in large enterprises which are the leaders of informatics applications. Commonly the systems used do not have a complex structure as they comprise only certain fields of materials management and most frequently, structures and volumes of materials turnover and planning of demand for materials. These systems do not perform regulatory functions which enable efficient control of procurement.

Computer applications for management in the sphere of trade are about five times lower than in the sphere of production. For instance, only 10% of wholesale trade companies employed informatics in their activities. Quite often operating systems are just an attempt to use a computer for solving partial, simple and not always the most important tasks and problems [(6) Grzyb, 1979]. However, those companies who have already adopted modern EDP for materials management benefit from better information system with increased credibility and faster access to data.

Actual EDP solutions for the transport system greatly depend on the basis created in the period 1970–1980. This was successfully coordinated by the Centre for Transport Informatics. One can mention the following characteristics of EDP implementation in transportation [(13) Wierzbicki, ed., 1984]:

- the majority of systems concern statistics and listing
- systems are installed for a single company and not for the whole group of companies
- a very limited number of systems are used for decision-making
- there is a lack of systems of inter-mode type ("combined systems" for different transport modes integrated in one EDP system)
- large deconcentration of computing capacities in the railway and road transport industries
- a lack of modern methods of computer communication.

The hitherto development of information systems in different areas of logistics shows many negative phenomena, namely:

[19]That term is used essentially for automated data processing for purposes of materials management. It comprises very simple systems as well as more complex ones.

- the introduction of new information systems to old organizational forms of management which are usually too complicated and not integrated
- inadequate development of programming
- insufficient unification and standardization of hardware and software which has resulted in an extreme variety of types (lack of compatability)
- little coordination of informatic applications in the country and a lack of cooperation between different branch systems, different companies and organization units
- insufficient level of development and usage of micro-computer systems
- poor "computer consciousness" of staff and irrational attitudes towards introduction of informatic systems.

The development of computer networks is also retarded by poor technical standards of the telephone network in the country. The level of automation of telephone links amounted only to 67% in 1985 with the absolute number of 113 telephones per 1000 inhabitants in the same year (in the countrysidee there were only 38 telephones per 1000 inhabitants). Usually all companies operate their own telexes while telefax services are quite recent and a comparatively rare phenomena.

The general conclusion should be that it is not the lack of hardware that limits a wider use of EDP in materials management, trade and transportation. This is caused rather by insufficient software and lack of management training.

3 Conclusions

Logistics is not a common term used in Poland nor the knowledge on logistic structures and strategies. Hence it is worth underlining that this report—according to the knowledge of its author—is a unique elaboration of this kind in Poland [(15) Academy of Economics, Katowice].

All the elements of logistics such as: distribution, transportation, inventories, warehousing, information systems have been subject to detailed research before but they have never been analysed within an integrated logistic framework. Therefore many research projects going on at different research institutes, universities, etc. might be quite well advanced in those separate fields of logistic activities but probably they will lack the coherent logistic approach. Hence this report could serve as a point of departure for further research on macro logistic problems in Poland.

The need for an integrated approach to the flow of goods becomes self-evident in Poland and, especially because of the fact that the actual logistic system, is not very efficient. It results from a general absence of explicit drive for efficient management and efficient company performance. The philosophy of management observed in many companies proves that profit or return on investments hardly become operational goals of an individual firm.

Economic practice established throughout the period of implementation of economic reform finally resulted in the limited role of profit for the survival of a company. It is mainly due to the market being constantly destabilized and the inflation connected to that, both bringing about a high probability of companies obtaining excessive, unjustified, financial resources further strengthening inflationary tendencies. On the other hand fiscal pressure tends "to put limits" on maximum company revenues, interfering with their autonomy and self-financing.

Such logic also influences the logistic system and its performance, together with all existing resource constraints (materials, fixed capital, manpower). Therefore the main problem now is to obtain the maximum output from the given volume of inputs (which it is possible to put on the market). That general idea could be understood directly as a technical project dealing with new designs of products or new waste reducing production technologies, but it could also be expressed as meaning all companies are aiming at better synchronization of supply, production and distribution.

The primary goal of logistic systems in Poland is to secure precise procurement of all economic units and institutions with only a little regard to the costs of that procurement. Hence the natural aim of logistics system in Poland is to deliver a given quantity of products (with respect to their quality as well) to customers, at the time they require them. The overall cost of this process is less significant (though not completely unimportant).

In these circumstances stocks play a role of "shock absorbers" when deliveries lack their promptness or quality. Inventory expenditures are the "normal" element of costs calculation and they are also included in the price of finished goods. That price is easily passed on to consumers since the average demand for goods is rather large.

Thus the direct link between the level of inventories and the performance of transport systems is not very important from the macro-economic point of view since there are many other very important factors which influence the level of inventories in the Polish economy. In that respect the system of trade of production is more essential. The direct interdependencies of transportation and stocks should be the subject for consideration at the level of a single company or a group of companies (that is – at the micro-level).

Therefore the development of new logistic technologies does not consist only of the improvement of transport and storage systems, and techniques. Neither could it be identified with a better information system alone. There must be parallel research efforts dealing with logistic flow in Poland. It should concentrate on two main issues:

- research in the area of inter-dependencies between companies
- investigation of production processes with respect to better management of materials flow but from the point of view of logistics principles.

These issues are crucial for dealing with the problem of integrated material flow not only in shortage of supply economies. Still they have not been considered very seriously though the interest in logistics is slowly growing.

True logistic channels cannot operate beyond conditions set by manufacturing processes. There is an essential feedback—optimal logistic performance of a company (and the whole economy) depends on its production abilities to achieve logistic goals. At the same time the criteria chosen for positive evaluation of logistic activities of a company should determine the design of the manufacturing process. For that reason the trade-off between logistics and production costs in Polish companies must be more accurately described and that requires detailed research, especially with reference to Flexible Manufacturing Systems, Computer Integrated Manufacturing, general mechanization and automation of production processes, etc.

On the other hand, all links and requirements for integration between distribution systems and manufacturing should be investigated to detail. Better knowledge is required of the different functioning of logistic channels; and conditions for their efficient operation. Perhaps these are the best recognized group of problems though still it would be essential to more closely merge research in the area of distribution processes with that in transport problems.

It is also necessary to develop an adequate information flow for logistics purposes so that it would support the overall performance with better utilization of computer capacities, and better software for logistic flows. However, these computer-based systems cannot be a cure for poor performance of a company since these systems are only the efficient technique of linking information concerning production, sales and deliveries. Hence the whole sphere of macro- and micro-economic control of logistics must be taken to account since presently logistics and particularly stocks and costs of transportation do run out of control. It must be clearly understood that a sophisticated computer-based system is in no way a guarantee for improved logistic performance.

Finally, one must note that the potential impact of new logistic technologies on economic practice depends largely on peoples' attitudes and knowledge of these concepts, their understanding and creative acceptance. Perhaps this would be the major obstacle – behavioural inertia. The wider information on logistic management could perhaps overcome that barrier and once managers realize how much looseness of various kinds exists at their plants they would try to reduce it in the most efficient manner.

Logistic concepts have proved to be successful and many companies in the West are quite experienced in their implementation and operation. It might be worthwhile to use their experience of how to handle these problems so that it would be easier to understand all conditions for success or failure of these ideas, both in capitalist and socialist countries.

References

(1) Duszek D. (1986). Wplyw systemu zaopatrzenia materialowo – technicznego na gospodarke zapasami w przedsiebiorstwie. "Gospodarka Matrialowa" 11.

(2) Fijalkowski J. (1983). Projektowanie magazynów wysokoregalowych, Arkady, Warsaw.

(3) Fronczak K. (1988). Kolej na kolej. "Zycie Gospodarcze" 48.

(4) Golembska E. (1986). Przestrzenne rozmieszczenie jednostek obrotu materialowego a ich funkcjonowanie. "Gospodarka Matrialowa" 21-22.

(5) Gospodarka w latach 1981 - 1985. Report of the Economic Consulting Council, Warsaw 1986.

(6) Grzyb St. (1979). Zastosowanie elektronicznej techniki obliczeniowej dla zarzadzania jednostka obrotu. Paper presented at the conference on "Organization of performance and methods of operation of trade companies as the condition for proper inventory managment". Scientific Society of Organization and Management, Warsaw.

(7) Haus B. (1985). Wplyw systemu zaopatrzenia na efektywność gospodarowania materialami u odbiorców. "Gospodarka Materialowa" 9.

(8) Kornai J. (1980). Economy of Shortage. Volume A and B. North Holland, Amsterdam.

(9) List (1987) prepared for the Board of Revision and Modernization of Organizational Structures, Warsaw.

(10) Matwiejczuk J. (1986). Instrumenty racjonalnego ksztaltowania zapasów w przedsiebiorstwie. "Gospodarka Materialowa" 15-16.

(11) Misiak M. (1989). Praktyka - intencje. "Zycie Gospodarcze" 7.

(12) Mrozek J., Glód T. (1984). Przeslanki prognozowania rozwoju bazy magazynowej na tle obrotu i jego struktury przestrzenno – rzeczowej. Center of Materials Management, Warsaw.

(13) Wierzbicki T. (editor) (1984). Podstawy informatyki w transporcie, Warsaw.

(14) Piwonii T. (1985). Charakterystyka magazynów wysokiego skladowania. "Problemy Magazynowania i Transportu" 1.

(15) Report on New Logistic Technologies in Poland (1988). Study prepared for the International Institute for Applied Systems Analysis. Academy of Economics, Katowice.

(16) Statistical Yearbook 1982. The Main Statistic Office, Warsaw.

(17) Statistical Yearbook 1985. The Main Statistic Office, Warsaw.

(18) Warzecha B. (1986). System kompensacy jnego wtórnego obrotu środkami produkcji. "Gospodarka Materialowa" 8.

(19) Wojciechowski T. (1983). Handel w systemie zaopatrzenia materialowo – technicznego. PWE, Warsaw.

(20) Wojciechowski T. (1988). Zmiany strukturalne w handlu zaopatrzeniowym w latach 1975 - 1985. "Gospodarka Matrialowa" 1.

(21) Yearbook of INdustrial Statistics 1986. The Main Statistic Office, Warsaw.

(22) Wojciechowski T. (1986). Reglamentacja materialów. Przyczyny, skutki i mozliwości ograniczenia. "Gospodarka Planowa" 10.

(23) Skowronek Cz. (1977). Sterowanie zapasami produkcy jnymi. PWE, Warsaw.

(24) Canowiecki Z. (1985). Wybrane problemy terytorialnej organizacji obrotu stala. "Gospodarka Materialowa" 11.

Logistics in Yugoslavia

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I. PHYSICAL LOGISTICS STRUCTURES

I.1. INVENTORIES IN THE NATIONAL ECONOMY

For the evaluation of the Yougoslav level of economic logistic we can use the facts on stock growth and compare those values in relation to the social product value (table 1).

TABLE 1 - A review of the increase of stocks as a part of social product

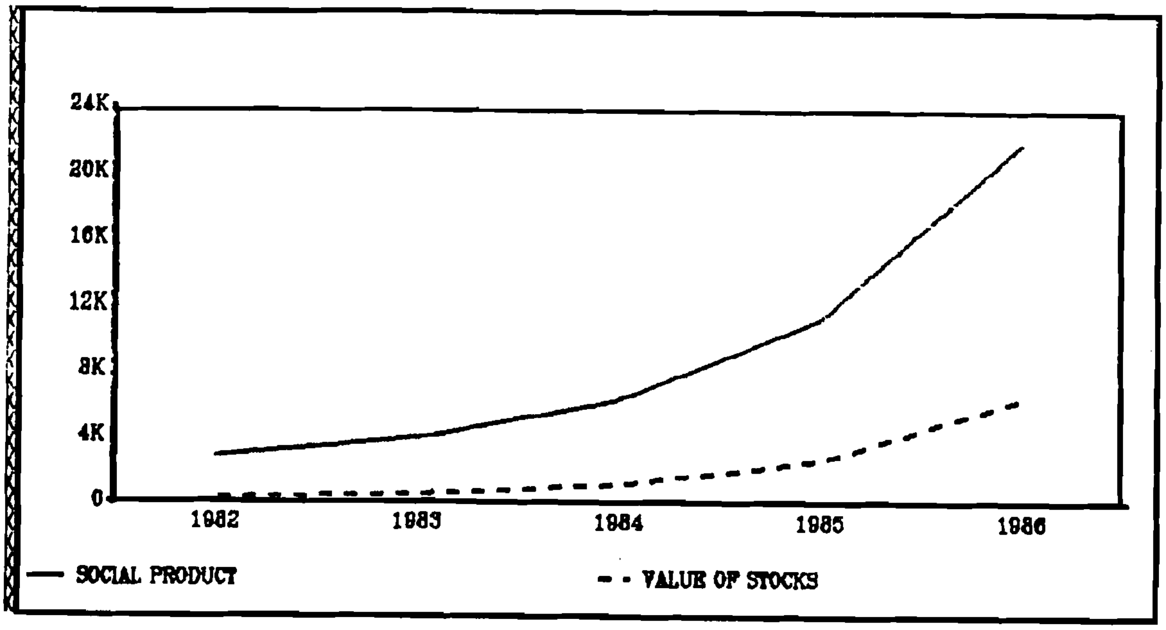
(82-86) (in billions of dinars)

YEAR	SOCIAL PRODUCT	VALUE OF STOCKS	INCREASE OF STOCKS
1982	2925	373	12,75
1983	4064	631	15,53
1984	6325	1145	18,10
1985	11285	2609	23,12
1986	22054	6396	29,10

From these facts we notice a high percentage of stock which indicates a high participation of bound capital in stocks. A constant growth of stock increase costs is obvious in relation to the social product value.

The so called stock financing which was defined in legislation is calculated by the principle of interest on working capital which is defined by the Social Accountancy of Yugoslavia.

Graphic 1 - The participation of stock increase value
10^9 dinnars in the social product value

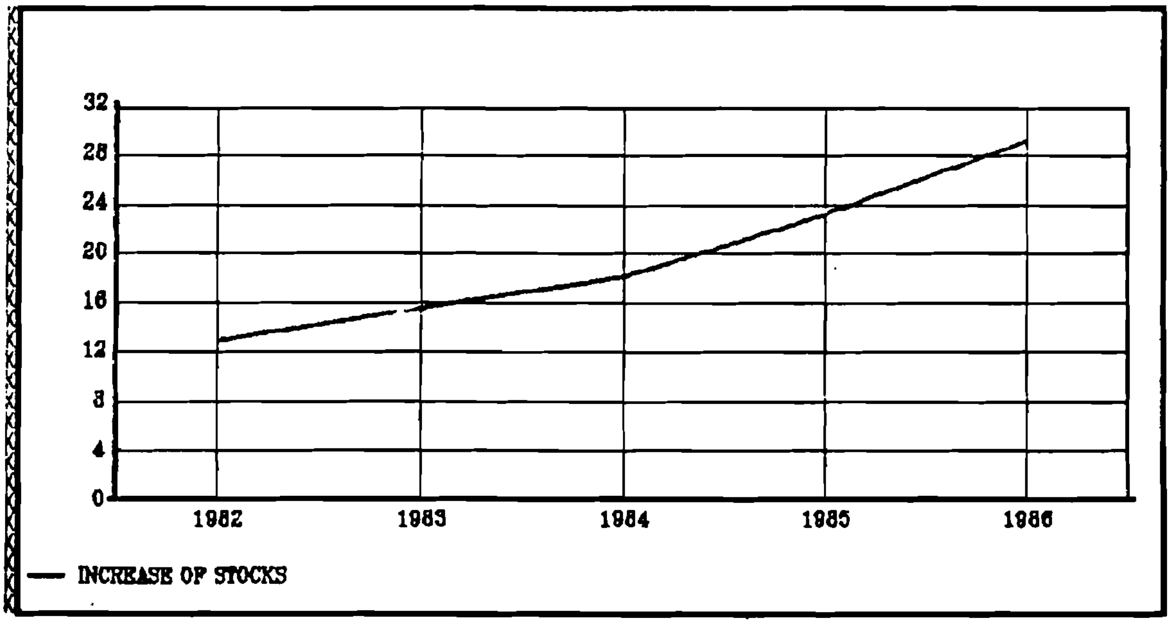


This interest consists of so called "bank interest" which remains unchanged during the whole year and an additional revalorization interes which was defined every three months up until the end of 1987, and from 1988 monthly; according to the Statistics of the National bank of Yugoslavia which gave the monthly inflation rates of our country. At present bank interest is 18% with a revalorisation interes from 15-21 % (from the beginning of the year), monthly.

The coefficient of stock turnover is very low, and the fact that the proportion between the storehouse surface (m^2) and the goods turnover (t) in 1986 was 1:4 is a good illustration.

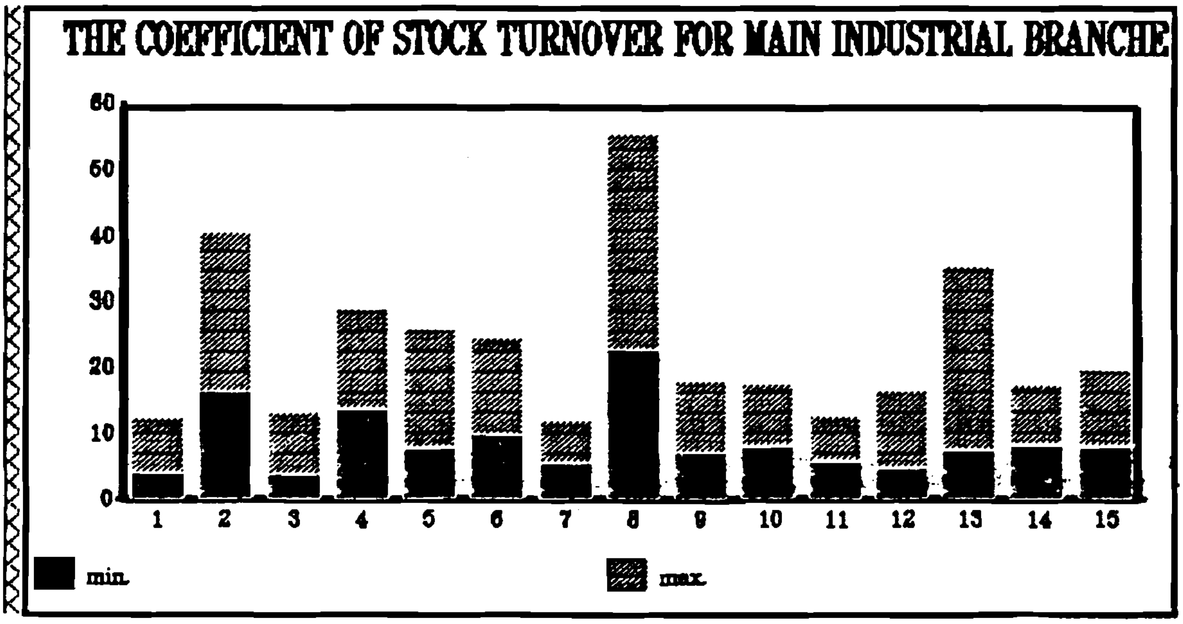
The investigation and the survey carried out in SR Slovenia in 1984 for textile, leather and rubber products, indicate the following turnover coefficients.

