FOUR ESSAYS ON TELEMATICS AND VIDEOTEX

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FOREWORD

This Research Report consists of four articles on issues that were subjects of research undertaken in the Information Technology Task of IIASA's former Management and Technology Area in 1981 and 1982. The report sets out the problems created by the introduction of new information services offered by videotex systems; the methodology described is representative of that used for innovation research in management and technology.

The papers analyze the technology and the possible new services involved. The bare existence of these services and of the uses that this novel technology offers is far from sufficient to guarantee success. One has to take into account all relevant relationships with other services, which creates a "selection environment" that finally determines the acceptance of the new technology. It is extremely difficult to predict the market penetration and rate of diffusion of videotex services, factors that would be of significance for decision and policy makers. The authors examine the penetration of other, associated technologies (such as radio and television) in different countries and cultures and relate them to economic and social factors.

New information services will be an important component of future society; indeed, they already have several definite features, whereas those of the future society are not yet discernible. Dr. Sebestyen addresses this problem, which transcends the macroeconomic impact of information technology and is a subject for study in the social sciences. Policies cannot be designed successfully without taking due account of all economic and social impacts of new technology. This seems to be the overall message of the report, together with an illustration of which uncertainties and risks a researcher in this field has to face.

TIBOR VASKO
Leader
Clearinghouse Activities

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'Unorthodox' videotex applications: teleplaying, telegambling, telesoftware and telecomputing

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Telephone-based videotex systems are slowly changing from systems that permit only information retrieval and limited message sending based on numeric, menu-type access methods to more sophisticated, multi-user, interactive, transactional systems. This is partly due to the concept of adding external computers to the videotex network and partly due to the emergence of more intelligent terminals.

In this paper, four major application areas, which have been made possible by these developments but have not yet received the attention they merit, are discussed in some detail: teleplaying, telegambling, telesoftware, and telecomputing. The authors maintain, and try to demonstrate, that these four areas will significantly influence the market-penetration and social impact of videotex systems.

1. Introduction

Telephone-based videotex systems, which we will simply call videotex systems, have been in existence only since the end of the seventies (see Woolfe 1980 and Maurer 1981 for general overviews).

Originating with PRESTEL in the UK, videotex systems were conceived primarily as information retrieval systems capable of limited interactivity using very simple, cheap terminals. Now the character of videotex is being changed by several recent developments: the introduction of 'external computers' providing whatever interactive options the information provider wishes to make available in the FRG, the arrival of more advanced terminals (capable of local processing of graphic instructions) in Canada, and the introduction of alphabetic access techniques to French systems.

Important to the success of videotex systems will be the scope of their application. The addition of external computers and intelligent terminals greatly broadens the range of applications. In fact, many potential and important applications have yet to be recognized.

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In this paper we focus attention on four new applications, which we feel will significantly influence the spread of videotex and its impact on society: teleplaying, telegambling, telesoftware, and telecomputing.

Teleplaying refers to the fact that videotex allows the realization of complex multi-person games whose appeal may be comparable to that of TV shows. Telegambling refers to a special category of teleplaying. Telesoftware refers to the fact that a videotex system can be used to store programs that can be downloaded into the user's terminal and executed there, opening up the potential for a multitude of fascinating applications. Telecomputing refers to the fact that the gateway function may allow access to computational centers by videotex terminals.

Although all of the currently available videotex systems claim to be interactive, many of them—such as the best known system, PRESTEL—offer only rather rudimentary interactive possibilities. Beyond recall of the frame desired, interactions are typically limited to a simple version of electronic messaging (in PRESTEL systems, via so-called "response frames").

It is widely recognized that videotex will only develop its full potential and have its full impact if it becomes a truly interactive service, with facilities beyond the retrieval and messaging functions. Since videotex centers cannot be expected to handle thousands of complex interactive processes simultaneously, it is generally accepted that full interaction must involve so-called external ('third party') computers. Such external computers (together with executable software) are provided and operated by information-providers, and are connected to the main videotex computers within a (usually packet-switched) computer network. A user accesses the external computer through the nearest videotex center which acts as a gateway.

The above concept was first realized in the FRG videotex system ("Bildschirmtext-Rechnerverbund") in 1980; it was also implemented in the French pilot trial (Teletel) where it has been operational since the summer of 1981, and it will be available in other countries (including Austria) in 1982. Since the German system is the only one with which some experience has been accumulated, comments on the use of external computers in videotex systems will refer to the situation in the FRG.

