MICROPROBLEMS OF THE FOREST SECTOR

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PREFACE

The microproblems in the forest sector deal with problems at the corporate and mill levels, however they can not be studied separately from the macroproblems, i.e., trends and problems at regional, national or global levels, because these macrosystems form that economic, political and sociological environment and climate where the individual companies and mills must be operated. The macrolevel problems can be most suitably studied nationally and/or internationally in suitable organisations or institutes and the results of these analyses must then be projected by the company's own staff to the company and mill levels. The microproblems discussed here can be roughly divided into the following groups:-

-- resource management
-- raw material procurement
-- technology
-- strategic planning
-- operational efficiency
-- marketing
-- policies

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INTRODUCTION

Included in the following will be the term forest sector which means the whole chain starting from Forest Management and ending in Marketing the final products. Also the multi-usage, forage, wilderness, conservation, water shed etc. is included. Figure 1 (Uronen, 1980b) gives a schematic presentation about the hierarchy of the problems (or inputs to this sector. In addition to this the regulations of authorities and the expectations and targets of different interest groups should be met and fulfilled. (Figure 2, Uronen 1980b.) The upper levels of the hierarchy of Fig. 1, i.e. macroproblems are global and universal and/or national, and regional and they can not be modeled, studied or solved inside a corporate or mill. This paper will deal with the problems, changes and demands as seen inside a corporate and/or mill and how systems analysis could more effectively be used there in solving these problems. But again, more and more the decision-making inside a corporate will be dependent on the development in the regional/national or even global economy and in the society; the trends and factors here form the "economical and political" environment where the technical decison making must be adopted.

GROUPING OF THE MICROPROBLEMS

Table 1 gives a grouping of different types of thus defined microproblems of the forest sector. However, this distribution between macro-and microproblems is totally artificial and in practical decision making at the corporate and/or mill level the macroproblems will be notified and taken into account