Graphic 2 - Percentage growth of participation of stock increase value in the social product value



The coefficient of stock turnover for main industrial branches are based on datas for all raw materials and final products in those branches, in 1987, as a result of recording in 10 areas in Yugoslavia for projects of goods transportation centers.

Graphic 3



LEGEND: 1.Coal ind.; 2.Building mat.; 3.Beverages; 4.Metal ind.; 5.Paper ind.; 6.Nonmetal products; 7.Livestock food; 8.Crude oil i.; 9.Rubber ind.; 10.Textile ind.; 11.Electric industry; 12.Furniture industry; 13.Metalurgy; 14.Leather products; 15.other products;

I.2. TRANSPORTATION SYSTEMS

Traffic in Yugoslavia takes part in:

- about 20% of basic funds in a social economic department,
- about 8% of economic income,
- about 20% of all economic investments,
- over 15% of amortization.

Traffic in Yugoslavia fails to keep up with the same branch in developed countries considering tehnical, technological and aspect of organization. It makes difficult for Yugoslavia to include in European traffic system and international labour division. The competitive power of Yugoslav economy has decreased on the world market and it all had a negative influence on logistic system. It also makes the economic crisis deeper. Some of the recent estimations show that the transport expenses includes 20% of total value of goods production, whereas containerization takes part in only 1% of the whole transport system. The analyses of facts on the chart G shows an obvious stagnation of development of all kinds of freight traffic except air transportation.

I.2.1. TRANSPORTATION OF GOODS

I.2.1.1. BRANCHES OF LAND TRANSPORT

The facts of some current tendencies in the land transport branches will be given first as well as those of some relations between the branches (this survey includes pipelines).

TABLE 2 - Goods Transport Volume

TRAFFIC BRANCH	1975.	1980.	1984.	1985.
Railway				
Transported tons	77.730	84.970	89.558	89.498
Loading	61.701	68.265	74.087	73.229
- Domestic transport	58.015	62.102	65.923	65.783
- Export	3.686	6.164	8.775	7.516
Import	8.600	10.002	10.009	8.783
Transit	7.429	6.603	7.484	7.416
Achieved NTKM	21.638	25.018	28.854	28.216
- Domestic transport	14.214	16.870	18.753	18.788
- International transport	7.424	8.148	10.101	9.428
Highway traffic				
Transported tons	130.133	201.556	175.532	171.386
Domestic transport	127.910	198.891	170.125	166.930
International transport	2.223	2.665		4.456
Tons km	12.282	18.997	19.887	21.209
- Domestic transport	10.928	17.349	17.154	18.323
- International transport	1.354	1.658	2.733	2.886
River traffic				
Transported tons	21.387	25.990	20.916	19.200
- Domestic transport	17.674	23.246	18.783	17.010
- International transport	3.713	2.744	2.133	2.190
Tons km	5.461	4.975	4.088	4.153
- Domestic transport	1.996	2.519	2.008	2.008
- International transport	3.465	2.456	2.080	2.145
Pipeline*				
Tons (in 000)	1.320	6.302	6.267	6.278
- Domestic	1.320	1.194	959	...
- Import	-	4.855	5.308	...
- transit	-	254	-	-
Tons km	109	2.159	2.493	2.504
- Domestic	109	83	56	...
- Import	-	2.053	2.437	...
- Transit	-	73	-	-

*** Pipeline transport presented here is competative to other forms of land transport. Until 1980. when international transport was organized, only domestic transport existed.**

I.2.1.1.1. Railway traffic

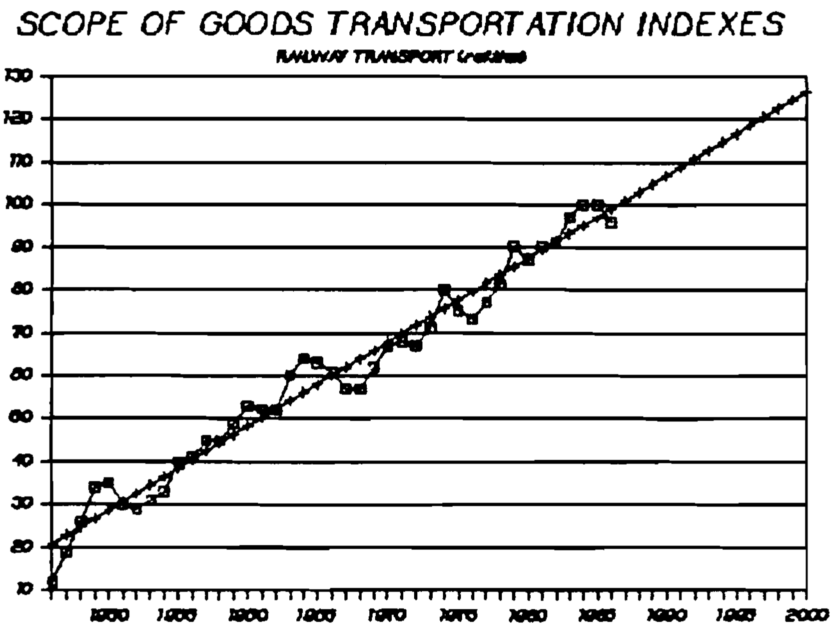
Railway traffic tendencies are presented by the average rates of increase of Transport volume for the periods 1975-1980, 1980-1985 and ten year period 1975-1985.

TABLE 3

I N D E X	1975-1980.	1980-1985.	1975-1985.
Transported tons	1,8	1,4	1,4
Loading	2,0	1,4	1,7
Domestic transport	1,4	1,2	1,3
Export	10,8	4,0	7,4
Import	3,1	-2,6	0,2
Transit	-5,8	2,3	0,0
NTKM	2,9	2,4	2,7
- domestic transport	3,5	2,2	2,9
- international transport	1,9	3,0	2,4

On graphic 4 it is shown goods transportation indexes in period 1946-1987 with linear trend till 2000 for railway. transport.

Graphic 4



I.2.1.1.2. Public Road transport

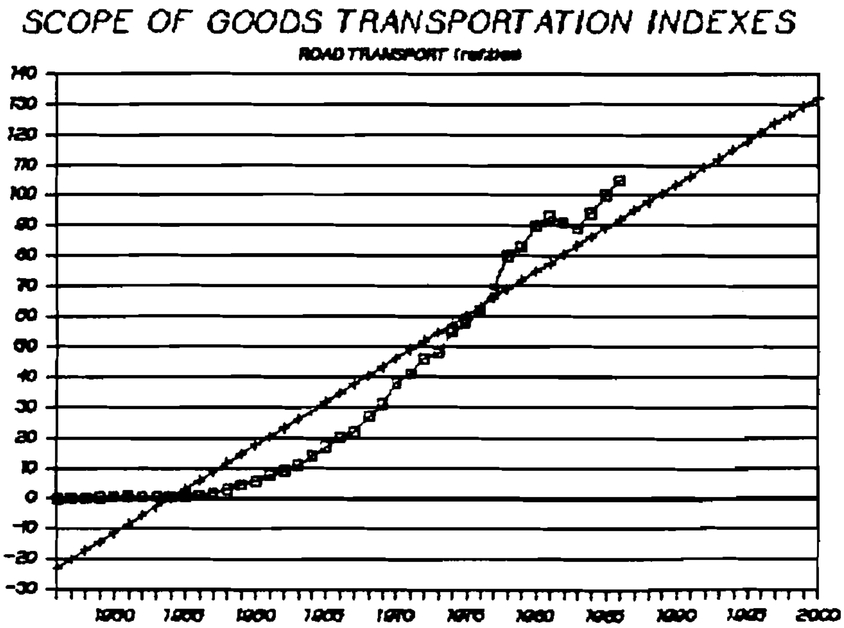
Tendencies in public road transport in this observed ten-year period are as following:

TABLE 4 - The rates of increase of the public road transport

	1975-80.	1980-85.	1975-85.
Transported tons	8,9	- 3,1	2,8
- domestic transport	9,2	- 3,4	2,7
- international transport	3,9	10,8	7,2
NTKM	9,1	2,2	6,7
- domestic transport	9,7	1,1	5,3
- international transport	4,1	11,8	7,9

On graphic 5 it is shown goods transportation indexes in period 1946-1987 with linear trend till 2000 for road transport.

Graphic 5



I.2.1.2. SEA TRANSPORT

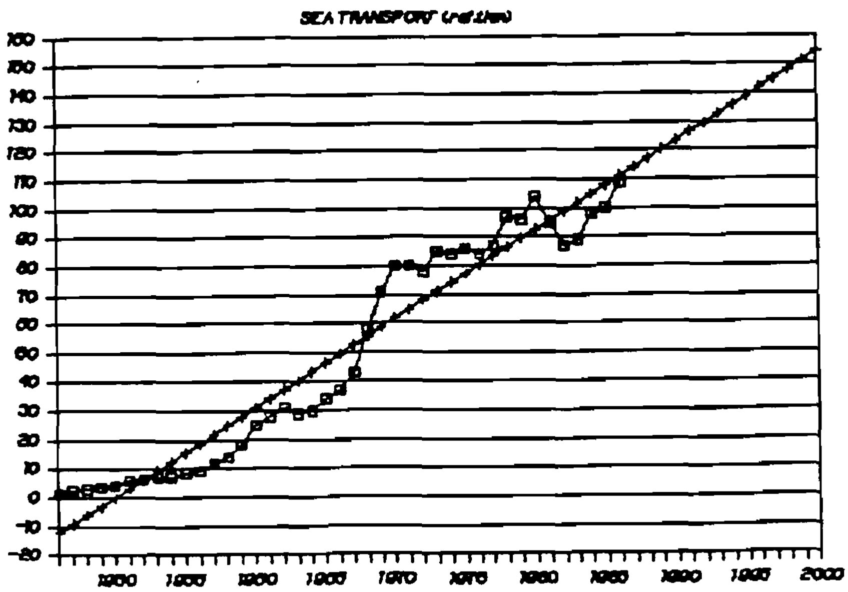
There was a further increase of transport volume from 1981 to 1985 - of 29,3 mil. tons which was 18,2% more than the volume transport in 1980 (24,7 t.mils). International transport volume was increased 22,6% but domestic transport decreased from 2,417 to 2,364 mil. tons. Total transport achieved decreased in 1985 (101.688 mil. tons) compared to 105.799 tons in 1980 (decrease 3,7%). International transport in this period decreased 3,7% and domestic transport 8,1%.

When we compare fact for the period 1975-1985 we can see that sea transport was increased from 20,3 t. mils in 1975 to 29,3 mil. tons in 1985 (or 44,4%) and domestic transport about 13,5%. Transport output was considerably bigger in this period - from 87,366 mil. tons in 1975 to 101.902 mil. tons in 1985.

On graphic 6 it is shown goods transportation indexes in period 1946-1987 with linear trend till 2000 for sea. transport.

Graphic 6

SCOPE OF GOODS TRANSPORTATION INDEXES



I.2.1.3. AIR TRANSPORT

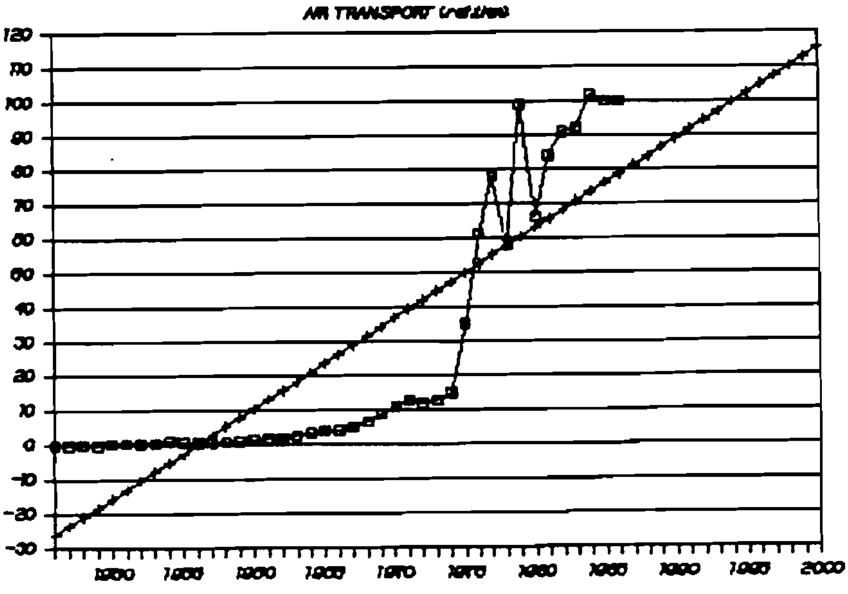
Air transport is one of the few traffic branches which show constant increase.

Air transport is continually developing although it had great difficulties in fuel supphly. Transport has increased from 32.479 tons in 1980 to 39.799 tons in 1985 (22,5%). International transport increased 20,3% and domestic transport 25,2%. Transport given in NTKM is even bigger, because the average transport route increased more: it was for 51,4% biger in 1985 composed to 1980. International transport increase was 56,7% and domestic transport 6,9%.

On graphic 7 it is shown goods transportation indexes in period 1946-1987 with linear trend till 2000 for air transport.

Graphic 7

SCOPE OF GOODS TRANSPORTATION INDEXES



I.2.1.1.3. River transportation

River transportation shows very unfavourable current tendencies. In the period 1975-1980 total among in tons had the average rate of increase 4% and the number of NTKM had the lower rate of increase of 1,8%. As the rate of increase in domestic transport is 5,6% and NTKM 4,8%, international transport had a decrease of 5,3% and 6,6% NTKM.

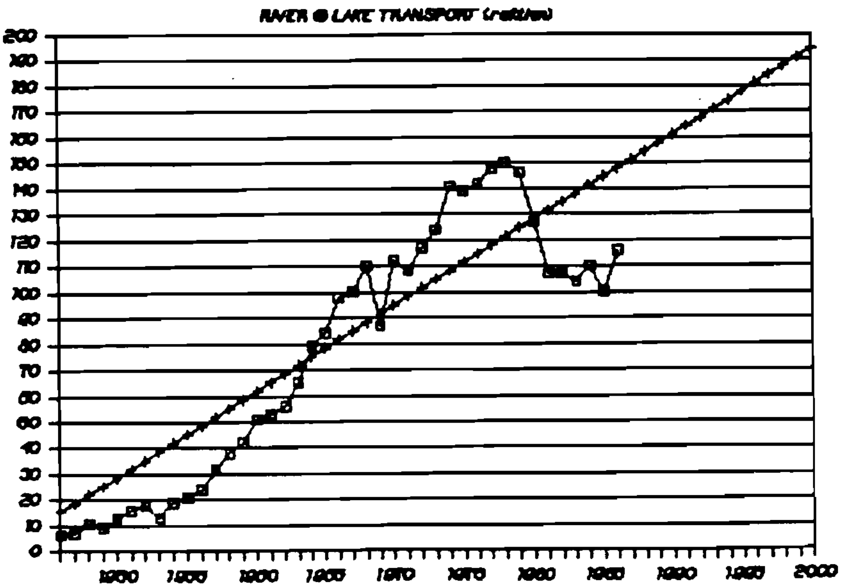
TABLE 5 - River transport rate of increase

	1975-1980.	1980-1985.	1975-1985.
Transported tons	4,0	- 5,9	- 1,1
- domestic transport	5,6	- 6,0	0,4
- international transport	- 5,9	- 4,4	- 5,I
NTKM	1,8	- 3,5	- 2,7
- domestic transport	4,8	- 4,4	0,1
- international transport	- 6,6	- 2,1	- 4,7

On graphic 8 it is shown goods transportation indexes in period 1946-1987 with linear trend till 2000 for river. transport.

Graphic 8

SCOPE OF GOODS TRANSPORTATION INDEXES



A Conclusion of the Current Tendencies in traffic from 1975 to 1985

Past decade analized in this report can be devided in two periods:

a) A periods from 1976 to 1980 in which our economy, although suffering from serious difficulties and weaknesses, structural unbalance and many other weaknesses in organization and efficiency of business and investment policy, had relatively favourable rates of growth and it comes as a consequence of big resaurces from foreign accumulation those resaurces were often inadequately invested.

b) The period of serious stagnation and crisis during the Planning period from 1981 to 1985 is still going on, with the highest of inlation until now, high unemployment rate and the difficulties in regulation of foreign loan debts.

A short evaluation of the past decade and the statementabout the economic crisis is given only as a frame in which all our business firms were working. The consequences of the crisis have deeply affected the tendencies in traffic activities.

Railroad transport

The dimension and technical equipment of our transport and draught capacities and railtracks as well as some objective territorial and seasonal unequalities make it impossible for Yugoslav railways to enlarge its transport volume and to take a greater part in total land transport. Some more significant improvement of railway transport demands bigger investment and the conditions which could provide the elimination of technical disorder and numerous subjective weaknesses.

Public road traffic

Goods transport volume of public road traffic is stagnate, but it still has a big part in total land transport volume. A small decline of transport in this branch is partly a result of some social measures and partly a result of stagnation of general economic development.

With some strategic social regulations railway was determined as the most important branch of land transport development. It caused the determination of the conditions for highway traffic development and road companies development. Anyway the latest measures of the Yugoslav economic policy which put market economy in the first place, give some new opportunities to road traffic as a flexible traffic branch, with an accent on the transport service quality. It makes possible for road traffic to have the biggest part in land transport.