External computers are presently being used [1] almost exclusively for three major applications: for booking purposes (by mail-order companies and travel agents), for monetary transactions (by banks), and for software experiments (by computer manufacturers). Although these applications are well suited for external computers in a videotex system and are indeed very popular [2], many obvious applications for external computers have yet to be tried out, among them services

[1] The distribution of the 14 currently active external computers in the FRG is as follows: banks (4), catalogue sales (4), travel offices (2), computer manufacturers (3), videotex service office (1).

[2] One of the four banks providing an external computer reports over 1,200 new 'electronic customers', i.e. more than 20% of the total number of participants in the pilot trial!

such as income-tax or mortgage calculations, highly interactive information-retrieval applications, operations-research applications or timetable-creation based on user needs, etc.

2. Teleplaying

An area we want to examine more closely is teleplaying. In teleplaying, the external computer provides software for playing games with one, a few, or a very large number of participants. The significance of teleplaying lies in its social component and in the fact that it may help not only to strengthen existing personal ties but also to establish new contacts. As has been observed by Maurer (1981), the telephone network has not traditionally been an instrument for making acquaintances. The notion of multi-person telegames may change this. But before discussing the still 'unorthodox' multi-person telegame, we will review briefly more 'orthodox' kinds of games made feasible by external computers in a videotex system.

An external computer can play the role of an opponent in most two-person card or board games, such as chess, go, Superbrain, and so on. However, we do not feel that such applications will be very important (except for 'resource sharing' purposes) as they are usually better handled by local microprocessors (in the user's home), by loading them with suitable software from, say, a tape-deck, or (more to the point) from a videotex computer as telesoftware. (We will return to the latter point in section 4.) In passing we note that external computers cannot be used to play the games of manual skill and reaction-time known as TV games (using some game-control paddles) or available in Penny Arcades—such as "Invaders", "Little-Brick-Out", etc. The response-times involved among the external computer, the communication-network and the user[3] are both too long and too unpredictable.

Another kind of telegame, for which we do feel that external computers are useful, is the one in which the computer does not act as player, but as administrator, referee, and provider of the tools necessary for the game. Suppose two persons A and B in different locations[4] want to play a game of chess. After having agreed on a starting-time (using the videotex message service), they log into the same external computer via the videotex gateway and request the game chess. The computer displays a chess board with the initial configuration of pieces on both videotex terminals and proceeds to request moves in turn, checking them for legality and displaying the current situation on both screens at all times. Adjacent to the display of the board there is a portion of split screen allowing A

[3] Switched telephone from the user to the videotex gateway computer, packet-switched data network from there to the external computer as typical solution.

[4] The tariff structure imposed for videotex will enter significantly. In countries (such as Austria) where only local call charges are levied for videotex usage independent of location, A and B may be hundreds of miles apart.

and B to carry on some conversation (by exchanging messages). Many other features will be available also: the computer will keep a record of how much time was required by each player; it would permit the game to be interrupted for as long as desired (for a dinner, or till next month); it would keep track of all moves, which would allow a re-play and analysis of the game after its termination (in fact, it could even perform or help in the analysis); it could act as partner, especially for beginners, in a 'teaching mode' (commenting on each move of the player, suggesting and allowing alternatives), etc.

Clearly, this kind of set-up is not restricted to two-person games but applies to all kinds of games, including card games. E.g., in a game of bridge, the computer would deal the cards, keep score, even fill in for a missing fourth player, if necessary. Again, many features not available in ordinary bridge might be available in this version: the possibility of analyzing a hand after the game; the possibility to ask for an 'extraordinary deal' (i.e., an unlikely distribution of cards); the possibility of dealing the same set of cards to various groups of people ('duplicate bridge' on a large scale, so to speak!), etc.

Certainly the variations will not be limited to currently available games. New games (some involving a very large number of participants) will emerge. There might be a simulated stock market game with an arbitrary number of participants who 'buy' and 'sell' stock, manipulate the 'prices' of stock, perhaps even using real money. There may be 'rallies' that start at a certain time (e.g., Saturday evening at 8 p.m.), for which one has to pre-register and to pay a registration fee, where one has to try to reach certain destinations (which can only be found by solving puzzles, answering questions, reacting in a certain way, and having a bit of luck) in order to obtain some prize, public recognition, or simply a particularly high score. The rally participant need not be one person, but could be a group of friends or a family unit, sitting around the same videotex terminal (maybe helped by other friends on other videotex terminals in some other location). This kind of joint, active participation contrasts favorably with the current passive and isolating TV-watching behavior that has greatly changed society over the last twenty years. The activities described may well help to dilute the activity- and communication-stifling influence of modern one-way media. We might see here one more instance of advanced technology helping to overcome negative side-effects of some earlier technology.