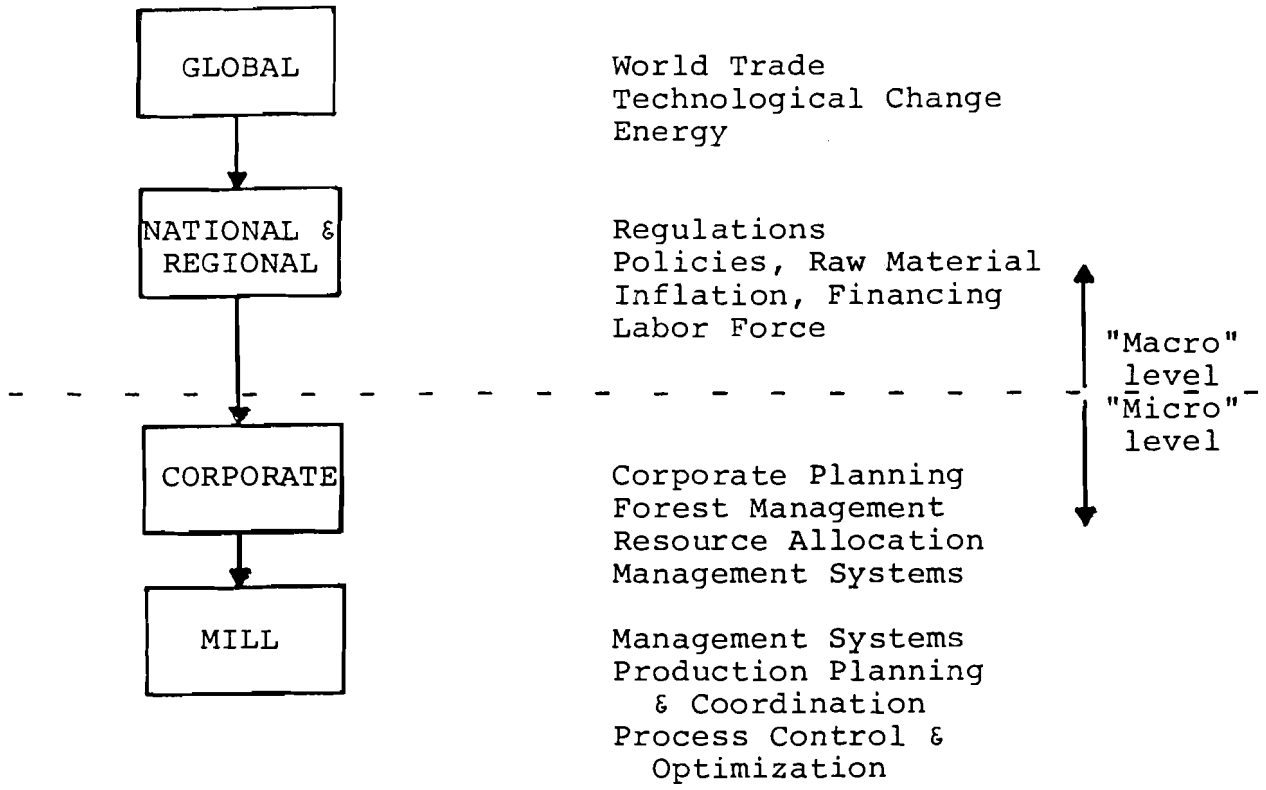

Figure 1. The hierarchy of problems in the forest sector. (Source: Uronen 1980b)

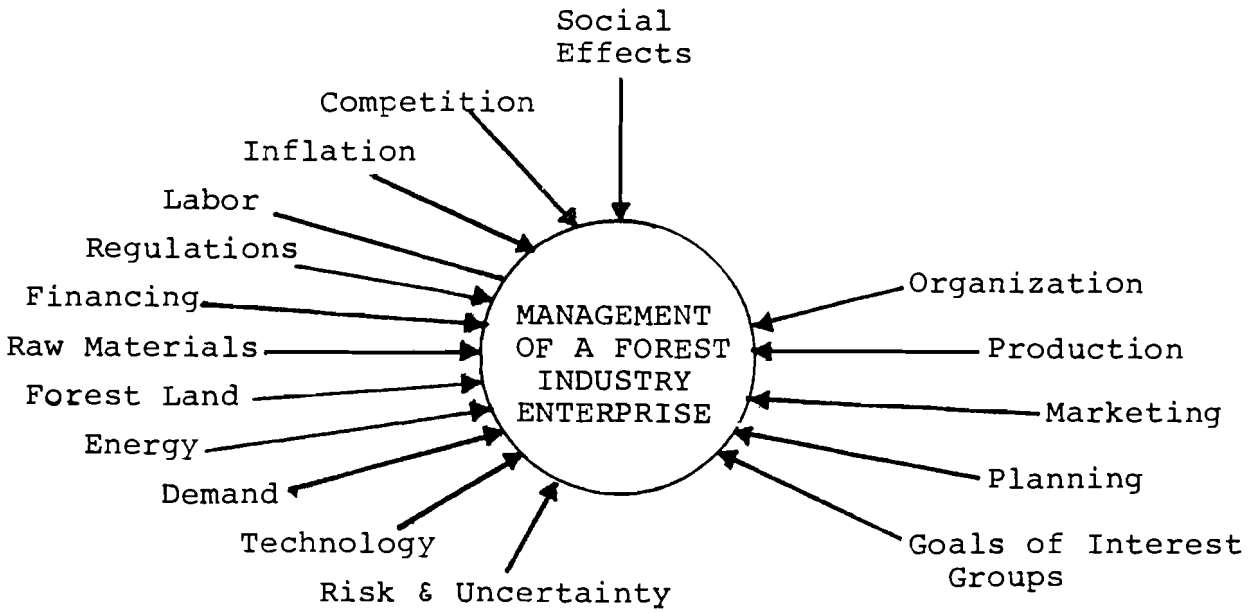

Figure 2. The "management environment" of forest industry enterprise. (Source: Uronen 1980b)

Table 1. Microproblems in the forest sector.

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a. Forest Management and Land Usage

- Sustained yield
- Stock inventory
- Yield and growth simulations
- Planning of activities
- Harvesting and transportation
- Competition on forest land
- Multi-usage of forest

b. Raw Material

- Procurement
- Transportation
- Storages
- Whole tree usage
- Labor force
- Mechanization
- Rationalizing

c. Technology

- Energy saving
- Pollution abatement
- Higher yield
- New products
- New raw materials
- Recycling
- Computerization and automation

d. Investment Planning

- Location
- Product mix
- Scale
- Technology
- Resource allocation
- Effect of regulations
- Multi-branch

e. Operation

- Labor force
- Training and education
- Automation
- Computerization
- Management systems

Table 1. (Continued)

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f. Markets

Demand (per quality)
Supply (per quality)
Changing end products
Competition (other technologies and materials)

g. Policies

Regulations
Taxation
Subsidies
Tariffs
Protectionism
Inflation
Financing

as far as models and/or data are available. Let us look a little more in details the different types of problems listed in Table 1.