River traffic

River traffic has been permanently declining for the past 15 years. It's inadequate infrastructure and the impossibility of fleet restoring are the parameters which indicate that this tendency cannot be stopped easily and the stagnation of further development in opite of declared social regulations. Because of the fact that a great part of international transport volume is realized by using foreign ships, and that many river ports are becoming transport centres the increase of labour volume can be expected. One of the important conditions for the development of goods transport labour in river ports in the cannal Rhein-Main-Danube, and the regulations of our river courses, especially the navigabitility of the Sava river.

Pipeline transport

When the Yugo-pipeline was put into operation at the end of 1979 it made possible the organization of the international transport of crude oil. But the energy crisis and the difficulties with foreign currency balance of our country made the using of this pipeline much below predicted transport volume (in 1980 only 50% of predicted 10 million tons was realized, and that quantity remained till 1985, but the transit of 250.000 tons from 1980 was not repeated again).

Although pipeline transport had these unfavourable tendencies, it´s construction was not a failure because Yugoslavia should have completed it´s logistic system when it built main pipeline, so it is to be expected that Yugoslavia will, in the years to come, increase the pipeline transport volume, especially when transit is concerned.

Sea transport

In the next few years the increase of transport volume is expected, but without some bigger investment and social support, and without a favourable credit policy, sea transport cannot improve its position in international exchange and transit in Yugoslavia. All in all, the sea transport is far below our real possibilities considering the position of Yugoslavia at the Adriatic Sea and its position in international economic relationships, especially with the developing countries. The investments have been increased for the past two years, especially in infrastructure and fleet, so we can expect an increase of work.

I.3. DISTRIBUTION CHANNELS AND PATTERNS

Distribution chanells and patterns nowdays are mainly formed as in developed countries with further essential modes:

1. Direct delivery "producer - buyer". This system of distribution is used mainly in raw materials flows between producers in production line, but also between deliver and retailer. Investigations realised in 6 big towns in Yugoslavia show that 49% of total distribution is realised by this system.
2. Distribution system "delivery-wholesaler-buyer". A lot of wholesalers have own warehouses for distribution which are used as service of retailers. Development of goods - transportation centers in Yugoslavia is a new great advantage for improvement of this system of distribution. Knowing trends up-to-date it is expected that the relative participation of this system will jump from 20% to 60%.
3. Four-level distribution.
   (Delivery-wholesalers warehouse-retail warehouse-buyer)
   The problems which exist with this distribution system that is the back of distribution strategy and policy, as much as development of warehouses which are small, unsuitable and without needed technology. That is the reason for longer and slower distribution cycle, unefficiency and bigger logistic costs.

Technology of transport and transportation process in Yugoslavia is characterized with many techno-organizational reserves. There are certain means with which we can influence the reserves, for example: technically, technologixally, through organization, economically, etc. When we talk of technological reserves in transportation certain facts must be kept in mind: official statistics on work and development of transportation do not give necessary information for the establishment of main reserves and the recognition of facts which influence the efficiency and quality of goods transportation in the transport chain.

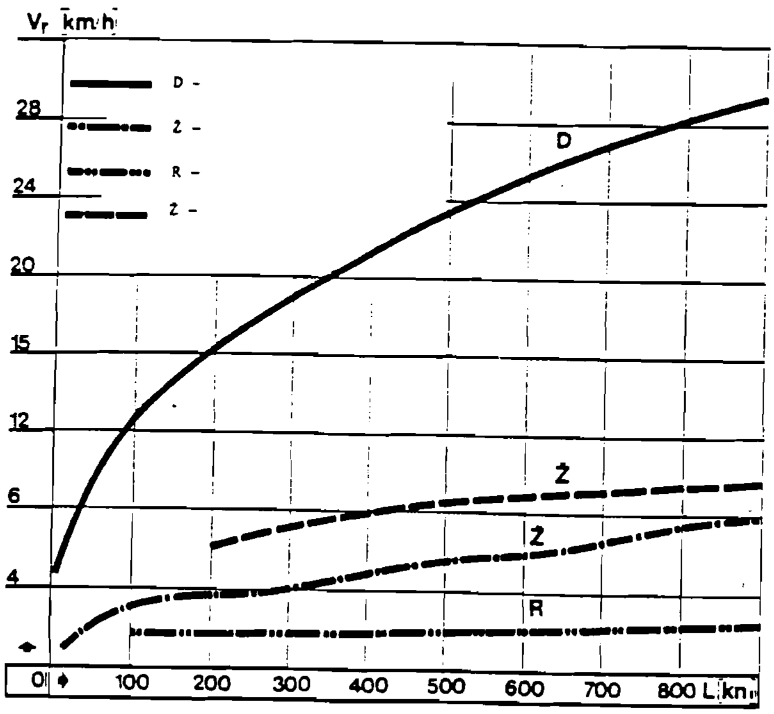
The development tendencies of all transportation branches are to increase the speed of transport. But, in practice much more time is spent on increasing the technical speed, while the exploatation (comercial) speed stands in second place.

In theory and practis not enough attention is paid to the delivery-speed of goods even though it is the delivery speed which presents the unique indicator of the level of transport functioning, or the transport system and its regulator.

The process of accelerating the movement of goods in all forms of transport depend of many diverse faktors. To have a complete picture of their dependence and effects we must divide them into detailed elements of process. In that sense attemps are made to perceive reserves in the transport cicle on which, with satisfactory efficiency, first of all can be influenced by better use of modern transport technique, technologie and organization.

The speed of delivring goods by way in accordance to mentioned research is shown on picture 9 .

The relation between the delivery speed of goods in railway, road and river traffic is given on graphic 9 .



LEGEND:

D - transportation speed of goods in road traffic

Z - general speed (transportation of goods in railroad traffic)

R - transportation speed of goods in river traffic

Z - transportation speed of goods in itinerary R.R. cars of railroad traffic

Graphic 9 - Comparison graphic of delivery speed in railway, road and river traffic

I.4. WAREHOUSING, MATERIALS HANDLING AND PACKAGING

The Social Agreement of integral transport predicts the following of statistics on the capacities and the quataty of work. The programme of statistic research predicts the following of information and evidence of objects (open and closed warehousing, amount of compleated work in the goods transport centres, industrial gages, cannales, ports, etc.). It would make possible a more accurate analyses of the warehouse work volume and the manipulation of goods in the logistic structure study.

TABLE 6 - The capacity of warehousing in Yugoslavia

	NUMBER OF WAREHOUSES	CAPACITY (t)	TOTAL SURFACE (m^2)	USABLE SURFACE	WAREHOUSE VALUE (din).
ROOFED WAREHOUSES	34.274	49.543.342			679.425.767
EAVES	2.145	2.507.204	1.410.700	1.177.264	11.091.585
OPEN WAREHOUSES	3.749	34.146.341	21.243.778	15.477.277	52.763.418

PORTS AND COMMODITY TERMINALS

As a representation of warehouse manipulating activity of the public sector we used facts of "Grouped ports" and goods terminals because they include all the main organizations who specialise in warehousing - manipulative services.

The Services Volume of Labour Organizations
for: ports, warehouses, and goods terminals

The stagnation of physical production volume in economy and traffic have affected the Organizations of Associated Labour "Grouping" which achieved about 3% less goods turnover in comparison with previous year. The decline of total turnover is especially noticeable in goods terminals and its fall is 16%, while ports have an increase of 1%.

TABLE 7 - Reloading according total type of goods

DESCRIPTION		SUMMARY	PARTICIPATION (%)	I N D E X
PORTS	1987	22.093	100,00	101
	1986	21.768	100,00	
GOODS TERMINALS	1987	5.698	100,00	84
		6.801	100,00	
SUMMARY	1987	27.791	100,00	97
	1986	28.569	100,00	

When we analyze the tendencies of reloading according to the type of manipulation

it can be concluded that there are no greater differences in a percentual participation of loading, unloading and direct reloading in relation to the previons years. The participation of reloading is 5% smaller in organization of good terminals and it shows that the demands for additional operations are reduced, and on the other hand that the organization of goods manipulation has been improved.

TABLE 8 - RELATION OF MANIPULATION 1987/86

1987.
1986. (in 000 of manipulated tons)

TABLE 8

	SUMMARY	UNLOADING	%	LOADING	%
PORTS	30.819 29.341	9.750 9.813	31,63 33,44	12.786 11.676	41,51 39,79
GOODS TERMINALS	10.627 12.189	5.081 5.886	47,81 48,28	4.741 4.870	44,61 39,95
SUMMARY GROUPING	41.446 41.530	14.831 15.699	35,78 37,80	17.527 16.546	42,28 39,84
	DIRECT RELOADING	%	RELOADING	%	
PORTS	4.699 4.664	15,24 15,89	3.584 3.188	11,62 10,88	
GOODS TERMINALS	219 143	2,06 1,17	586 1.290	5,52 10,60	
SUMMARY GROUPING	4.918 4.807	11,86 11,57	4.170 4.478	10,08 10,79	

In the situation when interests are very high, and the conditions are not good for new investments, as well as very small accumulation and reproduction capacity of the grouping, there is no considerable increase of capacity.

It can be noticed from the analizes facts that there is no increase of infrastructure capacity in comparison with the previous year, although some capacities are being built now. The financing problem of the building the infrastructure remains one of the most important to be solved in the next period. There is some increase of number of mobile capacities.

A certain restructuring and building of reloading capacities, for the modern transport systems could be expected in the next period, considering the fact that many of these organizations were declared to be the main factors of building and developing of goods transport centres in its gravitational zone.

TABLE 9 - Manipulated tons by mechanical and manual operations

DESCRIPTION		PORTS	% PARTICIP.	INDEX	GOODS TERMINALS	% PARTIC.	INDEX	SUMMARY	% PARTICIP.	INDEX
1		2	3	4	5	6	7	8	9	10
1. SUMMARY		30.819 29.341	100,00 100,00	105	10.627 12.189	100,00 100,00	87	41.446 41.530	100,00 100,00	100
2. SUMMARY (MECHANIZATION)		29.556 28.152	95,90 95,94	105	3.366 4.229	31,67 34,69	79	32.922 32.381	79,43 77,97	102
	COAST	12.556 12.860	40,74 43,82	97	- -	- -	-	12.556 12.860	30,29 30,96	97
MECHANIZATION	MOBILE	13.771 11,745	44,68 40,02	117	3.366 4.229	31,57 34,69	79	17.137 15.974	41,34 38,46	107
	SHIP	3.229 3.547	10,48 12,10	91	- -	- -	-	3.229 3.547	7,60 8,55	91
3. MANUALLY		1.263 1.189	4,10 4,06	106	7.261 7.960	68,33 65,31	91	8.524 9.149	20,56 22,03	93
4. % OF MECHANIZATION		96 96	- -	100	32 35	- -	91	79 78	-	101

TABLE 10 - ESSENTIAL DATAS ABOUT CAPACITIES OF GROUPATION FOR RIVER PORTS AND GTC OF YUGOSLAVIA

DESCRIPTION	PORTS	INDEX	GOODS TERMINALS	INDEX	SUMMARY	INDEX
ROOFED ($000 m^2$) WAREHOUSES	343 342,8	100	489 482	101	832 824,8	101
OPEN WAREHOUSES ($000 m^2$)	1021 948	108	256,7 245,0	105	1277,7 1193,0	107
GRAIN ELEVATOR ($000 m^2$)	6,5 6,5	100	- -	-	6,5 6,5	100
PORT CRANES (BR/t)	44/439 44/439	100	- -	-	44/439 44/439	100
AUTO-CRANES (BR/t)	59/1220 55/1145	107/106	105/2084 101/1867	104/101	164/3304 156/3012	105/100
FORK LIFT TRUCK (BR/t)	204/637,8 190/580,8	107/110	329/897,2 323/891,0	102/101	533/1535 513/1471,8	104/104
TRACTOR (BR/KW)	10/339 11/361	91/94	10/422 10/422	100/100	20/761 21/783	95/97
PALLETES	54.846 54.650	100	81.636 79.021	103	136.482 133.671	102
BOX-PALLETES	- -	-	35.129 96.758	36	35.129 96.758	36

THE EMPLOYMENT SITUATION

The qualification structure of the employed is still not satisfactory. In 1987 of total amount of the employed 8598, 47% of workers were without any qualifications, semo-qualified or unskilled workers. The number of the qualified personnel has increased 7% compared to previous year.

INVESTMENTS

The greatest investments are the investments in building structure (about 50%, equipment 20%, infrastructure 10%). There is a tendency of investing in goods terminals.

PACKAGING

As a part of the logistic system, is not given so much attention in the sense of logistic research, but most all in the technology sense of packaging. We will show research results of exploated pallete surface and the production of wrapping material which will give us a view of the global analise of usable packaging technology.

Until now several researches view of utilization of module pack, have been carried out in Yugoslavia.

The Yugoslav society of palletization compleated several times, the recording of transport packaging in the Belgrade railway station. Results show that of all the recorded packages (431) in most cases carboard boxes were used (77,26%). In second place were wooden boxes (8,12%). Wrapping materila with a rectangular basis, from the total amount of recorded packages were represented in 90,96% of cases, while the rest (barrels, sacks, cans, wrappings) appear in only 9,04% of cases.

In accordance to the percentual exploatement of palettes 800 x 1200 mm, all packages can be classified into four categories:

I	class	ut to 70%	- not suitable
II	class	"	- under exploited
III	class	"	- rarely exploited
IV	class	"	- well exploited.

On the basis of these measures, and recording to filmed surveys, we can conclude:

- 29,23% of packages are not suitable,
- 19,72% of packages do not have satisfactory use of palette surface,
- 34,34% of packages have a less use of palette sufrace,

- 16,71% of packages have a good use of palette surface.

The results of recording concerning the dimenions of packages, of finished articles carried out in the shoe industry, textil, food, chemical, tobacco and metal industries in the SR of Slovenia shows that the use of the palette surface is very variable from 10,60% up to a 100%. From the recorded packages the most equal percentage of used palette sufrace have packages in the metal industrie (from 73,3% up to 93,5% using palettes 800 x 1200 mm and from 70,5% up to 93,3% for palettes of 1000 x 1200 mm).

Packages of other industries in very few cases reach a value over 91% in surface palette efficiency use.

According to the Federal Bureau of Statistiques 697 organizations produce wrapping material in Yugoslavia, which in 1986 produced 572.287 m^3 of wrapping material with a total value of 269.314 x 10^6 dinars or 165% of the total industrial realization (rate of dolar in 1986 1 US $ - 457,18 dinars).

TABLE 11 - Production of characteristic wrapping-material on the basis of material type

WRAPPING MATERIAL	YEAR PRODUCTION IN TONS		
	1984.	1985.	1986.
1. METAL	389764	406285	403436
2. PLASTIC MASSES	162456	148953	147154
3. GLASS	389764	406285	403436
4. PAPER, CARDBOARD	559947	562o47	607896
5. WOOD	566000	613386	572287
TOTAL	2067931	2136956	2134209

I.5. LOGISTICS COSTS AND EFFICIENCY

We think that there are still no satisfactory results on the macroplan of this field, only of some microsystems (Work organizations regions, etc.). We can give "VEKS" Maribor as an example but it has to be noted that those organizations belong to the more developed region of Yugoslavia (table12).

TABLE 12 - The Logistic costs Structure of some Work Organizations in SR Slovenia

THE NAME OF THE WORK ORGANIZATIONS	THE PARTICIPATION OF LOGISTIC COSTS IN TOTAL COST WITH THE RAW MAT.COSTS	THE PARTICIPATION OF LOGISTIC COSTS IN TOTAL COSTS WITHOUT THE RAW MATER.COSTS
THE CELLULOSE FACTORY	23,16	55
CEMENT FACTORY	26,7	/
CONSTRUCTION COMPANY STAUBAR MARIBOR	18,2	/
FURNITURE FACTORY	21	/
GARMENT FACTORY	28,1	/
CHEMISTRY FACTORY	5,03	24,58
AUTOMOBILE TYRE FACTORY	/	13,58
ALCOHOLIC DRINKS FACTORY	32	51
FACTORY OF HOUSEHOLD APPLIANCES	13,5	52,8
PAPER FACTORY	20,97	/
MINERAL WATER FACTORY	34	42
FISH PROCESSING FACTORY	/	27,4
AGRICULTURE PLANT	32,6	/
TECHNICAL APPLIANCES TRADE 1.	/	56-89

In mentioned table it was used further cost structure:

- exterior transport - purchase
- interior transport
- warehousing of:
  - raw materials
  - uncompleted production
  - fikal productions
  - packaging
  - exterior transport - sale.

Economic relations between the Organizations of Associated Labour in logistic Transport line can be:

a) complementary
b) competative
c) combined.

The desicion can influence:

- economic effect of traffic participants
- total costs of transport.

The influence of transport costs on the product prices is given on table 13 (according to 1978 report).

Global results indicate that a relatively high intensity of transport service production is achieved. For production of these services a great part of capital assets is engaged and the level of transport costs is very high.

TABLE 13 - The influence of transport costs on the product prices

TRAFFIC BRANCH	PERCENT OF PARTICIPATION		
	Freight charges	Transport costs	Summary
Railway transport	1,52	0,95	2,47
Highway traffic	5,52	6,82	12,34
- public	2,66	1,30	3,96
- for personal use	2,62	4,99	7,61
- individual transport	0,24	0,53	0,77
River transport	0,15	0,33	0,8
Summary:	7,19	8,10	15,29

The characteristics of transport costs are:

- they are two or three times higher than the transport costs of the economy with more developed traffic system structure;
- that more than a half of transport costs are indirect transport costs.

There facts show that the choice of kinds of economic relations among the participants in the traffic system in our country is not optimal.

Therefore, the organization of traffic is not rational.

Total transport costs of goods production value from 1970 are under the influence of transport costs made in traffic for personal use such a big participations is determined by the costs of additional operations.

A few analyses are given as an illustration.