Here we come to the point made earlier, that game and entertainment activities on external computers in videotex systems may help one to establish contact and to communicate with persons with whom one would not have otherwise been involved, much in the same way as this happens over citizen-band radio.

Let us consider some concrete examples of the type of situation we envisage. In a rally with many participants, the software may well provide players with knowledge about how other participants are doing and possibilities for communicating with them, or even allow them to join forces for part of the undertaking. On a simpler level, let us imagine a program that allows people to walk around in a maze, choosing a cover name, and meeting each other as they try to find an exit, a mystery place, treasure, etc. As they meet, they could exchange messages which, starting with greetings, information on the maze ("that bridge leads into a cul-de-sac" or "my friend is waiting for me at the big oak tree, but I can't find it—do you know how to get there?"), and standard conversation, may lead to agreeing on a rendez-vous in the maze ("This was fun, Mazy-one. Let's try to find another mystery spot together some time" or "O.K. Sue, let's meet tomorrow at 3 p.m. at the entrance of the maze") or even lead to revealing one's real identity and a get-together in real life. Or there might be a super crossword puzzle that can only be solved through the joint effort of people from all walks of life. (In one scenario, anybody may participate, but his entry would only be accepted by the program if it is correct; his contribution would then be recorded and a prize would be awarded to the participants who contributed the most). Or there might be a competition in drawing pictures or inventing a limerick, or there could be a strategy game between two opposing groups of people.

We hope to have demonstrated that the possibilities are virtually limitless. A whole new entertainment and game industry based on videotex seems to us to be a very possible prospect. The social impact of activities of the kind mentioned could be substantial. The success of shows allowing for broad public involvement seems to indicate that our vision of mass participation in the electronic mass game currently *en vogue* is not so very far-fetched.

3. Telegambling

Telegambling is a special class of telegaming. The appeal of gambling lies in the fact that the involvement of bets and money on the one hand increases the excitement of gaming, and on the other hand it gives some persons the hope of becoming richer. Gambling is not new; it has existed throughout the history of mankind and will certainly continue to be with us.

From time to time, gambling has been condemned by different segments of society (such as churches) and promoted by others who were in a position to monopolize and/or tax upon it. Practically all legislation affecting gambling has been antagonistic to it. According to English common law (27 Corpus Juris p. 969), a game played for stakes was lawful if skill predominated, unlawful if chance predominated. Judgment on the status of a particular game was left to the court. According to the Encyclopaedia Britannica, California courts have held draw poker to be a game of skill, stud poker not. One Justice of the New York Supreme Court held duplicate bridge to be a game of chance, all others have held it to be a game of skill. For at least 300 years there has been controversy over licensing and state control of gambling. In most countries some forms of gambling are permitted. Wherever gambling is lawful, it is taxed. In the United States, professional gamblers are subject to federal taxation. Where betting is permitted, the tax is almost always a percentage of the gross amount and may range as high as 10% on horse or dog racing and even higher on lotteries.

Licensed 'constitutionalized' forms of gambling can be found in practically all societies: 'lotto', football-pool, state lottery, and racing are extremely popular in the UK, France, Germany, Austria, Hungary, Italy, Czechoslovakia and many other countries. In Hungary (total population 10 million) for example, week by week, 3 million lottery ('Lotto') tickets are sold. Football-pool is extremely popular as well. When some additional funds have to be raised—for example to support the participation of the national athletic team at the next Olympics—a 'dedicated' lottery game will be initiated by the government in order to raise the funds required. Characteristic of these national gambling games is that, in most cases, the government is involved to some extent. Either it has a nation-wide monopoly, or at least it enjoys collecting extremely high tax-revenues from the income made by national or private enterprises.

In many countries gambling has become a huge industry. For example, in 1979, gambling casinos in the UK had revenues of £185 million ($\approx$ US$280 million). And this amount shows an annual growth of 10.2% (Predicast World Cast P-1 1981). Similarly, the gambling industries in Las Vegas and Monte Carlo cannot complain about low earnings.