FOREST MANAGEMENT AND LAND USAGE

These problems are faced by each corporate owning remarkable area of forest land but also the managing of public forest or private forests include the same problematics and possible methods to be used.

The basic problems here include:

- -- Evaluation of existing stock inventory.
- -- Yield and growth models and predictions.
- -- Maintaining a sustained yield strategy.
- -- Planning of the silvicultural and harvesting activities in order to maximize the long-term production of timber.
- -- Increasing the productivity.
- -- Organizing and rationalizing the harvesting.
- -- Competition on forest land (agriculture, recreation etc.).
- -- Multiusage of forests (timber, recreation, wilderness, forage, water shed etc.)
- -- Activating the small forest owners for effective forest management.

The use of systems analysis and different programs in this area is quite a well studied area of applications (Uronen, 1980a). The local conditions (climate, terrain, soil, species, etc.) vary so much that the natural size of the planning area in this connection in Scandinavia is quite small, (a few hundreds of hectares) and the forest ownership distribution is another factor affecting that larger regional or even national Forest management plans are very difficult to accomplish in practice.

The ownership distribution for example in Finland is the following:

Private owners	65 %
State	24 %
Other public bodies	4 %
Companies	7 %

Thus the small forest farmer plays a key role in Scandinavia; therefore he should, by suitable incentives and other stimuli be activated to maximize the production of forests and assume active forest management policy. This is the only way to ensure the raw material for our factories.

Further problem here is caused by the fact that the average size of forest owned by private persons is rather small (in Finland 36 ha). Some investigations show that the minimum size for economic planning and harvesting of a forest unit is about 2000 ha. The small forests increase also the costs in procurement and rationalizing the logging and harvesting operations. Typically one bigger mill in Finland must annually do about 30,000 agreements with the private forest owners to get its raw material. Clearly the rationalizing and organizing the procurement of raw material and forest management activities is of great importance.

Typical systems analytical methods applied in forest management and land usage are given in Tables 2 and 3. Increasing the biological productivity of forests in Scandinavia is a difficult longterm planning problem demanding capital investments with very long payback period. The attitudes of small private forest owners and also changes in their social background (more investors, not farmers) will further complicate this situation which certainly will be a limiting factor for the raw material and thus for the expansion of the forest industry in Scandinavia. The problems of multiusage of forests is so far discussed only in individual cases when some area has been reserved for national park or for recreation. Systematic plans and studies do not exist. A further factor here to be included is the increasing use of wood as primary energy source. This will further harden the competition on raw material. In future this multiusage must be an important planning problem but mainly in regional and/or national context not so much inside a corporate of company.

PROBLEMS CONNECTED WITH THE RAW MATERIAL

This area of problems is closely connected with the previous one; basic question is how to increase the productivity of our forests and how to maintain long term sustained-yield strategy. The other important problem after the production of the biomass of forests is the "optimal" usage of it; burning, sawing, pulping, chemicals. These questions, however, are more "macro-problems". For a forest industry corporation the problems connected here are: procurement of the wood, logging, transportation and storage. Mechanization of harvesting is a key problem when we are facing the scarcity of labor force in harvesting operations. Especially in Scandinavia where the mills can get only a small portion of their raw material from their own forests the rationalizing of these operations is of primary importance in order to remain competitive with the U.S., Canadian and South American producers; this is especially vital in bulk products (market pulp, kraftliner, newsprint). Systems analysis can certainly be of some help here.

Table 2. Timber management.

Task, Objective \ Method	Mod. & Sim.	LP	NWA	GP	NLP	DP	MLP	OCT	DLP	SD	TSA	Other
Stock Inventory, Growth, Yield	*											*
Present Net Worth Maximation	*	*				*		*				
Sustained Yield	*											
Allowable Cut	*	*			*							
Harvesting Planning	*	*		*		*		*				*
Harvesting & Transportation	*	*					*					*
Silvicultural and/or Transportation Planning	*	*				*						

Table 3. Land usage.