TABLE 14 - A comparative survey of tariffs costs of railways, public road traffic and road traffic in interproduction

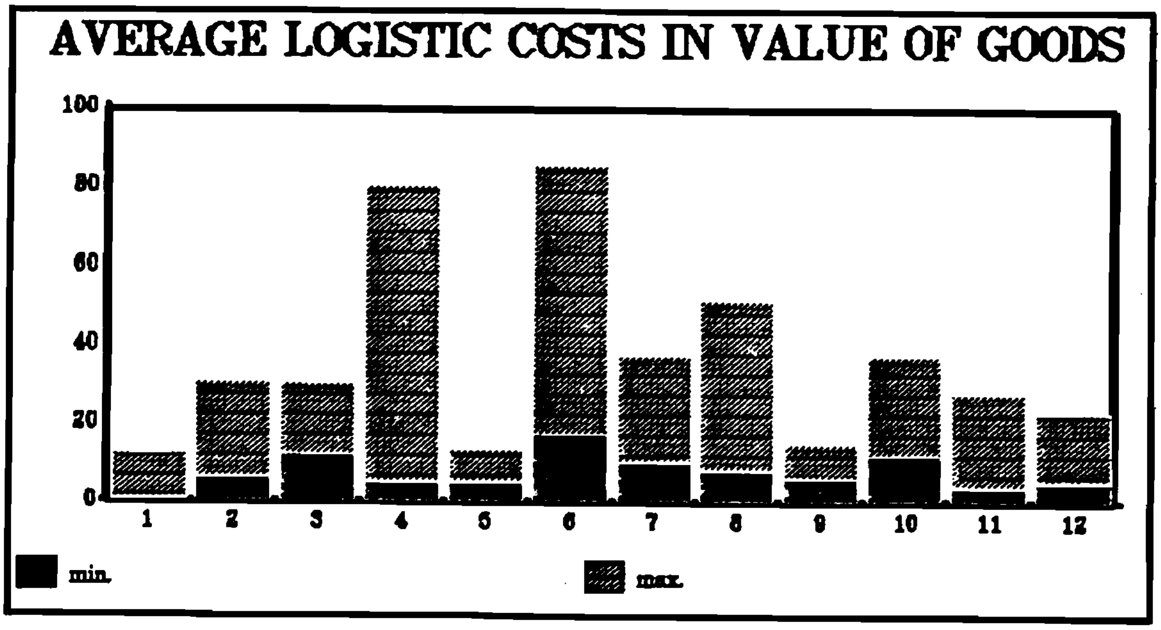
DISTANCE (km)	RAILWAYS 10 t	15 t	20 t	CARRYING CAP. (9,5 t) Public traffic	Interproduction
200	100	74,6	61,8	+ 50%	+85,0%
400	100	75,8	64,7	+163,5%	+22,0%
600	100	77,2	58,0	-ˉ39%	-21,6%

1) Current tendencies are opposite to the given relations which are based on the tariff´s costs. The main criterion in choosing the kind of transport was the speed, frequency regularity and quality of transport, after that comes the price of transport and the conclusion is that railways should fulfill these requests and it would name possible a double redirecting of traffic. The redirecting would be made in favour of railway and public road traffic.

2) Difference in costs of road and railway traffic come from the unequal infrastructure exprense cover. From the aspect of social community the unfavourable tendencies in transport for personal use can be discussed, but we must take into consideration the situation on the traffic service market and the fact taht the quality of transport service is the most important condition. We can expect its further development and a greater participation in goods transport.

On graphic 10 are shown average logistic costs in value of products in main industrial branches. The scope of costs is result of data collecting for 10 technological projects of goods transportation centers, made in 1988.

Graphic 10



1. RETAIL AND WHOLESALE TRADE	0.54-12 %	7. COAL	10-27.47 %
2. AGRICULTURE	6-25.4 %	8. OTHER PRODUCTS	8-43.5 %
3. WOODEN PRODUCTS	12-18.45 %	9. BEVERAGES	6-8.97 %
4. METAL INDUSTRY AND MACHINERY	5-75.71 %	10. NONMETAL MATERIALS	12-25.45 %
5. PAPER PRODUCTS	5-8.77 %	11. BLACK METALLURGY	3.82-24 %
6. BUILDING MATERIALS	17-68.58 %	12. TEXTILE INDUSTRY PRODUCTS	5.24-18 %

II. MANAGERIAL STRUCTURES AND STRATEGIES

II.1. ORGANIZATIONAL AND INSTITUTIONAL STRUCTURES

In the field of organisation in logistic system in Yugoslavia there exist micro and macro level.

On micro level, in firms, there are specialised enterprices for logistic activities and those with some specialised organisational units. Until 1989 there existed 3 essential levels of organisational forms conected with self-management system which exist. Now there exist only two levels of organisational forms - "firm" and "business system".

As profesional associations there exist "business associations and societies", as parts of Economy Chamber - Groupations for traffic and transport in comunes, regions, republics and Federation.

As specific form of unitization, with aim to improve and stimulate railways and multimodal transport, there exist "selfmanagement interest communities" in all republics, which duty is to direct funds made of taxis to users in field of railway and multimodal transport.

Till 1988 it was not possible to form private firm in the field of logistic, except road transport with private trucks. Today it is possible to registrate the private firm for all modes of logistic service, exept those for international work which is still area reserved only for public sector.

From 1985 in Yugoslavia exist first logistic engineers, and in 1988 it was founded first specialised logistic organisation as a part of "YUGO" car company.

II.2. ECONOMIC REGULATION OF LOGISTICS ACTIVITY

Development parametars in the table 15 , indicate the stagnation of the economic development after 1979. It partly comes as a Consequence of the second energy crisis which wasn't amortized by foreign credits as it was the case in 1973 during the first economic crisis. Unfavourably tendencies have appeared in 1979 so the country was faced with a very difficult economic situation characterized by stagnation of production and productivity, high inflation rate, fall of investment activities, big foreign indebtedness, high unemployment rate, national currency value decrease, real wage decrease, etc.

All these tendencies can be seen on the charts added. They had a considerable influence on the whole Logistic system of Yugoslavia and it was obvious in all its subsystems: transport, storing, manipulating of goods and all the following activities. Some systematic measures meant to solve these problems were brought by the Yugoslav Governmont have been realized in the period 1981-1985 ; they were part of the "Long-term" economic stabilization Programme and they should have made the crisis less acute, but they didn't give expected results.

	1	2			3								4				5
					8			9			10		11			12	
			6	7	13	14	15	16	17	18	19	20	21	22	15		
								INDEKS 1955 = 100									
1948	91	68	80	89	62	86	...	...	...	...	57	83	...	...	...	...	...
1949	92	90	87	95	69	85	...	...	...	...	72	94	...	...	...	...	...
1950	93	88	78	84	71	63	...	...	...	...	76	107	...	...	...	...	...
1951	95	83	86	90	69	90	...	...	...	...	74	98	...	...	...	...	...
1952	96	78	74	77	68	63	96	...	86	82	74	64	98	72	80	96	98*
1953	97	83	85	88	76	90	105	80	81	92	78	79	97	87	86	96	95
1954	99	91	88	89	86	80	109	88	102	80	83	87	95	90	95	91	108
1955	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
1956	101	100	95	94	110	83	83	102	123	109	104	98	101	105	103	105	102*
1957	102	108	114	112	129	120	101	121	145	142	121	110	100	115	111	106	120
1958	103	115	117	133	143	105	111	130	164	154	132	123	101	117	117	109	120
1959	104	123	135	130	162	139	130	148	184	158	152	131	101	114	125	110	139*
1960	105	134	146	139	187	125	154	168	212	187	184	148	104	122	141	118	145
1961	106	146	154	145	200	121	167	188	211	205	196	146	108	140	174	127	146*
1962	107	150	160	148	214	125	167	196	248	195	211	145	108	161	181	136	145
1963	109	153	179	165	247	138	186	223	278	225	227	158	108	177	193	141	162*
1964	110	163	199	182	286	146	206	252	295	270	240	181	114	220	224	154	184
1965	111	165	203	183	309	133	184	265	336	248	260	194	131	314	271	200	189
1966	112	162	219	199	323	154	176	280	364	302	276	196	146	369	337	246	213*
1967	113	161	224	201	322	153	186	300	371	328	292	184	149	351	363	262	226
1968	114	162	232	208	342	147	194	321	382	343	348	187	150	329	384	274	235
1969	115	167	254	229	381	158	212	350	427	388	404	205	154	372	415	294	251*
1970	116	174	269	244	416	154	231	392	446	483	455	229	168	444	483	323	268
1971	117	182	290	263	458	164	240	435	461	528	467	256	195	556	579	372	284
1972	119	190	303	273	494	159	240	465	536	496	472	277	216	709	666	429	286
1973	120	194	318	286	524	171	230	479	573	578	507	308	244	909	762	510	276
1974	121	204	345	307	580	181	246	508	578	659	568	322	316	1 000	980	641	291
1975	122	215	357	311	613	177	278	523	567	641	546	341	385	1 111	1 203	806	289
1976	123	222	371	317	633	189	293	544	652	597	548	343	408	1 282	1 372	885	298*
1977	124	232	401	341	693	198	323	582	623	685	586	360	446	1 429	1 564	1 000	307
1978	125	243	429	357	753	186	364	629	618	679	648	389	483	1 613	1 814	1 136	324
1979	126	253	459	380	813	197	401	660	645	799	673	402	546	2 000	2 196	1 389	323
1980	127	262	470	385	847	197	399	655	714	718	704	405	694	2 703	2 769	1 818	300
1981	128	269	476	384	882	200	379	650	748	627	689	408	1 000	4 167	3 794	2 632	283
1982	129	276	479	385	883	215	332	649	678	539	665	409	1 250	5 556	5 083	3 448	279
1983	130	281	472	378	895	211	294	618	677*	500	676	422	1 639	8 240	6 608	4 762	250
1984	131	287	483	382	945	214	273	605*	734*	477	721	452	2 564	11 445	9 714	7 692	232
1985	132	294	486	380	971	198	262	599*	788	488	743	471	4 762	18 290	20 000	13 111	241
1986	133	303	503[1])	391[1])	1 008	221	265	629	767	517	779	492	8 333	33 333	39 040	24 661	265
1948—1952	1,5	8,3*	2,0	0,6	6,3	−3,4	...	...	...	...	12,2	−0,9	...	...	...	...	...
1953—1956	1,3	6,3	6,6	5,2	12,9	7,0	−3,6	...	9,4	7,4	9,1	11,6	0,5	10,0	6,5	2,3	1,1*
1957—1960	0,9	7,6	11,3	10,2	14,1	10,8	16,7	13,3	14,6	14,5	15,3	10,8	0,7	3,8	8,2	3,0	9,1*
1961—1965	1,1	4,3	6,8	5,7	10,6	1,3	3,6	9,6	9,7	5,8	7,1	5,5	4,9	20,9	14,0	11,1	5,4
1966—1970	0,9	1,0	5,8	5,9	6,1	3,0	4,6	8,1	5,8	14,3	11,9	3,4	5,1	7,2	12,4	10,0	7,3
1971—1975	1,0	4,3	5,9	5,1	8,1	2,8	3,8	5,9	4,9	5,8	3,7	8,2	18,0	19,9	20,0	20,2	1,5
1976—1980	0,8	4,0*	5,7	4,3	6,7	2,2	7,5	4,6	4,7	2,3	5,2	3,5	12,7	19,5	18,2	17,4	0,9*
1981—1986	0,8	2,5	0,7	−0,3	2,8	2,0	−6,6	−0,7	2,0	−7,4	1,1	3,1	50,5	52,7	52,9	54,6	−2,2
1948—1986	1,1	4,6	5,3	4,3	8,0	2,8	2,4[4])	6,4[4])	6,6[3])	5,6[3])	10,3	6,9	13,9[5])	20,0[5])	20,0[5])	17,6[5])	3,0

Table 15 - MAIN ECONOMIC INDEXES

1. total population 2. the employed 3. index of physical volume 4. costs 5. index of real net personal income per employee 6. summary 7. per inhabitant 8. production 9. turnnover of goods 10. transport 11. produce 12. retail 13. industry 14. agriculture 15. construction industry 16. retail 17. export 18. import 19. goods 20. passengers 21. industry products 22. agriculture products[x)]

x) individual private sector.

The rationalization of logistic sistems in our country is first of all in the function of reducing transport costs, from the source to the final destination, especially from a position of a logistic servise beneficiary. In Yugoslavia, hower, the category of transport expenses represents the so called "supplementary production expenses" which means that the trade is not interested in cutting down on costs which in any case is troubled by the negative movements on the market, rather than compeiting with goods on the market they find greater interest in increasing the interest through transport costs. Even more the state does not find interest either due to the character of the tax policy.

In a situation of that kind it is normal that only the transport user wants lower cost of transportation and is exposed to all the irrationality. All this makes Yugoslavia the most expensive country in Europe concerning transportation costs. The market reacts on the high cost and no fictive administrative measure can avoid it. These problems especially have a bad influence on the international market where goods loose in concurence.

Even goods of high quality are less attractive to foreign buyers because of logistic costs which, when added to the price of production costs surpasse the so called world prices and the standard cost excepted troughout the world.

There is a relative stagnation of transport development in relation to the production development and it comes as a consequence of:

a) non-defined socially determined policy of transport development strategy;
b) inadequate coordination and cooperation among different forms of transport and the division of labour among them;
c) no income coordination in transport economy and its relation to economy;

II.3. INFORMATION TECHNOLOGIES

Computers and modern programming equipment are used more and more all spheres of logistic in Yugoslavia, although not equally in all parts of the country. There is a considerably high degree of corre ation between the using of computers, capacities, equipment for automatic data processing, number and qualifications of the employed on the one side, and the degree of the development of logistic systems in Yugoslavia on the other, and it could be a recatively good evaluation measure of a development of logistic level.

According to the facts on the chart 16, greatest degree of using the modern programming equipment can be noted in Slovenia, then comes Croatia, the autonomous region Voivodina, and Servia, while Bosnia, Macedonia and Montenegro have a very low degree which comes as a consequence of general economic development. It also affects the logistic system development in these parts of the country. Under the circumstances, there is a problem of unequal development in Yugoslavia relatively developed North and undeveloped South.

TABLE 16 - THE APPLICATION OF COMPUTER SYSTEMS IN YUGOSLAVIA

	SFRJ	BaH	MONTEN.	C	MACED.	SLOV.	SERBIA SUMMARY			
								WITHOUT REGIONS	KOS.	VOIV.
TOTAL AMOUNT OF AUTOMATIC DATA PROCESS. UNITS UP TO 1985.	1772	62	15	625	55	703	312	169	15	128
	188	4	-	66	5	75	38	24	-	14
1971-1975	423	27	4	147	11	158	76	42	1	33
1976-1980	622	21	8	241	25	190	133	86	9	42
1981	116	2	-	41	2	46	22	9	-	13
1982	92	2	1	35	2	42	10	1	3	6
1983	86	4	-	30	2	39	11	3	-	8
1984	81	-	-	25	5	44	7	1	1	5
1985	105	2	-	12	2	77	10	3	-	7
INDUSTY AND MINING	564	12	4	193	12	268	75	35	4	36
AGRICULTURE AND FISH INDUSTRY	51	-	-	16	1	22	12	-	-	12
FORESTRY	19	-	-	7	-	12	-	-	-	-
WATERPOWER ENGINEERING	4	-	-	1	-	1	2	-	-	2
CIVIL ENGINEERING	106	1	-	28	5	53	19	10	-	9
TRAFFIC AND COMMUNICA-TIONS	50	-	1	21	2	19	7	6	-	1
TRADE	204	2	1	85	10	72	34	25	-	9
NUMBER OF WORKERS WHO USE THE PROGRAMMING	12492	574	86	6727	558	2128	2419	1565	86	768
NUMBER OF WORKERS QUALIFIED FOR THE USING OF MANAGEMENT SYSTEM (I[illegible] GENERATION)	1915	71	14	523	64	786	454	338	19	100

II.4. HUMAN RESOURCES AND EDUCATION

Human resources engaged in transport system of Yugoslavia are 8 % of total number of workers. ON table it is shown number and qualification of workers in firms of all modes of transport.

Qualification structure of workers in transport system is worse then average for country.

The greatest firms are those in railway system - 8 of them has aproximately 125000 workers. Comparing with productivity and efficiency in other countries and related to some investigations realised in Yugoslavia, on Yugoslav railways there are 20% workers more then needed optimum.

Problem of statistics of human resources in transport in Yugoslavia is the result of statistic data collecting where the sources for data are organizations with essential activity of transport (traffic). Including the workers engaged in logistic in other firms with different essential activity, the total number of workers in logistic activities in Yugoslavia is 2-3 times higher of those work in transport firms. Including them average education level of workers is much worse then for transportation firms.

Education in the field of logistic has a few levels. Till 1987 in secondary schools existed field of specialization for drivers, warehouse workers and other semiqualified and qualified professions. Now there exist secondary transport schools which are with not so specialized but in the same range as other secondary schools.

Table 17 Workers in public transport enterprises and their qualification structure

	TOTAL%	HIGH	HIGHER	MIDDLE	ESSENT.	HIGH Q.	QUALIF.	SEMIQ.	QUALIFI
1	26.71	24.83	21.84	22.69	8.35	27.84	29.57	47.25	21.8
2	4.04	8.96	16.01	2.28	0.74	1.26	3.68	3.57	5.92
3	1.78	1.53	2.49	1.84	0.83	1.21	1.65	3.19	2.28
4	2.44	11.57	7.95	3.39	1.26	1.54	0.7	2.07	1.28
5	35.92	21.06	19.15	26.5	22.54	41.51	47.94	22.63	35.73
6	8.66	5.43	5	9.48	6.06	16.78	7.71	3.14	6.65
7	0.35	1.51	0.46	0.39	0.41	0.31	0.23	0.17	0.23
8	5.53	5.43	4.53	3.84	3.67	2.03	4.26	15.21	17.4
9	14.57	19.68	22.57	29.59	56.14	7.52	4.26	2.77	8.71
	100	100	100	100	100	100	100	100	100

	TOTAL%	HIGH	HIGHER	MIDDLE	ESSENT.	HIGH Q.	QUALIF.	SEMIQ.	QUALIFI
1	121903	4773	6159	21848	1834	17891	48831	13357	7210
2	18454	1723	4516	2199	162	811	6076	1010	1957
3	8112	294	703	1773	183	776	2726	902	755
4	11149	2223	2242	3262	276	987	1152	584	423
5	163958	4048	5401	25515	4952	26672	79153	6398	11819
6	39514	1043	1409	9129	1331	10785	12729	887	2201
7	1586	290	130	375	91	196	381	48	75
8	25218	1042	1279	3696	808	1305	7032	4299	5757
9	66502	3783	6366	28489	12337	4832	7032	783	2880
	456396	19219	28205	96286	21974	64255	165112	28268	33077
	100	4.21	6.18	21.1	4.81	14.08	36.18	6.19	7.25

L E G E N D:

1. RAILWAY TRANSPORT
2. SEA TRANSPORT
3. RIVER TRANSPORT
4. AIR TRANSPORT
5. ROAD TRANSPORT
6. URBAN TRANSPORT
7. PIPELINES
8. MATERIALS HANDLING ASS.
9. POST, TELEGRAPH & TELEPHONE

There are 5 Traffic and transport faculties and 7 higher schools in Yugoslavia. Every year they enroll about 2200 students and average percentage of passing is 15-20% on Faculties and 35% on higher schools. Except Traffic and transport Faculties there are department, for traffic and transport on 6 Civil Engineers and 5 Economic Faculties in Yugoslavia. All of them have postgraduate studies.