According to the Encyclopaedia Britannica, it has been estimated that during the 1960s the total amount bet in gambling games in the United States alone approximated US$50 billion (!) each year, that in England 48% of the adult population risked some money by gambling, and that throughout the world the amounts risked annually approached about 7% of personal income.

By comparison, only about 5% of personal income is spent on information (newspapers, TV and radio license-fees, books etc.). In fact, it is this portion of income that is expected to be redistributed after the introduction of information banks available through videotex services.

Back to gambling, it is estimated that the world-wide total of gambling losses to common or professional gamblers and the salaries of their employees, reached or exceeded US$25 billion. About 2,000,000 persons throughout the world, almost all of them entrepreneurs or employers in the gambling business, derived all or most of their livelihood from this source – according to Encyclopaedia Britannica.

(Would this mean that if videotex be used for gambling, many of the above 'jobs' would be in danger...?)

This rather long introduction to gambling was needed in order to point out that whenever new opportunities for nation-wide or local gambling arise, there are strong financial interests on the parts of most governments and some enterprises to enter this business and make as much money as possible. New information technologies such as videotex offer not only excellent opportunities in information retrieval, electronic fund transfer, electronic mail, teleplaying etc. They can be 'used' or 'misused' for telegambling as well.

Let us examine a few 'theoretical' examples:

(a) Football-pool. Football-pool is a traditional nation-wide gambling game. For example, the Austrian newspaper *Kurier* reported in its issue of November 14, 1981 about a "Toto" boom in Austria (population 7.5 million) whereby Austrian pool players placed bets amounting to AS20 million (US$1.3 million) for a single weekend. Another example: In Hungary, several hundred thousand football pool coupons are sold every week. The weekly pool guide "Turf", containing competitors' hints and a broad variety of football statistics, is one of the country's best selling weekly papers. In Hungarian football-pool, players bet on the outcome of 13 football games, with marking 1, 2, or x (first team, second team, tie). If all guesses are right, a separate guess on the 14th game can raise the value of the prize.

In a likely videotex version of football-pool, players would place their bets into the videotex system by filling in an appropriate response frame. The access fee for the response frame would be equal to the price of one football-pool coupon. Should the player require background information in order to determine the wisest selections, the 'electronic' (videotex) version of the pool's guide could be accessed to retrieve the necessary information, such as statistics or time series of previous games. Bets could be placed until the first football match contained in the pool begins. If a player wins, his prize could be transferred to his bank account by the electronic fund-transfer service of videotex.

(b) 'Lotto'. A class of state lottery – often called "Lotto" – is in Hungary, for example, even more popular than the football-pool "Toto". Week after week, 3–4 million coupons are sold throughout the country. The drawing of the lottery numbers (five out of 90) takes place every Friday at 11 o'clock; many in the country await with excitement the results of the draw.

'Lotto' could be put on videotex in a fashion similar to the previously mentioned football-pool. There is one major advantage of the videotex-supported versions of these games: namely, their ability to support and to speed up the process of evaluating and checking the lottery and football-pool coupons, which could be done automatically by an external computer. This process is still being done manually: more than one hundred workers take a full day and night to select the winning coupons. Through videotex the whole process could be completed within minutes and the exact sums of the prizes determined. In principle, it would also be possible to hold daily lotto drawings.

(c) Lottery. Another class of state lottery is represented by the North West German State Lottery, which runs over a period of six months with a drawing per month. In this particular lottery there are 300,000 tickets, with 107,858 prizes totaling over DM103 million. Players order their coupons by mail; within days, they are sent tickets and invoices. After each "class" (drawing), players receive the official winning list by mail together with a ticket for the next drawing. Notification of winning tickets is sent to the lucky players. Winning tickets are eliminated from the game and the prize money is transferred to the winners within about one week.

The game described above could be put relatively easily on an external computer of a videotex network. By on-line request for a coupon, a random number generator program run on the external computer could select a coupon for the player. The external computer would administer the coupons, and the corresponding players, and the drawing could again be done by means of the random number generator program. Selection and notification of the winners would be done automatically. The collection of money for the coupons and the distribution of the prizes could be done by the electronic fund-transfer function of videotex.