Task, Objective \ Method	Mod. & Sim.	LP	NWA	GP	NLP	DP	MLP	OCT	DLP	SD	TSA	Other
Planning of Land Usage	*	*			*							*
Forestry Budgeting	*	*		*								*
Non-Timber Products	*											
Multiple-Usage	*	*		*								*

More technological questions in the raw material side are for example; whole tree usage (causes problems in chemical recovery), optimization of the storage time between felling and pulping (a good example here is that in stone groundwood process remarkable energy savings can be achieved if processing takes place earlier than 24 hours after cutting the tree. Another example is the decrease of yield due to long-term outdoors storaging), and use of other than primary wood fibers (recycling, straw, etc.).

TECHNOLOGY

The technological change in forest industry is not so rapid and dramatic as for example in electronics; the forest industry is a mature industry having high capital intensivity and therefore long investment cycle (15-20 years). Traditionally the research and development work has in Nordic countries partly been concentrated in central laboratories owned by the industry. The investment on R&D in companies is typically 1-2% of the revenue.

The main features of the technological change in forest industry include:

i. Energy saving technology (recovery, bark and wood waste usage, cogeneration, energy management systems).

ii. Pollution abatement (new processes, closed mill concept, information and monitoring systems).

iii. Higher yield technology.

iv. New end-products and new demands on end-products.

v. New raw materials (other than wood, whole tree, recycling).

vi. Computerization and automation.

vii. Development of lower capital intensity technology.

viii. More efficient transportation systems and technology.

Table 4 gives a summary of the most important new technologies and processes at different stages of development in the pulp and paper industry. We can see that especially in pulping and recovery area very much development is on the way. On the paper mill side there are not so much new processes the main features are bigger and faster machines and improvements in formation and heat economy. The idea of "dry" papermaking is still far from reality.

One remarkable change has been the computerization and automation in this industry branch. Figure 3 (Uronen and Williams, 1978) presents the development of process computer systems in this industry. In addition to this there exists