II.5. RESEARCH PROJECTS

In Yugoslavia exist a large number of intitutions specialised for research projects in the field of logistic. Those research institutes belongs mainly to Traffic and Transport Faculties, projecting organisations on railways and greatest organisations for global engineering. All of that result that in Yugoslavia a gratest number of projects are done within republics and their research institutes and there are much less fundamental researches on national level.

Related to some parameters in Yugoslavia are realised about 2500 projects in the field of logistic annualy. Special advantage for improvement of investigations in this field is that exist the low which treate obligation of transport technology projects as a part of every projectn.

The greatest number of projects in the field of logistic are concerned to modernization of infrastructure in transport, while technological projects of industrial transport are mainly realised by nonprofessional projecting teams (teams involved in problems of essential production problems).

About 5% projects in last 5 years were about problems in multimodal transport. That field was most important in the strategic plans for economic stabilisation in the field of transport.

Projects are partly financed by specialized associations for science. In those situations is still obligation from users of projects to pay 50% of total amounts.

In march 1989 average bruto price of projects financed by specialised associations for science was 500 US $ per investigator/month.

REFERENCES

1. R. Perišić - Modern Transport Technologies, Belgrade, 1985.
2. Federal Institute of Statistics, Annual Bulletin
3. A. Grahor - Introductory report, Report from the fourth meeting of Yougoslav transport ingeneers
4. M. Dokić - Current Tendencies in Traffic,1975-1985.
5. Detailed S. Vojvodić - "Railway - as a support for overcoming the economic crises", Railway 9/86/3
6. Institute for economic transport: Transport cost influence on economy, Belgrad, 1981.
7. Detailed: An extract from a repport "Transport from personal use in the Yugoslav transport sistem", Report from the fourth meeting of Yougoslav transport ingeneers
8. Detailed: D. Petrović and S. Božićević - Report from the fourth meeting of Yougoslav transport ingeneers
9. Detailed: M. Čičak, D. Mandić - A report from Yougoslav railways conference on long term development of railway until the year 2000.
10. ITEO Ljubljana - Study for trade companies in Slovenia, 1986.
11. Detailed: Annual report of groupation for river ports and goods transport centres, Economic chamber of Yougoslavia, 1988.
12. Study - Investigation and defining of the number and layout of goods transport centers in Yougoslavia - ISF Beograd, chair for multimodal transport, 1986.

APPENDICES

Logistics in the German Democractic Republic

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Introduction

The German Democratic Republik (GDR) covers a territory of 108,333 km². The resident population, in 1987, was 16.641,300. Mean population density is 154 per square kilometre.

The administrative setup of the GDR includes the capital, Berlin, and 14 counties, subdivided into districts.

There was a distinctive industrial south-north decline when the GDR was founded in 1949. To cut down the intensity of this decline, comprehensive localisation measures had been taken. GDR's national economy is run and planned on the basis of socialist economy. Annual and five-year planning include all branches, spheres and operations and firms.

The early seventies have been marking a new stage in the intensifikation of economic growth, exemplified by the fact that the gross national product and national income have continuously been increasing with decreasing production input.

Table 1: Development of the gross national product, national income and production input in the GDR (in terms of comparable prices on a 1985 basis)[1]

Year	Gross national product		National income		Production input	
	value (tm M/a)	growth rate (%)	value (tm M/a)	growth rate (%)	value (tm M/a)	growth rate (%)
1975	532.4	5.8	158.2	5.6	374.3	5.9
1980	655.2	4.2	193.6	4.1	461.6	4.3
1985	748.6	3.6	241.8	5.2	506.8	2.9

Table 2 lists developments of the national income produced and net product of selected spheres of economy.

1) Source: According to data taken from the Statistisches Jahrbuch der DDR

Table 2: Developments of the GDR national income produced and net product of selected spheres of economy (in terms of comparable prices on a 1985 basis)[1)]

Year	National income produced		Net product of selected spheres		
			Industry and producing trades	Building/ construction industry	Agriculture and forestry
	(million M/a)	(%)	(%)	(%)	(%)
1970	121 563	100	100	100	100
1975	158 157	130	133	126	111
1980	193 644	159	169	144	111
1985	241 863	199	217	180	134

During the period 1970 ... 1985, the average annual growth rate of labour productivity in the national economy (measured in terms of 1000 M of national income produced per gainfully employed person in material production) had been as follows:

1971/85: 5.6 %

1976/80: 3.9 %

1981/85: 4.2 %

One essential feature of economic progress had been the fact that production growth came to pass with energy and material consumption decreasing. Thus it had been possible to dramatically reduce annual unit consumption of economically important energy sources, raw and reusable materials per unit of industrial commodity production. Reductions amounted to

2.8 % in 1971/75

3.9 % in 1976/80

5.3 % in 1981/85.

As for the product main lines of industry, it had above all been the products of the chemical industry, power economy and metallurgy to receive an essential impetus.

1) Source: According to data taken from the Statisches Jahrbuch der DDR

Table 3: Development of GDR industrial commodity production in terms of product lines (actual prices)[1]

Product main line	1975		1980		1985	
	(mill. M)	(%)	(mill. M)	(%)	(mill. M)	(%)
Total	216 660	100.0	339 568	100.0	541 814	100.0
among others						
Energy and solid fuels	16 547	7.6	35 575	10.5	63 894	11.8
Chemical products	29 378	13.6	53 029	15.6	103 565	19.1
Metallurgical products	14 417	6.6	26 284	7.7	48 384	8.9
Building materials	4 298	2.0	6 626	2.0	10 280	1.9
Machine building and vehicle construction	46 674	21.5	73 071	21.5	99 167	18.3
Electrotechnics/ electronics and instrument building	19 807	9.1	29 477	8.7	44 411	8.2
Light industry[2]	22 441	10.3	32 521	9.6	49 902	9.2
Textile industry	12 227	5.6	19 213	5.7	30 517	5.6
Foodstuff industry	39 097	18.0	48 422	14.3	70 636	13.0

Industrial commodity production in selected branches of industry had been developing as follows:

Table 4: Index of industrial commodity production in selected branches of industry (1970 = 100)[1]

Sphere	1975	1980	1985
Industry	136	173	211
Power economy	128	170	201
Oil, natural gas and coal industry	145	180	218
Ferrous metallurgy	140	170	196
Machine-tool building	156	239	344
Electronics industry	188	308	616

1) Source: According to data taken from the Statistisches Jahrbuch der DDR

2) except for textile industry

Investments and stocks of fixes assets had been developing within the scope of overall economic delvelopments as follows:

Table 5: Development of investments and fixed assets stocks in the GDR (in terms of comparable prices on a 1985 and 1986 basis respectively)

Year	Producing spheres				Non-producing spheres			
	Investments		Stock of fixed assets		Investments		Stock of fixed assets	
	Value (tmM/a)	Growth rate (%)	Value (tmM/a)	Growth rate (%)	Value (tmM/a)	Growth rate (%)	Value (tmM/a)	Growth rate (%)
1975	43.9	5.2	673.5	5.8	11.9	8.5	281.0	4.8
1980	51.2	3.1	861.9	5.1	14.5	4.0	353.2	4.7
1985	48.3	3.4	1068.1	4.4	14.3	3.6	442.0	3.9

During the period of 1970 ... 1985 the amount of annual investments had been increasing from 43.7 thousand million M to 62.6 thousand million M, that is , by 43 %. Fixed asset stocks increased by 776 thousand million M and 106 % respectively.

It has above all been in the course of the past five years that the combines existing in industry, building and construction as well as in other spheres have been developed to be modern economic units of management of large-scale production.

At present, there are more than 300 combines under the control of the centrally managed and regionally administered industry and of the other spheres.

Table 6: State of development of the GDR combines in 1985

Sphere	Number of combines	Blue- and white-collar workers (1000)	Fixed assets stocks (tm M)	Commodity production (tm M)
Centrally managed industry	129	2 690	440	435
Regionally administered industry	95	200	14	21
Other spheres	92	718	78	52

The number of centrally managed industrial combines rose from 35 in 1970 to 129 in 1985.

Foreign trade is of increasing significance to the economy's development. Within a period of 15 years, from 1970 ... 1985, its volume has been increasing by more than 140 thousand million foreign exchange marks (as clearing units).

Table 7: Development of foreign trade turnover of the GDR[1)]

Turnover	1970	1975	1980	1985
	(Million foreign exchange marks as clearing units - actual prices)			
Total	39 597	74 394	120 101	180 191
of which				
Export	19 240	35 105	57 131	93 490
Import	20 357	39 289	62 970	86 701

Railway provides for about 96 % of export transport to CMEA countries and 45 % of imports. Another 11 % of imports are covered by maritime traffic.

About one fourth of the international transports are export of services, with about 65 % of which are being provided for by rail and some 35 % by ship.

Turnover of home trade in consumer goods, in 1988, amounted to a value of approximately 130 thousand million M.

Table 8 : Development of retail trade turnover of home trade in consumer goods in the GDR[1)]

Turnover	1970	1975	1980	1985
	(million M/a)			
Total	64 059	81 805	99 986	113 030
of which				
Foodstuffs and stimulants	35 776	42 493	50 179	56 888
Industrial goods	28 283	39 412	49 807	56 142

1) Source: According to data taken from the Statistisches Jahrbuch der DDR

Goods turnover in trade in means of production for the material and technical provision of economy and for partial provision of the population amounts to approximately 55 ... 60 thousand million M.

In the GDR, increasing efforts are being taken to push up the economic potential by accelerating commodity circulation. An important task in this respect is to apply logistic solutions in all spheres of national economy.

The present state of the art in the GDR with a view to the application of CAD/CAM workstations, robots and automation solutions in production and transportation and with a view to the introduction of efficient information and communication technologies is an essential basis for the introduction and further development of logistic technologies. In this process an increasing number of possibilities are being opened up to control and regulate stochastic processes of material flow in the fields of procurement, production and sale.

That is why logistics is gaining more and more in importance to the effective and economic organization of materials circulation. The stepwise implementation of logistic solutions in industry, trade, transportation and other important spheres has the objective of providing for the

- production-oriented procurement of raw materials, materials and unfinished products,

- demand-oriented and efficient production and

- efficient and economic sale of final products

on the basis of computer-assisted control of material flows.

I. Physical logistics structures

I.1. Stocks in national economy

A decisive condition for developing the GDR's national economy are properly structured stocks of raw materials, materials and products. This objective originates principally new, qualitative requirements on stock optimization, calling for the application of logistic working methods.

One feature of the overall development of material stocks is the fact circulation of circulating means had been speeded up during the period from 1980 through 1985. Average stocks increased by 0.5 ... 1.3 % on the basis of an annual growth of industrial commodity production by an average of 4.5 %. Ever since these developments have been stagnating, with stocks being on the increase, above all with consumers.

(Data on the extent and structure of material stocks available in the GDR have not been published.) In the past three years, average growth rates in total stock developments have been amounted to 2.7 to 5.1 %.

The main causes for insufficient acceleration of stock circulation are found to be

- lacking optimum proportions as to the development of sub-supplier and final products,
- increasing excess and short stocks, resulting in a national income tie-up,
- lack of logistic solutions to the effective and economic organization of systematic cooperation within and outside combines, firms and enterprises,
- insufficient proportioning of stocks among suppliers, consumers and means of production trade facilities.

In consideration of all these trends, efforts are being taken in all branches in order to achieve a continuous material flow through all stages of production right to the final product, on the basis of small stocks, short delivery periods and a high degree of flexibility. This includes above all

- the improvement of the system of budgeting and allocation, contracting and contractual reliability, ordering and delivery periods and stock management,
- change of the volume and stock composition of raw materials, materials, unfinished products and finished products within the scope of the national economy, to the effect that stocks are being shifted from consumers to manufacturers and to the means of production trade to be kept there at a future ratio of about 30 % : 35 % (the present ratio is 70 % : 15 % : 15 %).

The absolute stock reduction and reversal of the development of stocks of circulating means in order to increase stock availabilities and procurement tasks are closely linked with measures concerning the change of systematic cooperation, with the application of methods of computer-assisted stock standardisation and with the gradual centralisation of warehousing and storing on the basis of modern in-house transport, handling and stocking technologies.

By integrating logistics into the process organization of material flows it will be possible to achieve ever shorter throughput times, small stocks of means of production, a high degree of utilization of equipment and a reliable execution of orders and deliveries geared by the concomitant information flow to procurement, production and sale.

Of gaining importance to an increase of flexibility and availability on schedule of raw and working materials as well as sub-supplier products will be specific delivery contracts on the basis of fixed ordering and delivery conditions. Accordingly, orderers of raw materials and products are held to advise suppliers on their requirements for the following plan year, and this one month at the latest, after having been assigned their targets by State. Suppliers are obliged to conclude with orderers annual contracts on all deliveries in terms of rough assortments and delivery times.

The increasing application of logistics in the field of stock management will render it possible in the next years to come to reduce material, raw material and finished product stocks and to improve procurement stability and quality.

These objectives can be achieved if stock keeping on an effective national-economic level along the lines of low-storage and non-storage production respectively is backed up by a quantitatively and qualitatively efficient freight transport system and if even in-house transport, handling and storing processes are linked with external transport and handling on a logistic basis.

This calls for new yardsticks to be imposed on warehouse management. In the GDR we have succeeded in generally improving procurement and stock management by systematically developing storage capacities and intensively expanding warehouse management potentials. Storage capacities, however, are dissipated; existing premises and facilities are partly obsolete, and excess stocks are a burden on warehousing.

At present, some 25 % of the means of production and 55 % of the consumer goods pass through warehousing. The principal working area (HFF) per warehouse is 575 m² on an average, in consumer goods wholesale trade, and 650 m² in the means of production trade.

As of 1963, construction of warehouse having a capacity of 9000 ... 12000 m³ of principal operational volume (HFV) has been given priority. Now, for the past ten years, above all warehouses up to 140 000 m³ of HFV have been built.

Until 1980, the value of fixed assets per employee employed in domestic trade amounted to about 29 000 M. In warehouses having a low degree of mechanization it comes up to 50 000 M per warehouse hand, in fully mechanized warehouses, 60 000 M ... 70 000 M, to range between 125 000 M and 250 000 M in modern warehouses. Workplaces equipped with microcomputer-controlled devices and robot equipment are valued at amounts up to 300 000 M.

Analyses have given to show that production and storage operations executed will spread over a great number of production sites and stores in many factories. Therefore, additional measures are required to streamline territorial organization of warehouse management.

The present structural changes in production will be of an essential influence on hitherto developments. What will be necessary above all in the nineties is to increase the percentage of direct deliveries and to drastically improve material and technical supply be the agencies trading in means of production. These requirements will continue to increase as technical, technological and organizational top performances in process automation of constant material flows are materializing, calling for efficient and effective stock management at all levels of responsibility.

I.2. Transport systems

Freight transport has undergone an intensive development along with overall economic and industrial developments.

The transport policy of the GDR is geared to the continual perfection and increase of efficiency of the uniform transport system including all transport branches and capacities.

Thanks to effective measures taken in the field of management, planning and organization as well as economic stimulation of activities in freight transport it has been possible, above all ever since 1980,

- to limit more than before transport and handling services requirements to economic essentials,
- to secure economically substantiated requirements by means of more stability and quality and increasing continuity,
- to further minimize the overall national-economic extent of production, transport, handling and storage processes.

As a result of the intensification of the national-economic freight transport processes it has been possible to reduce

- the volume of freight transport by 13 %,
- unit consumption of energy in transportation by 23 %, and
- unit transport expenditure by 26 %.

ever since 1980.

Index of unit transport expenditure (domestic freight transport done in terms of ton/kilometre per unit of produced national income in 1000 M)

1970	1975	1980	1985
100	96.3	91.2	69.6

The index for 1987 was 64.9.

At the same time the share of the low-energy transport carriers railway and inland navigation in the total domestic goods transport services - excluding company transport - was increased from 62 % in 1980 to 72 % in 1987.

A comparison on an international scale gives to show that in terms of labour division in the transport branches the share of railway and inland navigation transports in the overall domestic transport services in the GDR is very high. This is above all due to the high proportion of bulk cargo (coal, building materials, fertilizers, ores, chemical elements, timber, grains, a.o.) amounting to some 70 % as well as to the consistent shifting of transport operations from road to rail, amounting to some 38 million tons within the period from 1980 ... 1987.

Moreover, freight transport during the past period of development featured above all the following issues:

- Electrification of the railway network,

- Formation of sundries depots and transition to combined sundries traffic,

- Formation of wagon-load depots,

- Reduction of the number of junction points,

- Organization of container transport.

During the years 1980 ... 1985 decisive progress had been made insofar as

- production and transport had been more closely linked with the objective to reduce transport expenditure on a national-economic level,

- the introduction of production optimization and of production transport chains had been accelerated for important national-economic kinds of goods,

- container traffic and other advanced transport technologies were further developed and cooperation among the transport branches was intensified,

- management, planning and balancing had further been improved in order to develop the freight transport, and

- responsibility of the traffic-managing authorities (Ministry of Transport, County Councils) and economic sectors had been increased.