(d) 'Teleroulette', 'teleblackjack'. Games such as roulette or blackjack could also be put on videotex network on a nation-wide basis. An external computer performing all the functions of the 'bank' could easily be programmed and put into operation. Players could place their bets at any time of day, and many players could access this special 'third-party' computer simultaneously. Administration of the game and the addition or deduction of money could also be done automatically. Necessary fund transfers between users' bank accounts and the roulette or blackjack center could be carried out through the electronic fund-transfer function of videotex. Placing the bets would be done in an interactive way. The computer would ask for the placing of bets, users would type in their bets, say "$10 on the second dozen", or "$5 on number 36", etc. Then the bets would be closed, and a random number generator program would select a number between 0 and 36. Then the computer would determine the losers and winners. Electronic fund transfer to the bank account of the winner could then be initiated.

(e) 'One-armed bandit' through videotex. An early version of the slot machine or 'one-armed bandit' was invented by Charles Fey of San Francisco in 1895. He called his machine the "Liberty Bell' and rented it to a local saloon on a 50–50 basis. Another version of the invention was developed by H.S. Mills, who set up his factory in 1889. By 1932 his company was making 70,000 machines a year. This seemingly harmless attraction is in fact big business: according to the Encyclopaedia Britannica (1967), the town of Las Vegas (population 70,000) has 10,000 licensed slot machines. The owners pay a tax of US$250 per year on each machine to the Internal Revenue Service, plus an income-based tax to the state. In 1932, *Fortune* exposed the profits made from a respectable business that only sold the machines: it quoted the turnover on slot machines for 1931 as US$20 million for greater New York alone, and US$150 million for the whole of the USA. It was calculated that on the average machine, 1,000 games at a total cost of $250 would return $61.75, leaving a profit of $188.25 (Edward de Bono 1974). Early models were followed by more sophisticated ones.

Obviously it would be technically feasible for an external videotex computer to perform the function of an armada of 'one-armed bandits'. Such a computer could easily take the bets, run a random number generator program, run the game, and check the bets against the generated result. Finally, any transfer of funds could be done by the videotex system itself. The class of gambling games in this category could obviously be as broad as one finds at present in casinos anywhere in the world.

(f) Horse racing through videotex. Betting on the result of a horse race is a principal form of gambling. Because it is universally taxed, it is the only form on which audited statistics are always available. In the late 1960s, betting approached an annual volume of US$5 billion in the US and £300 million in the UK (Encyclopaedia Britannica). Surprisingly, more money was bet through bookmakers than at the track. In the UK, where bookmaking is licensed, the amount bet through bookmakers is about twice that bet at the race tracks. Thus there are good chances for videotex-supported bets on horse racing.

In addition, wherever horse racing is popular, it has become big business, with its own newspapers and other periodicals, extensive statistical services, self-styled experts who sell advice on how to bet, and networks of telephone and telegraph wires that furnish information to betting centers, bookmakers and their employees, and workers around the horses and stables.

A videotex-supported information bank could provide an invaluable service in collecting, organizing, and storing the above 'valuable' information. From the technical point of view, electronic betting on horseracing could be done in the following way: bets on the horses could be placed in the same way as in any bookmaking office, practically until the start of each run. Before placing his bets, the player could request statistics, chances, and biographies of horses and jockeys via videotex information banks. After each run, an external computer would appraise the results on-the-spot and notify the winners and losers. Transfer of money would be enhanced through the electronic fund-transfer capability of the system. In a more advanced version, a dedicated cable-TV channel could report live on the events around the stables and at the tracks.

The list of gambling games that could be played on videotex is practically endless. Here we have only attempted to point out the potential of this videotex application and to show that videotex-supported gambling is feasible from the technical point of view. Many questions remain open, however, such as whether or not it is desirable from society's view-point.

Let us assume that it is. In this case, what kind of data-security measures would have to be taken in order to assure that, for example, children do not get access to the system even if they should get hold of their parents' user name and password? Or what should happen if an adult is addicted to gambling and does not care whether he loses his monthly salary within a few hours...?

And last but not least, there is another important aspect of telegaming and telegambling. The social role of gaming and gambling is and should not be primarily to win or make money. The more important role of these activities is to bring people together while entertaining them and thereby to provide the precondition for establishing human contacts, for creating opportunities for serious and less serious chats, talks, and discussions, for making new friendships and maintaining old ones, or for simply getting away from the daily rut. Whether or not the interactive capability of videotex is adequate for these purposes has yet to be proved. The picture of a pub at the next corner where regular visitors would gather around the same table every Wednesday and Friday and drink their usual beer or wine, and where a card game would follow a certain, well-prescribed ceremony is, from the psychological point of view, not quite the same as starting a "random number generator program" and an "automatic card distribution" routine. The manner of playing a certain game—according to the cards in one's hand—cannot be expressed in the same way if one plays it through videotex since one cannot show one's temper, one's happiness about the game, one's cleverness in playing the game, or one's resentment about a bad hand. Also, the usual 'background chats' while playing would disappear to a great extent. What would happen to the 'kibitzer' watching others playing their cards? (Although technically this is also possible on videotex, would it in practice be likely to take place?)