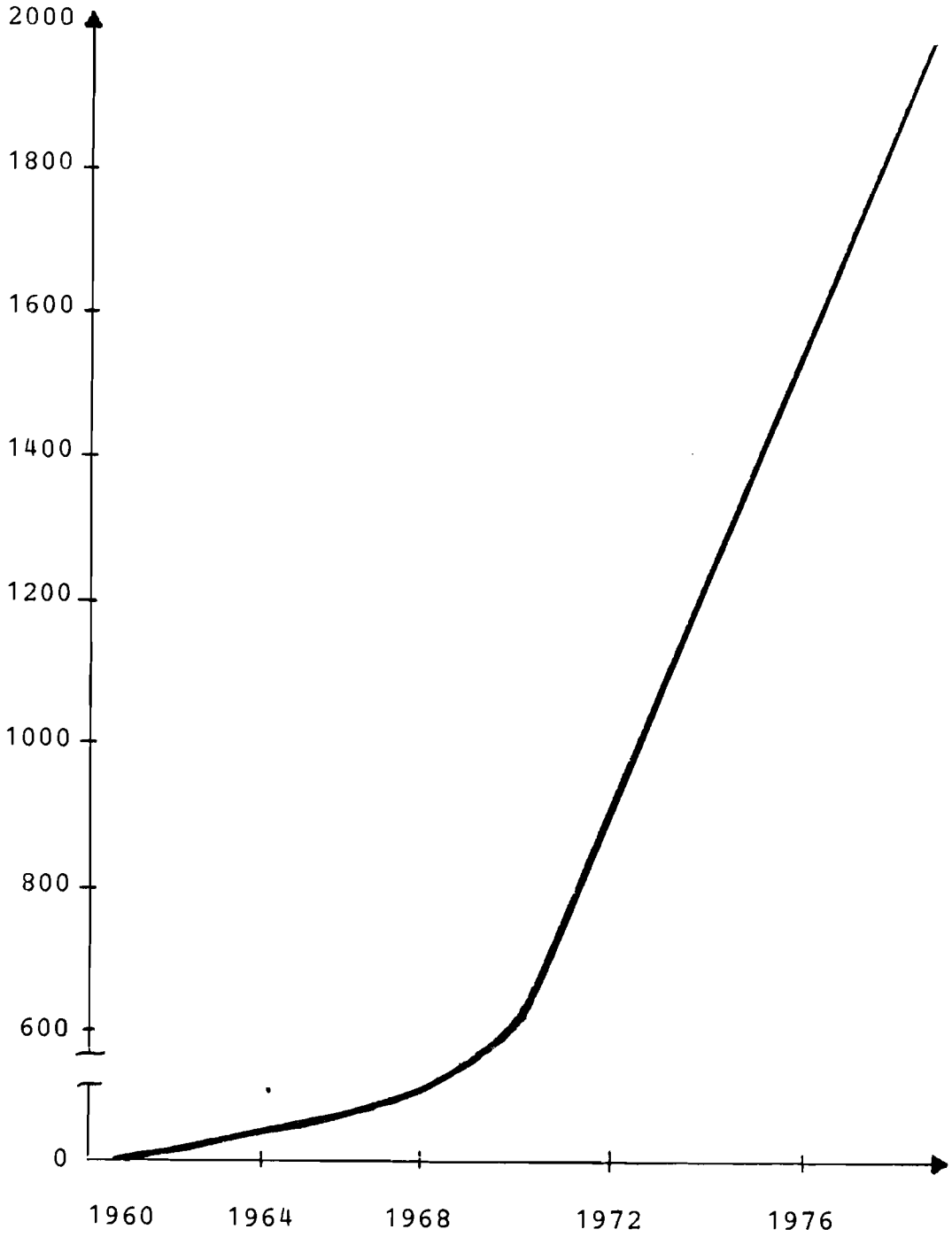

Figure 3. Development of computer control installations in the pulp and paper industries. (Source: Uronen and Williams 1978)

Table 4. Summary of new technologies and processes in pulp and paper industry.

Stage \ Area	Wood Preparation	Pulping and Recovery	Washing and Cleaning	Bleaching	Stock Preparation	Sheet Formation	Mechanical Water Removal	Drying	Computer-ization
Idea or Laboratory	Pipeline chip trans-portation	Alcohol pulping Amine pulping Hydrotropic pulping Ketone pulping Biological pulping		Electrolytic & Ozone bleaching	←	"Dry" paper making	→		Wholly automated mill
Pilot plant	Steam impreg-nation and bark removal	Biological+ TMP Biological+ O_2 Alkaline/O_2 Nitric Acid Hydrosulfide/ SO_3 Pyrolysis recovery		Vapor phase bleaching Chlorine free bleaching		Dry forming	"Extended-nip" press High intensity pressing	Thru drying Fluidized bed	Total mill hierarchy
Commercial (very few) applica-tions		Polysulfide S-free pulping Fluidized bed recovery Raphson closed mill	Displace-ment Bleaching/ Washing	Oxygen bleaching Displacement bleaching	Chemical beating	High consistency forming	Double felting Vac drying		MIS and production planning systems
Commercial (several applica-tions)	Whole tree chipping Dry debarking	TMP Pressure GW Solvent de-inking				Twin wire converted flow		Flash drying Thru drying Air drying	Computerized process control systems

a big number of administrative and other computer systems and now the tendency clearly goes towards the integration of all these in a hierarchical management and control system. The distributed hardware has made it technologically feasible and economically attractive. These systems and the problems and research work needed here are discussed in details elsewhere (Uronen, 1980b., Uronen and Williams, 1978). Figure 4 (Uronen, 1980b) gives a schematic picture of the development of the different "generations" of computer systems in the pulp and paper industry.

Recycling has very much importance in energy saving (in mechanical integrated paper mills) and raw material saving. It may have also very much effect "upwards" (i.e., on the markets), if the effective recycling can be established. On the other hand it depends on the development of deinking technology and further research efforts are needed for example in solving the "multiusage problem" i.e., after certain number of usages the fibers will become too weak and they cannot be used any more.

INVESTMENT PLANNING

As indicated in Table 1 the main problems in investment planning are: location, product mix, scale and technology.

The location of the mill is very much related to the wood resources available and the transportation costs will also become important due to ever increasing energy prices.

Product mix will probably change. Typical product mix at national level for example in the U.S. is given in Table 5. Changes are not very rapid, but in OECD countries the most rapid increase is in printing and writing papers and in some packaging boards; on the contrary in developing countries the biggest increase in demand is in tissues and in basic packaging material (unbleached kraft paper board).