On this basis, freight transport in the GDR had been developing during the period from 1970 ... 1985 as follows:

Table 9 : Development of freight transport in the GDR in terms of transport volume and services[1)]

(a) Development of transport volume (mill t/a)									
				Breakdown					
Year	Total	Railway	Share (%)	Public road transport	Share (%)	Company transport	Share (%)	Inland navigation	Share (%)
1970	764.0	262.0	34	180.0	24	283.6	37	8.5	2
1975	935.1	288.9	31	178.7	19	409.5	44	14.6	2
1980	1111.9	311.6	28	166.8	15	562.9	51	16.3	1
1985	970.4	347.9	36	139.8	14	415.3	43	17.7	2
(b) Development of transport services (mill tkm/a)									
1970	128008	41513	32	6197	5	6036	5	2358	2
1975	152742	49681	33	8019	5	8672	6	2362	2
1980	155294	56395	36	9739	6	11282	7	159	1
1985	144809	58668	40	7479	5	7577	5	2431	2

The mean transport distance concerning the individual transport branches had continued to be relatively constant in the course of the past years, amounting to

- apprx. 170 km for railway,
- just under 55 km for public road haulage,
- a good 18 km for company transport, and
- some 135 km for inland navigation.

There is a high degree of development of the network of transport routes across the territory of the GDR. Network density is as follows:

- Railway 0.13 km/km^2 (FRG: 0.126; Czechoslovakia: 0.103; Poland: 0.087)
- Road 1.15 km/km^2 (FRG: 1.94; France: 1.45; Poland: 0.95)
- Inland navigation 0.02 km/km^2.

1) Source: According to data taken from the Statistisches Jahrbuch der DDR

The network density of the technical infrastructure increasing from north to south is in accordance with the structure of local division of the productive forces and settlement structure. Static and dynamic traffic densities had been developing as follows:

Table 10: Traffic density in freight transport[1)]

	(a) Static traffic density (1000 t/km)		
Year	Rail transport	Road haulage	Inland waterway transport
1980	21.87	6.05	7.09
1985	24.75	4.45	7.64
(b) Dynamic traffic density (mill. tkm/km of traffic network)			
1980	3.96	0.17	0.94
1985	4.17	0.12	1.05

The backbone of the GDR freight transport system is railways.

The railway network comprises 720 access points, some 7400 junction points and 162 marshalling yards as well as 14 000 km of lines. During the years 1971 ... 1985 more than 1 160 km of lines had been electrified; electric locomotives provided for more than 40 % of traction services.

Considering a percentage output of more than 70 % and a volume percentage of appr. 34 % in domestic freight transport, railway provides for 70 % of low-valued bulk cargo and for about 30 ... 35 % high-quality products. The basic technology in railway freight transport is by block-train operation, by which some 60 % of the freight transport volume are handled.

Public goods road haulage provides for about 10 % of transport services, whereas some 15 % are covered by company transport of the various branches of economy. Computer-assisted coordination helps effectively to put on and utilize to capacity, vehicles operating in inland long-distance traffic. Public road transport offers at present a wide range of services in the local sector up to a distance of about 50 km, amounting to about 85 % of its transport volume and 35 % of its transport services.

During the period from 1971 ... 1985 almost 1 400 km of roads and autobahns had been built.

1) Source: According to data taken from the Statistisches Jahrbuch der DDR

Inspite of their significance to bulk cargo transport, output of inland navigation (2300 km of river and canal lines) and pipelines (1307 length), considering certain relations, are ranking low, amounting only to less than 2 % of total transport outputs.

Inland navigation makes full use of the energetic advantages offered by the existing network of waterways, above all by pusher operation.

Since 1970, 620 km of pipelines for oil and gas transport have been built.

The GDR maritime transport and port economics are instrumental in fulfilling foreign trade objectives. Transport output of maritime transport increased by some 23 thousand million tkm during the period from 1970 ... 1985, to go up to a value of more than 92 thousand million tkm in 1987, constituting more than 50 % of the goods transport output of the total of transport carriers. During the same period, 1980 ... 1985, the freight turnover in the GDR seaports doubled, to attain some 24.8 mill. tons in 1987.

Another modern transport system to provide for foreign-trade transports is the train-ferry line between the ports of Mukran (GDR) and Klaipeda (USSR) opened in October 1986 as an addition to the traditional railway and shipping lines between those two countries. By the end of 1988 a goods volume of more than 4 mill. tons had been trajected. As of 1990, some 5 mill. tons of goods are to be transshipped both ways by a total of 6 ferries. In order to guarantee a high degree of efficiency of the ferry technology a modern computer-aided information system of management, arrangement, control and accounting of the transport and handling processes (RISMU) has been developed.

The organization of container transport has been an essential condition for coping with economic effectiveness with the qualitatively increasing transport requirements in national and trans-border goods traffic. Due to its economic advantages involved it will for a long term be the transport-logistic centre piece of cargo transport in the GDR.

At present, the territory of the GDR has been opened up to container transport to 75 %. Some 60 % of the containers will be prepared for dispatch through places of transshipment of the railways, factories and enterprises and other points of transshipment by split transport (i.e. road advance and/or follow-up transport),and another 40 % via corresponding licensed stations.

At present, some 46 700 20'containers are available for use, 87 % of them, for transportation. Forwarding of the containers is being done by container train service and by conventional freight trains.

As of 1988 comprehensive rationalization of dispatch and accounting jobs in national container transport has been possible on the basis of the "ZEFBA Container" computer project.

In 1986, 4.7 million tons of goods had been shipped in containers, that is, five times as much as in 1970.

Table 11: Development of railway container transport[1)]

Year	Number of 20' and other containers	Transport volume (1000 t/a)	Transport services (mill. tkm/a)
1970	185 524	890	179
1975	358 253	2 036	423
1980	486 500	2 935	664
1985	735 993	4 527	1 066

The international trend of structural change of industrial commodity production results even in the GDR in that the valuewise production growth is becoming dominant. The proportion of goods of a high value density is on the increase. Such products of a high value density are subjected to increasingly new requirements on transport, transport duration, promptness of delivery, transport adaptation to production rhythms and transport quality with a view to the protection of goods from damage, destruction and loss.

Whereas transport of high-quality goods is on a fast increase, the speed as far as bulk-cargo transport is concerned has distinctly decelerated ever since the early eighties. With the exception of brown-coal transports, which will continue to increase, near saturation has come to pass.

The fast growth of high-quality transport goods calls imperatively for solutions orientated to freight types of transport organization, which have to be made available by logistics. At the same time the field of application has to be extended and new transport technolgies created.

Logistic solutions had been developed during the past period of development, primarily for bulk-cargo transport, because such cargoes do constitute an extraordinarily high proportion of the total freight volume.

1) Source: According to data taken from the Statistisches Jahrbuch der DDR

During the first stage, important cargo flows had been formed completely new and efficient by means of the methods of linear transport optimization, involving an concomitant structural separation of these flows and delivery relations, respectively, realized by them.

In order to achieve further reduction effects the concept of transport optimization was extended in the second stage to be one of production-transport optimization, by veriabilizing, within limits, the restrictions imposed by production and consumption, by including effectivity characteristic values (action coefficients) and by extending optimizations to several sorts of cargo and to several production and transport stages respectively.

The solutions arrived at by production-transport optimization have to be secured for permanent operation. This is effected in a complex approach in the third stage within the scope of production-transport rationalization, the practical implementation of which are above all the production transport chains, with these chains constituting the realization of the logistic principle of advance information.

At present, the expansion of the logistic field of application constitutes an important task in the GDR, comprising all sectors of national economy.

The further development of the freight transport system is focused on

- the further development of innovative complex transport technologies and
- on the extension of freight transport technologies specific to the respective branches of transport.

Characteristics of innovative freight transport technologies are

- the introduction of logistic production-transport chains,
- the expansion of container and pallet transport,
- the development of modern general cargo und small cargo technologies.

The further development of innovative freight transport technologies is linked with the widespread effective application of information and communications engineering.

Already now the following forms of the communication-engineering basis are being used for logistic solutions in the GDR:

- The telephone and telex network for communication among transport customers themselves as well as among transport customers and transport coordination and dispatcher organs respectively,

- Dedicated lines and the hand-operated data network for direct data exchange among EDP systems operated by transport firms and by the transport customers.

As soon as the public data network is available, the dedicated lines and hand-operated data network will gradually be removed, to be replaced by corresponding data network connections.

The implementation of the basic logistic work principle to the effect: ... "that by application of the key technologies it has to be assured that the material needed (raw material, working material, product) be available in required quantities in its proper state at the proper time at the proper place at minimum expenditure and effort" - is of a qualitative and quantitative impact on the transport, handling and storage processes and requires an adequate transport-logistic offer of services on the part of the transport branches.

The introduction of logistic production-transport chains for selected types of bulk goods in 1986 has established important bases for a more reliable organization of the cargo flow on the basis of controlled information flows. Their implementation will provide a new technological level for 60 % of the railway cargo transport volume.

Being to the fore of these efforts is the objective to cut down by an annual 3 ... 3.5 per cent the expenditure on energy, material, working time and transport service costs in terms of one national income unit.

By 1990 ten logistic production-transport chains will be set up. The implementation of these chains will result in major economic effects as to the economic and effective realization of cargo transport processes, saving of transport efforts and as to an increase in stability and reliability concerning the supply of industry and other sectors of the national economy.

The first logistic production-transport chain, set up for iron ore, was put into practice in 1986. Its introduction has resulted in significant economic effects, and important scientific and technical experiences have been gained for the preparation and introduction of further logistic transport chains (for instance, for the "Solid Fuels" production transport regime and for the "Sugar" production-transport chain).

All in all, the practical result of this new logistic systems approach has been a more economic and effective organization of the material flow of iron ore at less expenditures of transport, handling and storage jobs. An important result is the achievement of a logistic information lead. This advantage is being used to make precise arrangements for raw material expenditure and to realize transport, handling and storage processes much more economically and effectively.

As a result, cost savings as to

- pig-iron production,
- transport, transshipment and storage processes at the Metallurgical Plant "Ost",
- transshipment processes in seaports,
- railway transport processes

had been amounting to some 6 million M in 1988, thus resulting in a reflux period of six months.

The development and introduction of the floatglass production transport chain has resulted in an overall reduction of transport losses in railway shipments. The basis for this has been the introduction of a logistic technology replacing the then rigid loading method with a view to the material flow and allowing of applying the gliding loading method.

All in all, this new logistic system approach has resulted in a quality- and demand-adequate supply of the national economy.

In particular,

- transport damage has been cut down by 66 % and by 435 000 M per year, respectively,
- timber consumption for cargo safeguards has been reduced to 25 % of its hitherto value.

The floatglass production-transport chain has yielded cost savings totalling 3.4 mill. M.

Along with the further expansion of the container and pallet transport significant projects concerning the modernization and widespread effective application of information and communication technologies are planned.

As the process of upgrading and renewal of production is continuing, the transport of high-quality and small-tonnage goods in small-cargo and sundries transport is gaining much in importance. The objective of guaranteeing a high degree of speed, delivery promptness and flexibility in transporting such goods is intended to render conventional sundries transport more efficient than until now, by developing logistic solutions, and to modernize it, by applying information and communication techniques.

The Berlin-Ostgueterbahnhof general cargo dispatch office is a first exemplary solution as to the application of modern key technologies in general cargo transport in the GDR.

As a result it can be realized that since April 1988 the dispatch and reception of some 350 tons of general cargo per day has been by computer assistance. The 11 CAM workstations set up allow of speedy handling and data processing, involving some 1000 consignments every day. 12 Computers collect, among other things, all the data needed for dispatch, identify distances and computate fees. On the reception side, the computers arrange for the vehicles necessary for about 100 runs a day and execute, among other things, performance accounting for the vehicles.

In this way a total of 21 workers and 300 000 M in prime cost are economised every year, while the capacity of goods wagons can be increased by 15 %.

After adaptation of the software modules to the conditions of other sundries handling depots this example will be applied to other GDR goods stations.

The development of freight transport technologies specific to the given branch of transport ist geared to perfect the basic technologies in terms of their reliability and efficiency and to introduce continuously logistic performance concepts in connection with modern transport technologies.

The strategy of further application of logistics within the scope of development of the GDR freight transport system is intended to develop high-quality services by intensifying the transport processes and modernizing the transport capacities as well as by the all-round application of modern information and communication technologies, and to implement them step by step.

I.3. Distribution channels and structures

As of tradition, in the GDR, circulation of means of production comes to pass in the following two ways: by direct transaction and by inclusion of the means of production trade. At present, manufacturers will deliver about 80 % of the means of production directly to consumers. This percentage has not been changing essentially ever since 1970.

Circulation by direct transaction involves above all the following advantages:

- no intermediate storage, hence, no need of repeated warehousing and evacuation of products,
- possibility of using beginning-to-end packaging,
- favourable conditions for precise coordination between production and demand,
- low expenditure as to movement of goods.

The advantages of circulation through the means of production trade are in

- the posibility of changing production assortments into assortments that are to a large degree adapted to consumer needs,

- a better adaptation of the supply rhythm to the consumer rhythm, which cuts down uneconomic stock keeping on the consumer side,

- an economic and effective utilization of transport capacities for the supply of consumers with small batches by corresponding supply runs in the given territory.

The means of production trade having an approximate share in supply of 20 % along with its total of some 130 trading enterprises is responsible for, and takes care of, essential sections of material and technical supply of the national economy. Its function is that of an intermediator, by bringing circulation partners together, and of an organizer of material and commercial circulation processes. They concern exchange relations, where

- there is no synchronism in the rhythms of production and consumption,

- production is made for stock,

- supply is from available stocks,

- sub-supplies require special kinds of circulation (procurement according to assortments, deadlines and places of use).

The specialization effects are complemented by additional forms of division of labour within the means of production trade, which, without subdivision, is organized in terms of whole-sale and retail trades.

It ist estimated that merchandise turnover of the means of production trade will be on an absolute increase.

Besides combines and firms in economy the trading enterprises of the'means of production trade supply the institutional market as well and even private consumers through special trade facilities as far as a few assortments are concerned (i.e., paints and varnishes, passenger car tyres, building materials). This share of supply in the total turnover of the means of production trade amounts to appr. 14 %.

The specific feature of the means of production trade and its national-economic significance is, among other things, exemplified by the fact that the 12 centrally managed combines and branches of trade supply some 500 000 consumers, 80 ... 90 % of whom are small consumers. The assortment of the means of production trade comprises far more than 650 000 articles, which is to say that they are kept in stock. So, for instance, the machine-building trade provides some 35 000 consumers with approximately 310 000 products of the metal-working industry, of electrotechnics and electronics; the chemical trade about 120 000 consumers with some 65 000 chemical and chemo-technical products, photo material, paints and varnishes, tyres; the bulding materials trade, some 100 000 consumers with about 45 000 different products of the bulding materials industry, heating equipment and sanitary ceramics; and the forms of the industrial textiles branch, some 70 000 consumers with about 90 000 items for use in the garment industry, shoe and leather goods industries.

Apart from these supply commitments this branch of trade renders specific services to public consumers, and it sees to the circulation of imported means of production (e.g. fork trucks, rolling bearings) within the GDR.

The significance of the means of production trade for stock keeping can, among other things, be seen from the fact that in 1985 this branch es share in the total circulation volume was, for instance, 74 % with a view to rolling bearings and 64 % with a view to screws. Other assortments' shares range between 10 and 100 %.

The further development of flexible manufacture in production and of integrated automation solutions involves the following requirements to be made both on the system of direct delivery and on the means of production trade as far as the arrangement of material and technical procurement and, thus, for the systems of distribution are concerned:

1. Consumer procurement over a wide range of assortments per delivery. This involves above all in the case of deliveries to major consumers an increased delivery frequency rate in terms of small supply amounts per delivery.

2. Supply after short and binding intervals, that is, time limits in terms of hours up to a maximum of 14 days, as a rule.

3. Widespread application of customer-oriented forms of offer and sale, with regard to additional services to be rendered in future, and on the basis of sufficient stock structured according to plan.

4. Development and perfection of logistic provision systems, highly mechanized and partly automated transport, handling and storage processes as well as modern relations of cooperation among manufacturers, stock keepers and consumers of means of production.

Besides rationalization efforts to be taken in the storage business, the expansion of actual user business is of particular importance. In this sort of business commodities do not pass through the warehouses of the means of production trade but will be conveyed directly from manufacturers to consumers.

It is presumed that the share of direct traffic will increase in the next years to come on the understanding that the range of goods which meets consumer demands should be kept stable and that the goods flow should be accelerated. The objective is for bringing about such a proportion of the two kinds of circulation that is in keeping with national economic considerations.

Thus, for instance, part of the wholesale enterprises operate already today on the basis of computer-assisted, articlewise stock control, permitting flexible ordering and delivery arrangements, including contracting.

The consumer goods trade increases continuously its annual commodity turnover (comp. Table 10). There is a workforce of almost 650 000, employed at 95 000 retail sale facilities, 160 major warehouses and working as drivers for a total of 16 000 vehicles. The present number of computer workstations is about 2600, controlling and balancing the movement of goods on an international scale covering both the wholesale and retail trades. In order to assure articlewise information processing for the computer-assisted management of procurement processes, it is necessary to process a great amount of bulk data (some 3 million information units every day).

The development of logistic chains in the consumer goods trade features the following trends:

1. The article flow for supply of the retail trade sales points from the wholesale warehouses is by computer control for all assortments in all counties on the basis of modern information engineering.

   Thus, at present, a total of 850 CAM workstations is in operation in combination with central computers for the management and control of handling, stock-keeping and transport processes in the shop goods branch. In other sectors of the in-house logistic chain, ranging from the registration of goods received, storing place administration, ordering organization, sales analysis and claim service to transport optimization, processes have been remodelled.

2. For the further development of cooperation among production firms and trade 400 workstations have been set up for the overall execution and control of the contractual and goods purchase processes in the wholesale trade and department stores.

3. Thanks to the application of modern computing and terminal cashing equipment, including label readers, in the Berlin Centrum Department Store, a remodelled, articlewise, sales and handling organization all through the producer - department store storage - sales, chain is in operation, covering more than 500 single items - partly by application of the EAN bar code. The turnover increase achieved in this way has exclusively been due to the acceleration of movement of goods and to cutting down storage times, while supply reliability has been increased at the same time.

4. The application of information logistics in goods handling, for instance, among sales sections indepartment stores and large-scale storages with the aid of connected computers and remote data transmission, has resulted in a reduction of stocks and winning storing spaces for other uses. Moreover, goods availability has essentially been reduced for sales.