Thus there is a fear that videotex-supported gaming and gambling—although technically possible—cannot provide the same atmosphere one finds in a casino, in a pub, or among friends—in our view an essential part of this activity. In order to be able to judge the potential impacts of videotex gaming and gambling on society and its role in entertainment, many pilot trials—preferably with the inclusion of legislative aspects—should be carried out and evaluated. We should not be afraid of looking into this field more closely.

4. Telesoftware

External computers are extensions of basic videotex at the information providers' end. It is also conceivable—but this has not yet been implemented in any current videotex system—to extend videotex at the users' end by providing intelligent terminals, i.e. terminals that can execute stored programs. The programs to be executed may have been created by the user, may have been loaded from a local external storage medium (like a tape-deck) or may have been loaded from the videotex systems. Such software, stored in the videotex system and 'downloaded', similar to ordinary data but executed in the videotex terminal, is called 'telesoftware'.

It is our contention that telesoftware is a viable alternative to program storage and distribution and that it will have a major influence on the spread of videotex penetration. Before we discuss the typical telesoftware that might be made available in the future, a number of technical and economical facts should be brought to mind.

Intelligent videotex decoders capable of handling telesoftware should be available by 1983 for about $500 apiece. Compared with the price of other electronic and media equipment competing for the same segment of households' budgets, this should be sufficiently low to allow significant market penetration. In addition to the cost factor, two other obstacles have been responsible for the lack of decisive progress in the area of telesoftware. One is the question of programming language: since there is no universally accepted programming language for microprocessors, severe compatibility problems arise. (Note that even the use of a more or less standard language such as Mini-Basic does not really solve the problem, since the non-standard input/output and graphics commands block cross-micro compatibility.)

It is quite possible that the existence of various 'dialects' of a programming language will impose an additional burden on intelligent terminals. In that sense, countries where videotex developments are controlled centrally and rigidly (such as France) are most likely to be able to overcome compatibility problems.

The second obstacle is transmission speed. As a consequence of the essential need to check for transmission errors when loading executable programs, the downloading of a substantial program may require up to five minutes. A number of techniques for reducing the required transmission time are emerging, the most noteworthy of which are ideas for initiating program execution before the program is fully loaded and for separating text (such as in explanations and error messages) from the program itself, retrieving it from the videotex system only when needed.

Thus despite the obstacles presented by high terminal price, the need to standardize programming languages, and the need to shorten loading times, it is foreseeable that telesoftware will become a workable option.

The appeal of telesoftware and its underlying concept lies in the fact that a user, without requiring any external storage device at home (likely to develop occasional mechanical problems) nevertheless has access to virtually unlimited random access storage within the videotex system: user programs, user data, and programs and data from the other sources are all available within the system. Indeed, videotex may offer an optimal means of distributing software to the residential and small business market. New software releases could replace obsolete ones without the user even noticing.

The wide range of potential telesoftware can be roughly divided into five categories:

(i) games and entertainments,
(ii) software for the residential market,
(iii) software for the business market,
(iv) videotex-related software, and
(v) systems software.

We will discuss each of the five categories in turn.

i. Games and entertainment

Many of the game applications mentioned in section 2 under teleplaying (on an external computer) could also apply to the local computer, i.e. the intelligent terminal, if it is downloaded with the appropriate software.

Indeed, the intelligent terminal is a better solution in a number of instances. This is true first of the Penny Arcade variety of games of skill, which cannot be realized with external computers, as explained earlier. We believe that even multi-person games of skill requiring half a dozen or so game-controls can be implemented using telesoftware and have substantial relaxation and entertainment value, something that has been overlooked so far. Secondly, it is true for those games in which one person plays against the computer. The downloading of a chess program with its subsequent execution, independent of the videotex network, is a more reasonable alternative to tying up the computing power of an external computer and requiring an open telephone line and port all the time.