The electronic data processing and information technology does not remarkably affect the demand of papers in the next 10-15 years, but locally it may already have some effects; for example France has made the decision to replace the telephone catalogues with electronic terminals by the years 1981-84. In Central Europe 250,000 t/year light printing paper for telephone catalogues will be used (Baumann, Neudeck, 1979). Figure 5 gives a possible trend in this special quality for France and Western Germany. It is clear that similar studies for planning new capacity and selecting product-mix are very important because after investment the pay back time is long (15-20 years) and you are stuck with the selected product mix (more or less). Thus the aggregated global or similar forecasts and trade models do not give sufficiently data for investment decisions at company level. The basic questions are: available raw material (what could be produced), pricing and transportation of raw material, forecasts by products taking the changing

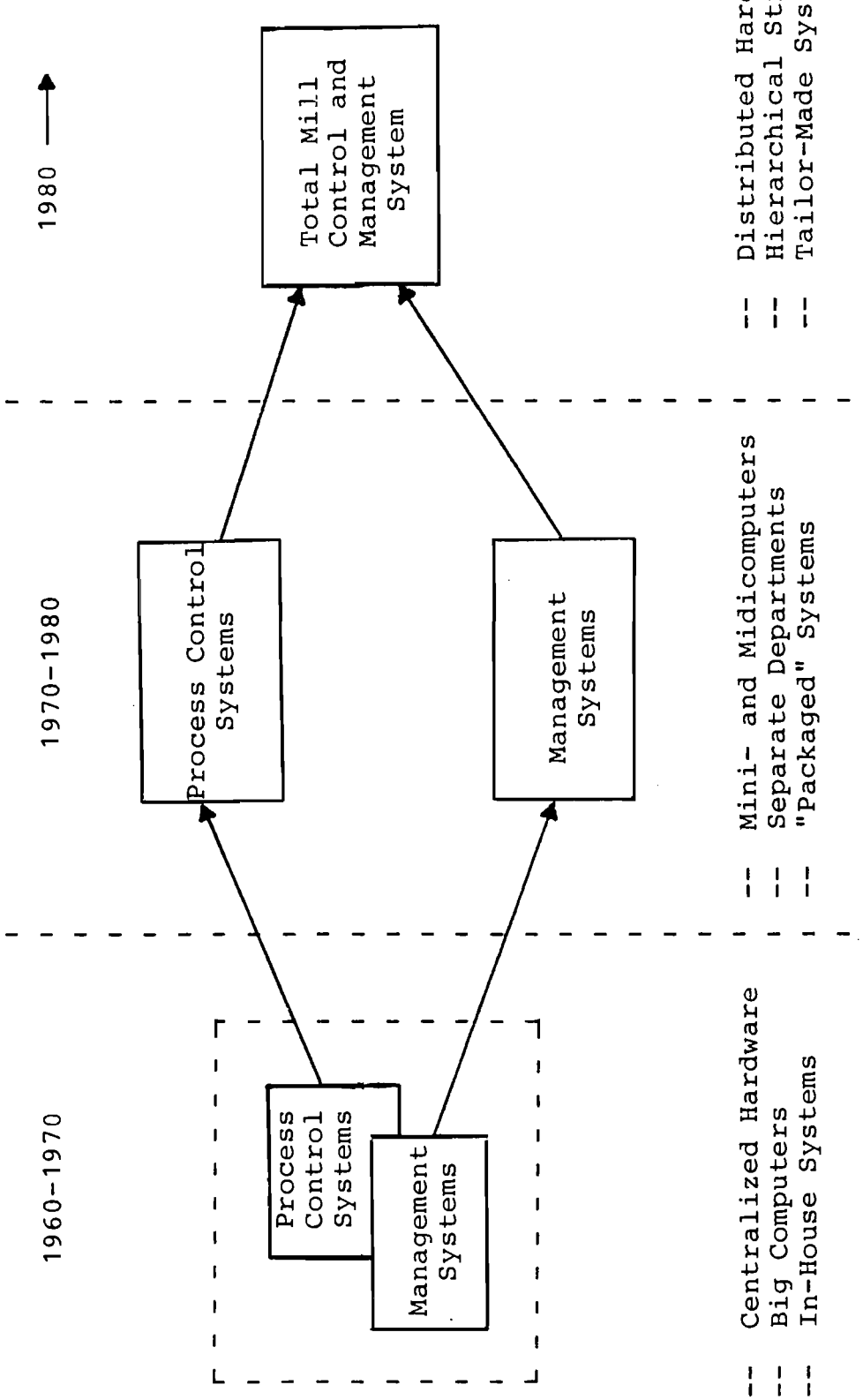

Figure 4. Development of computer systems in the pulp and paper industry. (Source: Uronen 1980b)