5. In order to facilitate customers' shopping conditions, computer-assisted sales and cashing methods have been developed. To this end, above all personal computers and counter terminals as well as cash computers are used. Part of these devices are being fitted for money card purchasing and for articlewise registration of movement of goods by means of optical reading. Thus, for instance, an integrated sales and dialog system has been set up for the Berlin furniture trade, making use of remote data processing for sales dispositioning in all major sales facilities by permitting access to the enterprise's total stock. The computer-assisted preparation of purchase contracts reduces furniture sales times up to 70 %.

6. Measures geared to standardize packing materials, transport vehicle spaces and storage capacities, to use modern handling, transport and storage equipment on the basis of computer techniques and automation as well as to implement overall machine-readable product identification in the production - whole-sale warehouse - retail trade - cash-register sales chain are intended to allow of overall logistics application that 10 ... 30 % of efficiency reserves should be opened up as a result.

I.4. Stock keeping, materials movement and packaging

With the intention of accelerating production, circulation and freight transport processes, the integration of logistics into socialist management, by taking advantage of modern computation engineering, and allround rationalization of the handling, storage and packing processes on the basis of effective technologies and modern technical facilities is of great importance. To this end stable material flow chains and systematic cooperation are just as important conditions as are short turnover times and flexible stock keeping.

The producing sectors are to an increasing degree provided with computer-assisted demand systems, permitting flexible responses to changing demands. To this end automated in-house transport, handling and storage projects have been developed. With the aid of mainframe computers, CAM workstations, robots and automated handling facilities and use of process computers in material, tool and shipping stores mixed manufacturing and material flow systems of a high capacity have been devised in the electronics, electrotechnical and chemical industries and in machine tool building. Besides, traditional handling techniques (such as, for instance, use of fork trucks, electric trucks, rack trucks and other mechanical devices) and conventional equipment for handling and storing (included in here even pallets, bins and boxes) will continue to exist for a certain time still.

In the domestic trade sector modern high-rack storages in connection with computation equipment and automated transport, handling and storage technolgy has come into origin. Due to the introduction of forms of international goods encoding for selected groups of assortment for a start (e.g., hosiery, film stock and other consumer goods) there are now conditions for controlling material and information flows according to logistic principles. This renders it possible to organize the aggregate of handling, stock keeping, in-house and external transport and packaging right through, beginning from manufacturers to consumers according to time- and cost-beneficial criteria. All the same, operatives in production, in trade and consumers will in the next few years to come be faced with the exacting challenge of dramatically reducing technologically conditioned throughput times, by applying efficient transport, storage and packaging techniques on the basis of microelectronics and logistically controlled material flow and distribution lines.

In transport a number of modern facilities for handling and storing bulk goods have come into existence in the GDR sea ports and inland harbours, and this also in cooperation with the coal industry, building trade and agriculture. Of great importance to GDR's freight transport are the 27 places of transshipment for large containers, equipped with efficient container gantries, and another 22 transshipment points for split and combined container transport.

Within the scope of general cargo transshipment, at present effected in mechanized operation at about 53 %, further conditions are being created in order to implement the integrated utilization of microcomputer technology for preparation, execution and accounting of the sundries transport and for the full integration of consignors' and consignees' information and communications systems.

In the field of packaging, the requirements to be made on the transport-adequate product design - and, to a part, in analogy to packaging design - can be summarized according to the principles

- system-adequate,
- damage-preventing and
- effectivity-conducing.

It is on such a basis that maximum dimensions and the number of single items can be determined according to the given technical details of vehicles, handling devices and storage buildings.

In many fields transport, transshipment and handling of goods subject to loading guidelines and specific packing patterns, and the goods are secured by cargo safeguards and filling in of empty spaces in the means of transport. There is an increasing use of optimization models for the effective utilization of stowage spaces in the means of transport.

If packaging permits the formation of unit loads, transport, handling and storage is by mechanical and automated operation respectively. In this way modern transport, handling and storage techniques (automatically operating high-rack storages, computer-controlled industrial trucks and devices, palletizers and other things) are made efficient use of.

Choice of packaging is subject to stress and duty values holding for rail transport. For confirmation of the proper dimensioning of transport packing materials, depending on

- cargo properties,
- transport, handling and storage stresses,
- packing materials used,
- design of transport packaging,
- loading method, and
- economical use of material,

the sender is free to check his transport packaging with a view to stresses either on his own or avail himself of the services rendered to this effect by facilities attached to the Forschungszentrum Verpackung in Dresden (nationally owned Packaging Research Centre, Dresden) or by the Zentrales Forschungsinstitut des Verkehrswesens in Berlin (Central Transport Research Institute of the GDR).

I.5. Logistics costs and effectivity

Characteristics of logistic work principles applied in important GDR combines and firms are

- the development of demand systems, according to which consumers request delivery of their material needs in keeping with their actual production demands,

- instructions on binding timings for sub-supplier items and for the respective transport carriers,

- opt mizing lot sizes with the objective of ordering and observing terms of delivery,

- stipulation of uniform responsibilities for material flows in their entity,

- interlinking of production and in-house transport, handling and storage processes with the objective to execute cargo flow control on an integrated logistics basis.

In the GDR, essential financial and material means are earmarked for logistics organization solutions to be applied in production, trade and transport. Following expert assessments and international empirical values the share of these costs in GDR's produced national income has almost doubled since 1975.

This increase in logistics costs is manifest above all in the fields of industry and trade, where development of process organization by means of up-to-date computer engineering, automation solutions and production methods is at its fastest, where relatively high expenditure is required, but where even effectivity growth is at a rapid increase.

Table 12: Development of logistics costs in GDR's national economy[1]

Sector	Costs (thousand mill. M)[1] 1975	1980	1985
Production (including procurement and sales)	10.9	18.7	41.3
Transport and handling[2]	15.0	18.9	25.0
Storage	5.0	7.2	10.3
Total	30.9	44.8	76.6
Percentage on industrial commodity production (%)	14.3	13.2	14.1

It is estimated that due to the introduction of modern freight transport technolgies and further rationalization of storage management expenditures in these fields will continue to increase until 1995.

1) As established on the basis of expert assessments; no statistical data have been published

2) Referring to appr. 970 mill. tons to be shipped in the GDR every year

II. Management structures and strategies

II.1. Organizational and institutional structures

Management

Administration and planning of GDR's national economy is being effected by the Council of Ministers (diagramm No. 1). The planned economy of the GDR is based upon Five-Year Plans and Annual National Economic Plans. All ministries, combines and enterprises of the national economy are included in plan drafting as a result of which the quotas set by the state are confirmed as binding plans for ministries, combines and enterprises by the Council of Ministers.

GDR transport operates on the basis of the uniform socialist transport and traffic policy.

The Ministry of Transport is in charge of central administration and planning of transport.

The territorial administration of transport is in the hands of the counties of the GDR and their districts, cities and towns. Their vehicles are the territorial traffic-managing bodies. There is a close cooperation between the central management and the territorial transport managements.

Management of the branches of transport and of the domestic freight transport enterprises is being realized as follows:

1. Railways

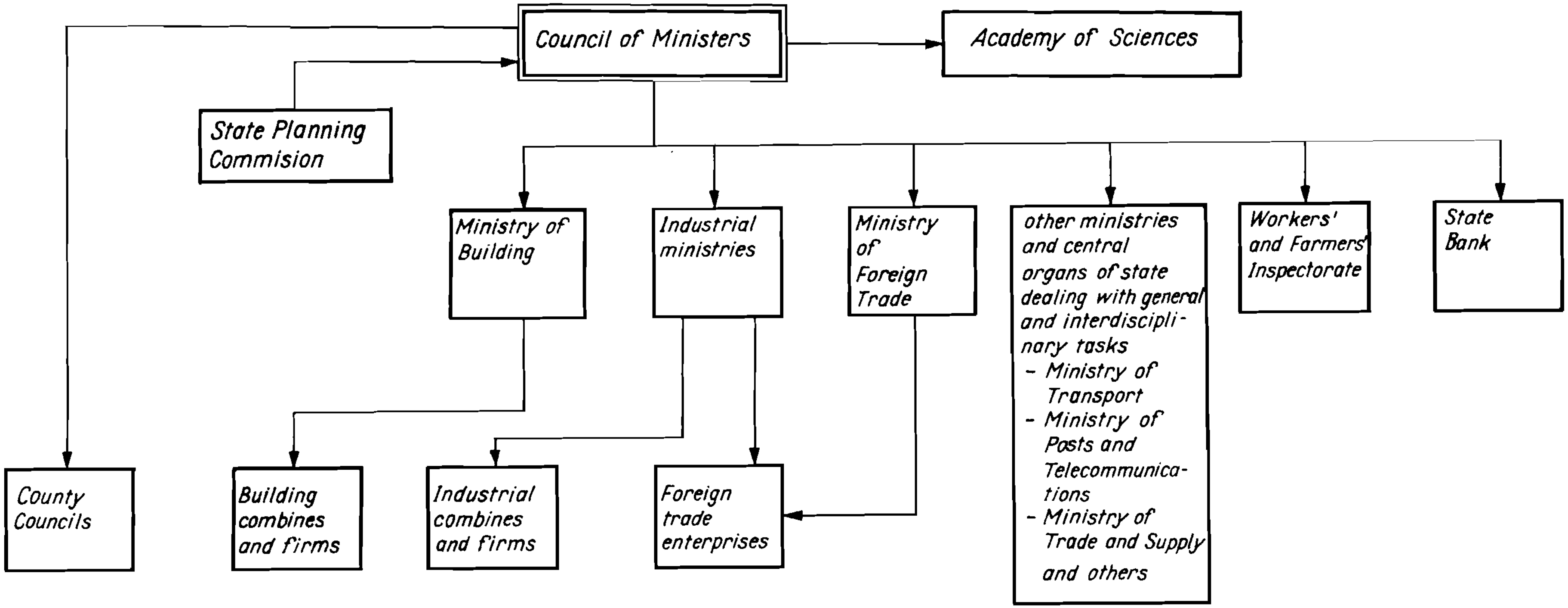
The Central Administration of the Deutsche Reichsbahn (DR) as National Transport Undertaking, is part of the Ministry of Transport. The Deutsche Reichsbahn is subdivided into the divisions railway transport, railway vehicle maintenance and railway construction.

The character of the transport process causes also the direct operational ensurance of the railway operation by central management. This task is taken care of by the DR Main Staff for the Operational Management responsible to set the objectives of organizing the transport preparation, effective technologies of the transport processes and the control of the railway operation.

The railway transport division is territorially subdivided into eight Reichsbahndirektionen (Rbd - railway decentral administrations). In oder to control the local Establishments for railway operation and traffic (railway stations) there are 23 departments, the Reichsbahnaemter (Rba).

In accordance with DR's division of labour the stations, the locomotive depots and railway maintenance workshops are among the most important local railway establishments.

Diagram No. 1: Management structure of GDR's national economy



For the territorial management of railway transport the Rba and, moreover, the subordinated Rbas are responsible as far as the railway operation and traffic are concerned.

Connecting railways form one basis of railway transport among consignors and consignees. The National Board for Connecting Railways has the task to supervise and control all connecting railways in the technical field. The implementation of the connecting railways in the management of the companies concered depends above all on transport volume, existing track lengths and on the kind of service operations. Major connecting railways are run by independent managements.

2. Road transport

National administration of road transport is being done by the transport-managing bodies of the counties on the basis of the directives issued by the Minister of Transport. The technical guidance given by the Road Transport Main Administration of the Ministry of Transport is focussed on the implementation of uniform transport-political, economic and technical principles for all transport combines.

The basic units of road transport management are the Verkehrskombinate (nationally owned transport combines), subordinated to the respective County Council. These combines include different numbers of legally independend road transport combines.

The road transport organization structure covers also private companies in the field of public road transport and company transport.

Company transport management differs from one branch of industry to the other, ranging from the subordination to general administrative departments, via special transport departments to independend transport companies (as, for instance, in the case of trade transport enterprises).

The effective use and the long-term development of the company transport fleets have to be ensured by the management concerned.

3. Inland navigation

National administration of inland navigation and waterways is by the Ministry of Transport.

The centrally administered VEB Kombinat Binnenschiffahrt und Wasserstraßen (inland navigation and waterways) comprises, among others, the VEB Binnenreederei (inland shipping company for goods transport by domestic ships), the VEB Wasserstraßenbau (waterway construction) and the VEB Binnenhäfen (river ports responsible for goods transshipment, handling and storage).

4. International transport

With the objective of ensuring international transport operations the Ministry of Transport concludes inter-governmental agreements and treaties with other states or authorised heads of transport enterprises subordinated to the Ministry (DR, VEB DEUTFRACHT) to conclude non-governmental agreements and treaties with foreign transport organizations. The VEB Kombinat DEUTRANS is the most important organ to prepare external trade transports, by coordinating foreign trade with transport operations, and to actually effect external trade transport jobs by road.

II.2. Economic regulations concerning logistic aktivities

The basis of further development of economic regulations of logistic activities in the GDR is the perfection of socialist enterprise management by taking advantage of modern computer engineering. New conditions are being created by applying the new self-financing principles. This will give more effectiveness to the reproduction process in all its different phases. Essential factors are as follows:

- Establishment of stable relations between the final and supplier industries,

- Perfection of the balancing and contractual systems,

- Orientation of economic regulations in national economy towards the economization of the circulation of funds, circulating means economics and economic stock structure.

An increasing feature of the economic regulations is that logistics is being understood as an overall concept of planning, control and supervision of material and information flows integrated in the managerial activities, beginning from customer ordering to the delivery of final products to customers.

The centrepiece of the system economic arrangements for logistic activities is national-economic planning, balancing and accounting of the freight transports. The firms, enterprises and combines plan transport expenditure in relation to the production volume. The object of planning are the transport costs for utilization of the public transport branch, company transport costs by means of motor vehicles, the freight transport volume and freight transport output and capacities of company fleets of road vehicles.

The transport balances of the public branches of transport and the territorial transport balances of freight transports by road are drafted on the basis of the transport requirements made by enterprises. As a result, a GDR transport balance is made up in comparison to the transport requirements made by the enterprises, combines and branches and the transport capacities available. Then, in accordance with such a transport balance, the enterprises and combines are assigned transport indexes as state plan indicators for the employment of transport services rendered by the public transport branches as well as for the transport operations effected by company transport.

Moreover, as far as the transport branches railways and inland navigation are concerned, the local transport offices have to be informed every month on transport requirements. Another important part of arranging economic activities in the field of freight transport is the coordination of transport tasks by the GDR Central Transport Committee, County Transport Committees and District and Town Committees. The most important tasks to be complied with by these committees are as follows: Discussion of long-term conceptional objectives, allocation of tasks to the various transport branches, development and utilization of transport capacities and analysis of transport situations.

The price system for domestic freight transport is of a high priority within the system of economic regulations for logistic activities. Ever since January 1st, 1982, the price system for domestic freight transport has undergone major changes. The formation and, hence, differentiation of freight transport prices is based on variable transport expenditure, referring to one transport unit to be settled by the respective price.

Cargo transport by rail is subject to prices per ton/kilometre, depending on freight classes and volume classes.Goods sort differentiation is on the basis of four classes, volume differentiation on the basis of six classes.

The tariff system is also highly differentiated as far as freight transport by road is concerned. This holds above all as far as such services at destination runs, pick-up runs and distribution runs, other services and special services, full-utilization consignments, delivery and cartage of car loads by rail as well as turns by ship and accessorial services are concerned.

As for the container transport as a typical logistic service, a standard container transport tariff includes all the fees as to railway transport, use of railway-owned containers, container transshipment and handling, and forwarding and pick-up by motor vehicles.

Altogether, freight transport prices, by way of effective price levels and differentiation in terms of sort of cargo, volume and distance, are a stimulant to reducing unit transport expenditure and leads to an effective division of labour and cooperation between the railway, road transport and inland navigation branches of transport.

II.3. Manpower, resources and personnel training

There are 20 000 ... 25 000 graduates every year to complete their technical and scientific training at GDR universities and technical colleges. Part of them is contributing in the fields of research and development in accelerating the scientific lead with the objective of applying logistic and its principles of organization in economy.

Among the important tasks to be solved by a great number of engineers, technologists and socialist managers employed in the field of research and in practice - backed by a new training pattern for engineers and economists - are, as integration of logistic is on the increase:

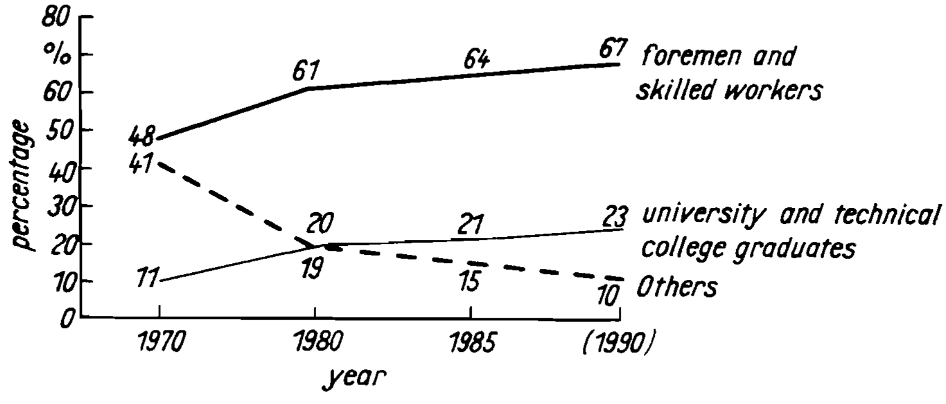
- development, organization and application of production-controlled material flow systems in combines, firms, enterprises and cooperation chains as well as their tying-up to form CIM chains,

- development of logistic stock-piling strategies for materials, unfinished products and finished products,

- development of logistic transport service offers and of operation mangement systems for external and internal transport, handling and storage.

The goal-oriented training and upgrading and in-service training scheme as pursued in the GDR is reflected in the following qualification structure:

Diagram No. 2: Development of the qualification structure of workers in the GDR



In order to assure an engineering and economic potential, among others for developing production-transport regimes, the "transport logistic" branch of studies has been introduced at the Dresden Transport University in 1988. As of September 1989 teaching and research at the Warnemuende/Wustrow Engineering College of Navigation will be based upon the same training objective.