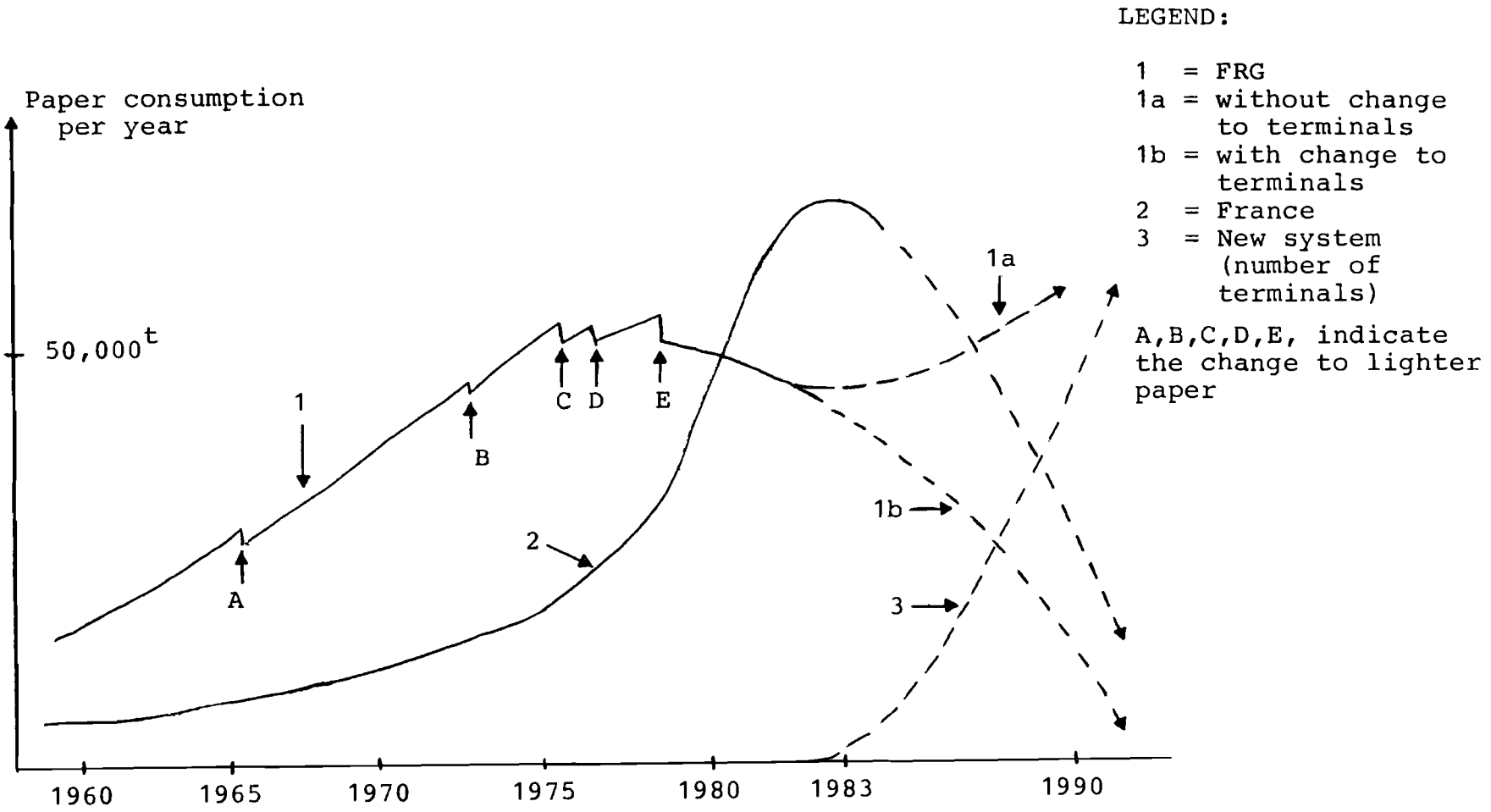

Figure 5. The forecast of the consumption of the telephone catalogue paper in France and in FRG. (Source: Deutsche Papierwirtschaft 1979)

Table 5. Production distribution in the U.S. paper industry. (US Environmental Protection Agency, 1977/API)

Product	% of 1974 US capacity
Unbleached kraft paper	7.1
Unbleached kraft paperboard	22.6
NSSC corrugating medium	7.2
Recycled paperboard	14.0
Construction paper	3.5
Bleached market pulp	7.8
Dissolving pulp	3.8
Printing/writing paper	18.8
Bleached board and bristols	8.3
Tissue	7.0
Newsprint and uncoated groundwood	8.1
Bleached packaging papers	2.1
Special papers	1.3
	100.0

technology (affecting the production and end-product substitution) into account, announced investment plans in the quality elsewhere, marketing situation, capital, etc.

Especially in Scandinavia due to the high raw material, labor and energy costs we cannot any more be competitive in the so called bulk products (market pulp, kraftliner or newsprint) we must produce higher converted and more specialized products and then the above mentioned studies are still of greater importance.

The effects of governmental actions and regulations and regional policies will have great influence on the investments of the forest industry. Very serious effects on the new investments (and also causing closing of old "marginal" mills) do have the environmental regulations. Studies in the U.S. for example show that the growth of new capacity has decreased due to the extra costs of environmental investments causing a capacity shortage of 15% in 1977 (Lippke, Huges and Carrougher 1975). This also has an increasing effect on the pricing of end-products. Especially important are the effects of these and other regulations on the "marginal" mills.

One other interesting trend in the investment policy of bigger forest industry companies is the enlargement into new branches of industry. Typical examples in Scandinavia are manufacturing of machines and equipment for the pulp and paper industry, electronics, ship holding etc. This can for some companies form a solution not to be so sensitive for economical regression in the main business.

OPERATIONAL EFFICIENCY

The modern mills with ever increasing capacities and higher level of technical sophistication and automation are very complicated dynamic systems with high capital intensiveness. So the operational efficiency should be optimized under varying conditions. Especially in the near future we will be in a situation where 80% of the production takes place during other than normal dayshift on normal working days when the responsible top and higher management staff is on site. In this kind of situation the shift-going personnel needs special tools and reliable and updated information from the processes and from the overall situation. Here the computer based information and production planning and control systems will be valuable. The development of these systems is today very rapid and first systems are already in operation. This is an area where plenty of research and development work is needed and systems analysis is in essence. In planning of these systems special attention should also be paid on efficiency supervision and reporting (consumptions, yields, efficiencies, availabilities, etc.). Today it is technically possible to automatize almost every operation in the forest industry; the basic question is what is the optimal way to combine the human resources with high technology i.e., what is the optimal level of automation. The operational efficiency is closely connected with the technological change and innovation.

Especially important here are also education and training of the personnel at each level of organization, maintenance of equipment and keeping this industry attractive for people as a working place. The effective use of management systems and the further development of them (both hardware, software and orgware) is very important. These questions are more closely discussed in Uronen (1980b).

MARKETS AND POLICIES

The items mentioned in Table 1 under these subtitles are more or less discussed already in preceeding chapters. Further they are more "macro" problems, but the reason I want to list and mention them also here is the following: Even if the markets and governmental and other actions and policies are global, national or regional, the models available and the predicted effects are not directly applicable to certain

company or mill. Each mill is different (technology, size, location, cost structure, financial situation etc.) so these "macro" problems and the results from studying them at national or regional level must in each individual case be projected to the company level. This can best be done by the company's own planning and systems group in cooperation with the experts in macro-studies and forecasts

SUMMARY

The micro and macro problems in forest industry cannot be separated from each other. However there is a natural "division" for these problems and studying of them; the macro problems are global, national and regional and they can best be studied internationally and/or nationally in suitable organizations with sufficiently multidiscipline staff. These results must then be projected and applied in the company and mill level by the company's own staff and thus the general features will be and must be taken into account when solving the microproblems inside a company or mill.

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