The University of Transport "Friedrich List" in Dresden cooperates also with other universities and institutions of higher education, for example, with the Wilhelm-Pieck-Universität Rostock, with the University of Economics "Bruno Leuschner", Berlin and with the Leipzig College of Trade. Apart from establishing the "transport logistic" branch of studies within the Transport Technology Section, specialized training at the Transport and Business Management Section and advanced training facilities within an extended and coordinated scope are being prepared.

II.4. Research projects

Since the early eighties efforts have been increased in the GDR to carry out research projects on logistic solutions. The introduction of computer- assisted production-transport chains and island solutions in various enterprises and combines has marked the entry into the practical application of logistic solutions.

Until 1990 efforts will be taken to work on logistic research projects concerning the rationalization and innovation of national-economic material flows on the basis of 5 main directions:

1st Main Direction: Inter-branch logistic production-transport chains

- Pilot project of end-to-end logistic interfacing of production and transport for the "Solid Fuel" -Regime
- production-transport chains in the building sector, chemical industry and agriculture, forestry and foodstuffs industry and processing industry

2nd Main Direction: Production logistic

- Integration of logistic objectives and solutions into national-economic automation projects
- model solutions for all-in combines logistic in the processing industry

3rd Main Direction: Trade logistic

- logistic concepts in the means of production trade
- logistic solutions in the consumer-cooperative trade with domestic goods
- logistic information systems in the trade with production and consumer goods

4th Main Direction: Transport logistic

- Further development of the container transport system and application of further forms of combined transport in inland traffic

- logistic techniques in small goods transport

- Logistic goods distribution centres at the interface of transports and loading economy in the fields of small goods transport and transshipment and handling of bulk goods

- Use of containers and development of straight transport chains in sea transport

5th Main Direction: Basic research on logistic

- Methods of process development and economic assessment of logistic systems and of management, planning, accounting and stimulation of logistic processes

- Foundations of information technology.

Conclusion

In view of the accelerated development of the productive forces the reduction of the reproduction cycle is becoming a decisive effectivity factor. The crux of the development of logistic solutions is to ensure a continuous flow of materials through all stages of production up to the final product on the basis of small stocks, short delivery times and a high degree of flexibility. Rationalization, modernization and partautomation of transport, transshipment, handling and storage processes are an essential condition in order to achieve an optimum of interfacing between transport, transshipment and storage processes and manufacturing processes.

The implementation of logistic on a national-economic scale calls for constructing efficient inter-process and inter-branch communication systems. The conditions for this are created in the course of the stepwise installation of the public automated data network in the GDR, entailing an improvement of the possibilities of interconnecting date acquisition, storage and processing resources of the enterprises, combines and institutions which are logistically linked up with one another.

The comprehensive application of logistic and its work principles calls for systematic training and postgraduate training of personnel for them to acquire multiple skills in the fields of transport, handling, transshipment and storage processes.

All down the line beginning from managers to every single worker there must be a thorough understanding of logistic and everyone is required to master their respective tasks. That is why the challenge is above all for personnel training on all levels, besides the further improvement of the training profiles and patterns.

References:

Blessing, K.; Schmidt, H.: Die Integration von Produktion und Transport als Bestandteil der Veredlungsstrategie in der metallurgischen Industrie (Integration of Production and Transport as a component Part of the Upgrading Strategy pursued in the metallurgical Industry) DDR-Verkehr, Berlin 19 (1986) 4, pages 99-101

Dörre, G.: Erfassung und Darstellung von Materialflüssen (Registration and Presentation of Material flows), Wissenschaftliche Zeitschrift der Hochschule für Verkehrswesen, Dresden 33 (1986) 5, pages 747-752

Ellger, U.; Krampe, H.; Teßmann, G.: Grundlagen und Voraussetzungen für den schrittweisen Übergang zu komplexen logistischen Lösungen im Bauwesen (Foundations and Conditions for the stepwise Transition to complex logistic Solutions in the Building Industry) DDR-Verkehr, Berlin 21 (1988) 5, pages 133-135

Feige, D.; Richter, K.-J.: Entwicklung der Modellkonzepte für die Transportoptimierung (Development of Model Concepts for Transport Optimization) DDR-Verkehr, Berlin 21 (1988) 1, pages 10-12

Fischer, H.; Meier, H.; Teßmann, G.: Die Aufgaben der Transportökonomie und Informatik beim Aufbau rechnergestützter Produktions-Transportketten - Erfahrungen aus der Transportkette Eisenerz (Transport Economics and Informatics Tasks for setting up computer-assisted Production-Transport Chains - Experience from the Iron Ore Transport Chain) Vorträge - 15. Verkehrswissenschaftliche Tage, Hochschule für Verkehrswesen Dresden, Tagungssektion VIII, pages 28-32, Dresden, 1987

Fischer, H.; Meier, H.; Teßmann, G.: Lange Leitung verkürzt den Prozeß (Long Lines shorten Processes), Spectrum, Berlin 18 (1987) 8, pages 8-9

Fries, R.; Godau, A.: Innovation und Verkehr (Innovation and Traffic), Transpress Verlag, Berlin 1989

Hanisch, W.: Gütertransporte als Ladeeinheiten sind oft die rationellste Lösung (Freight Transports in Terms of Unit Loads are ever so often the most rational Solution), Technische Gemeinschaft, Berlin 33 (1985) 1, pages 22-23

Hanisch, W.: Zur Ausarbeitung langfristiger TUL-Konzeptionen im Produktionsmittelhandel (On the Elaboration of long-term TUL Concepts in the Means of Production Trade) IRAP-Information, Berlin 18 (1985) 1, pages 7-13

Richter, K.-J.; Westik, G.: Die Informatik als Instrument zur Steuerung und Leitung des Stoffflusses (Informatics as an Instrument of Controlling and Directing Material Flows), Wissenschaftliche Zeitschrift der Hochschule für Verkehrswesen "Friedrich List", Dresden 34 (1987) 1, pages 33-40

Richter, K.-J.: Modellbildung und Systemanalyse als Bestandteil logistischer Konzeptionen (Modelling and Systems Analysis as a component Part of logistic Concepts), Verkehrsannalen, Vienna 34 (1988) 3, pages 5-13

Richter, K.-J.; Vogel, H.: Ökonomische Bedingungen und Formen transportlogistischer Lösungen in der DDR (Econimic Conditions and Forms of transport logistic Solutions in the GDR), DDR-Verkehr 22 (1989) 5, pages 139-142

Schwabe, R.: Multimodaler Transport Operator - Gegenwart und Zukunft des Spediteurs (Multimodal Transport Operator - Present and Future of Forwarding Agents), DDR-Verkehr, Berlin 19 (1986) 9, pages 261-263

Strobel, H.: Computerintegrierte Prozeßautomatisierung und Logistik (Computer-integrated Process Automation and Logistic, DDR-Verkehr, Berlin 22 (1989) 5, pages 137-138

Teßmann, G.: Rechnergestützte integrierte Produktions- Transportketten - theoretische Grundlagen und praktische Anforderungen an ihre Entwicklung (Computer-assisted integrated Production- Transport Chains - Theoretical Foundations and practical Requirements on their Development), DDR-Verkehr, Berlin 18 (1985) 9, pages 261-265

Teßmann, G.: Höhere Integration von Produktion und Transport durch komplexe Produktions-Transportrationalisierung (Higher-level Integration of Production and Transport by all-round Production-Transport Rationalization), Hochschule für Verkehrswesen "Friedrich List", Dresden, 1985, Dissertation B

Teßmann, G.: Die rechnergestützte Produktions-Transportkette Eisenerz - Ergebnisse und Erfahrungen zur Durchsetzung moderner Technologien im Gütertransport (The computer-assisted Iron Ore Production-Transport Chain - Results and Experience concerning the Implementation of up-to-date Freight Transport Technologies), DDR-Verkehr, Berlin 19 (1986) 12, pages 362-365

Teßmann, G.: Grundlagen und Erfahrungen zum methodischen Herangehen an den Aufbau rechnergestützter Produktions-Transportketten (Foundations of and Experience in the methodical Approach to the Setting-up of computer-assisted Production- Transport Chains), DDR-Verkehr, Berlin 20 (1987) 9, page 26 and following pages

NEW LOGISTICS TECHNOLOGIES PROJECT

SYNOPSIS FOR NATIONAL REPORTS ON LOGISTIC STRUCTURES, STRATEGIES AND PROSPECTS

I. OBJECTIVE

The aim of a National Report is two-fold:

(a) to describe and evaluate the operation and efficiency of the logistic system, as well as the trends of development, the influencing factors and the socio-economic consequences, and

(b) to provide data, and analysis for cross-national comparisons of logistic structures and strategies.

II. REQUIREMENTS

The research areas and questions listed in this Synopsis and the Activity Plan should be considered as tentative and each research group is free to investigate other aspects also as well as to choose and use the most appropriate methods of analysis.

Regardless of how detailed and which aspects the national study covers the logistic data required should be presented according to the format described in this synopsis to serve cross-national comparisons and more in-depth analysis.

For the timetable of the national reports refer to page 58 of the Activity Plan.

III. METHODOLOGICAL ISSUES

A macro-economic system's approach should be applied to analyze the national logistic structures and strategies. For this purpose the national economy is defined as a material flows and stocks system. This system should be investigated from two points of view:

(a) as a physical system, represented by the actual material flow processes (transportation, storage, handling) and the related technologies, infrastructures, human resources, etc., and

(b) as an administrative system – the managerial and institutional structures and their strategies and policies, information and commulnication technologies, etc.

The systems should be studied on both the national economy level and on the branch level (according to the suggested classification). The manufacturing industry should be analyzed in detail (according to, at least, the 2-digit level of the International Standard Industrial Classification (ISIC).

The aggregate data and the macroeconomic studies should be supported (complemented) by several case studies, the aim of which is mainly to exemplify megatrends, e.g., a total logistics concept at the company level as well as to establish connections between the macro and micro levels.

IV. STRUCTURE

The national report should consist of the following parts: introduction, macro–economic study, new logistics technologies trends and forecasts, case studies, summary, and data appendix. Each part should reveal the history, the state of the art, and the future of the studied phenomenon.

V. CONTENT

1. Introduction

A short general description of the national economy: state of development, characteristics of growth, distribution of GDP, exchange rate of national currency, interest rate, rate of inflation, economic system, foreign economic relations, etc. Logistic evaluation of the geographic, economic, social and other features of the country.

2. Macro–Economic Study

2.1 *Physical Structure*

Using the collected data described in the Data Appendix (Item 5), and other sources logical and econometric analysis should be performed to reveal the main trends and the influencing factors in the development of the physical logistic structure. Some of the possible research areas, in order of priority, are as follows:

(i) Measuring of logistic (inventory, transport and storage) costs, and logistic efficiency.

(ii) Inventories (tendencies in inventory formation, inventories and the business cycle, econometric inventory models, inventories in the input–output models, models to analyze inventory forming factors).

(iii) Transportation (tendencies in the development of the transportation system, models to forecast the future of the different types of transport, use of containers and pallets, etc.

(iv) Distribution channels and patterns (tendencies in the development of the distribution patterns – direct distribution (producer to consumer); distribution through intermediate companies (wholesalers, brokers, etc.); models to optimize the distribution channels and patterns, etc.

(v) The impact of foreign trade on logistic structures.

(vi) Warehousing, materials handling and packaging.

(vii) Labour resources in logistics.

2.2 *Administrative Structure and Strategies*

Examples of research areas, in order of priority, are:

(i) Main characteristics of policies and regulation of the economic activities which have an impact on logistic performance, e.g., transport, trade, finance, tax and regional policies and the long- and short-term planning systems.

(ii) Organizational and institutional structures related to logistic actvities, e.g., description of the allocation of the logistic responsibilities on different levels in companies, regions and the government.

(iii) Research priorities in logistics: national program, Dollars spent, aims, methods and expected results. Give reference to most important publications.

(iv) Information technology and logistics, e.g., informatics investment, EDI (Electronic Data Interchange) promotion and logistic control systems.

(v) Human resources in logistics management, education, qualification, etc.

3. New Logistics Technologies Trends and Forecasts

The term new logistics technologies stands for a whole set of innovations of technological, organizational, economic and managerial character in production, trade, transportation and communication aimed at raising the efficiency of the material flows in the economy. Certain combinations of these innovations forming a more or less defined system have become known under definite names such as JIT (Just-In-Time), MRP (Material Requirements Planning), EDI (Electronic Data Interchange), FMS (Flexible Manufacturing Systems), Guaranteed Supply, etc. The following research questions should be investigated:

(a) Clear definitions and classification of new logistics technologies in your country;

(b) Penetration rates of the various new logistics technologies measured as a percentage of sales or number of companies per ISIC sector;

(c) Trends in technical development performance improvements for each new logistics technology, e.g., lead time improvements from first to second generation of JIT systems;

(d) Forecasts and scenarios of penetration and development of new logistics technologies with special emphasis on prerequisites, barriers and technical breakthroughs.

4. Case Studies

We are collecting case studies describing the early carriers of new logistic "frontiers" to support and explain the trend–breaking innovations in the physical or administrative systems.

Three types of case studies are welcome (the national report should preferably contain all of them):

(i) Logistic chain (distribution system) of a product through several companies;

(ii) Logistic system of a production (industrial, building, agricultural) company;

(iii) New logistic technologies applied by a wholesale (production goods) company.

The following research questions should be analyzed:

(a) What are the changes in the "new" in comparison with the "traditional" logistic performance regarding production, transportation, storage, handling, information system, management, etc?

(b) What is the new division and reallocation of tasks within the company (between the different organizational units) and in the logistic chain (between producers, consumers, wholesalers, and transport companies, etc.)?

(c) What are the requirements of the new logistic technologies towards production, transportation, storage, handling, informatics (communication and data process), education, and qualification level of the labour force, etc?

(d) What are the hindering and the accelerating factors – both technological and economic?

(e) What are the economic consequences of the logistic changes (e.g., changes in inventory levels, warehouse space, fixed capital, location, handling, transportation and information costs, labour costs, etc.) and for whom – the producer, the wholesaler, the consumer and the transport company.

5. Summary

The main conclusions of the national study should be presented and proposals for research areas for more in-depth cross-national analysis should be made.

6. Data Appendix

Data available from the following sources is being collected directly by IIASA:

1. Yearbook of Industrial Statistics, Volume I, United Nations, New York.
2. National Accounts Statistics, United Nations, New York.
3. Annual Bulletin of Transport Statistics for Europe, Volume XXXVII, Economic Commission for Europe, Geneva, 1985.
4. World Transport Data, International Road Transport Union, Geneva, 1985.
5. Statistical Trends in Transport 1965–1983, European Conference of Ministers of Transport, Paris, 1986.
6. Technico-Economic Analysis of the Role of Road Freight Transport. Road Transport Research, OECD, Paris, 1986.

We kindly ask the national teams to provide us with data from their countries that are missing or not yet available in the above publications and to help us adjust the data to harmonize with the definitions in the UN Industrial Statistics preferably on IBM 5 1/4 inch compatible diskettes.

Please help us to find the missing data in the UN Industrial Statistics for ISIC sectors 2–4 for the time period 1960 (if available) – 1986 (or latest available) particularly for:

(a) inventories (divided into materials, fuels and supplies, work in progress, finished goods), and

(b) transport costs (by transport mode).

We also require data for the following ISIC sectors: 1: Agriculture; 5: Construction; 6: total and divided into Wholesale Production Goods, Wholesale Consumer Goods, Retail Trade, Restaurants and Hotels; 7: total and divided into Transport, Storage and Communication; 8: Finance, etc.; 9: Community.

If available we also require:

1. Transport Indicators

- Transport of output from ISIC sectors and the whole economy in cost, ton-km, ton, averge length of haul, goods value: for rail, road (hire or reward, own account), inland waterway, pipeline, sea, air and domestic, import, export.
- Number and size of vehicles and containers per type.
- Length of transport network per mode.

2. Storage Indicators per Sector

- Warehouse space (m^2, m^3)
- Value of handling equipment
- Manpower cost
- Annual warehousing cost per value of inventory

3. Logistic Administration Indicators Per Sector

- Manpower, total and highly skilled
- Lead time for deliveries (manufacturing, administration, transport)
- Cost (% of sales)
- Telephones, computer terminals, informatic investment, communication services bought per sector, total and for logistics.

4. Additional Indicators per Sector

- Export, Import
- Size distribution of companies (production unit) according to: gross output, value added, number of employees, fixed capital.
- Fixed capital
- Manufacturing or industrial sales – total and by ISIC
  - (a) production goods (investment, intermediate), consumption goods
  - (b) production goods (wholesale, direct)
  - (c) consumer goods (wholesale, retail, direct)

5. Input/Output Tables

(As detailed as possible, most recent, ca.10 and 20 years earlier)

6. General Data

- Territory
- Population
- Annual rate of growth of GDP (national income)
- Exchange rate of national currency to US $
- Real interest rate for inventory investment
- Expenditure on the GDP (if not published in UN National Account Statistics)

for the West Economies Gross Domestic Product – total	*for the East Economies* Net Material Product – total
1. Government final consumption expenditure	1. Consumption of the population
2. Private final consumption expenditure	2. Consumption of the non-material sphere serving the community as a whole
3. Gross fixed capital formation	3. Net fixed capital formation
4. Increase in stocks	4. Increase in material circulating assets and in stocks – in stocks – in incomplete capital formation
5. Export of goods and services	5. Export
6. Import of goods and services	6. Import (-)

All data should be defined and measured in a harmonized way according to UN Standards and any deviation from them should be indicated.

7. Additional Indicators for the Circulation (Trade) Sphere

(a) Manufacturing or industrial sales – total and by ISIC industries (or products)

- production goods
  - investment goods
  - intermediate products
- consumer goods

(b) Wholesale sales – total and by ISIC industries (or products)

- production goods
  - transit (producer to consumer)
  - through warehouses
- consumer goods

(c) Retail sales

- durable goods
- non-durable goods

(d) Number of companies

- wholesale (production goods)
- wholesale (consumer goods)
- retail

(e) Size distribution of trade companies (by type) according to sales

(f) Warehouse (storage) space by type of trade

- wholesale (production goods)
- wholesale (consumer goods)
- retail

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