More surprisingly, even games involving a number of persons at different locations can often be accomplished using intelligent terminals rather than an external computer, even if no messaging is supported (as in some rudimentary PRESTEL versions). To understand how this works, consider the case of two persons, A and B, wishing to play a game of chess. A and B choose a frame n_A and n_B, respectively, which they are entitled to edit (observe that $n_A = n_B$ is *not* possible in most videotex systems), and inform each other of the frame number and download the chess program. Both A and B enter the frame numbers of n_A and n_B. For the sake of explanation: A's program requests a first move from A, carries out that move on A's screen and enters the move with appropriate code on the frame n_A. B's program, which has been polling frame n_A every 10 seconds, recognizes A's move, carries out that move on B's screen, prompts B for a move, carries out that move on B's screen, enters the move with appropriate code on the frame n_B, which A's program keeps polling, etc.

It should be clear that games involving more than two persons can be handled analogously. Thus, much of what has been described under teleplaying on external computers might apply to intelligent videotex terminals. Only the capabilities of such terminals will impose a certain limit.

ii. Software for the residential market

Telesoftware (in addition to game programs mentioned above) in this area will include programs for 'home economies' such as mortgage, installment-payment, and income-tax calculations; a package to evaluate a portfolio of stock; a program simulating a very sophisticated desk-top calculator; software for creative tasks like composing pictures from picture elements found in videotex or composing music, which can be played by using an attachment to the intelligent terminal; etc.

A number of applications will use the videotex system 'in the background' in an essential way; after a picture has been composed as mentioned above, it might be stored in videotex and a request could be sent to a company to produce a slide, print, or poster from the frame deposited; or after editing an address-file it might be sent off to some firm to prepare address labels; or after editing a letter it might be sent off to an appropriate institution to print it and mail it to the designated address(es). The last possibility might be particularly useful if the PTTs involved hesitate to establish the videotex mail gateway proposed in Maurer et al. (1981).

Clearly, the above list is not meant to be exhaustive; it is merely intended to give some clues to what might happen. We are well aware of the fact that for every application we can think of now there will be half a dozen nobody ever thought of emerging in the future.

iii. Software for the business market

Assuming that the intelligent terminal is sufficiently well equipped, just about any software now available for commercial purposes may be made available via videotext as telesoftware. Even if terminals end up with a disc drive attached to them, maybe the most elegant way to re-write a floppy disc with a piece of systems software may be to load it from videotex rather than to copy it from a master discette (which would no longer be needed).

Again, the presumably good color graphic features of the videotex terminal and the videotex system as back-up will open up additional possibilities: the request to output drawings on fancy multi-color plotters not available in ordinary business environments; the possibility to load telesoftware permitting the use of a simple query language on a database; the automatic evaluation of videotex response frames; etc.

iv. Videotex–related telesoftware

Among the units of telesoftware available on an intelligent videotex terminal, will be some that will make the use of the videotex system more convenient. Typical possibilities include software for marking frames for convenient recall later, for performing alphabetic searches based on a numeric menu-type index, for automatic polling of certain frames (e.g., to collect statistical data or to evaluate response frames) and, of course, for editing videotex pages. Although intelligent terminals will not allow all of the complex possibilities found in dedicated information provider systems, it seems quite likely that a reasonable amount of frame preparation and editing will be possible.

v. Systems software

As has been mentioned earlier, intelligent terminals may well be programmable by the user. In this case telesoftware could include language systems, compilers, and supervisory systems to allow the user to work with a wide choice of languages and software systems.

5. Telecomputing

In the previous section telesoftware was described at some length. Looking from the broader view of information technology, telesoftware is merely the transfer of data-files containing 'source' or 'machine' computer programs from a videotex computer to the personal computers of end-users. If, however, one regards videotex technology as 'the cheap computer network for the man on the street', one should also consider a few more videotex application classes supporting computation in general (fig. 1). An external computer with a high computational capability linked by the 'gateway' concept to the videotex network could perform time sharing or batch computations for users with simple modified TV sets using an extended alphanumerical keypad/board, or for users whose own personal computers are connected to the videotex network. In the latter case, only those computations that cannot be performed locally would be carried out by the external computer by utilizing its bigger core and secondary storage capacity. Also in applications requiring some sort of special hardware or output device, based on the resource-sharing principle, external computers with appropriate peripherals would also be accessed. For example, a special high-quality laser printer could be used to print text demanding high-quality printing.

External computers could be used also for storing and maintaining 'telesoftware'. Thus, if one type of personal computer connected to the videotex network

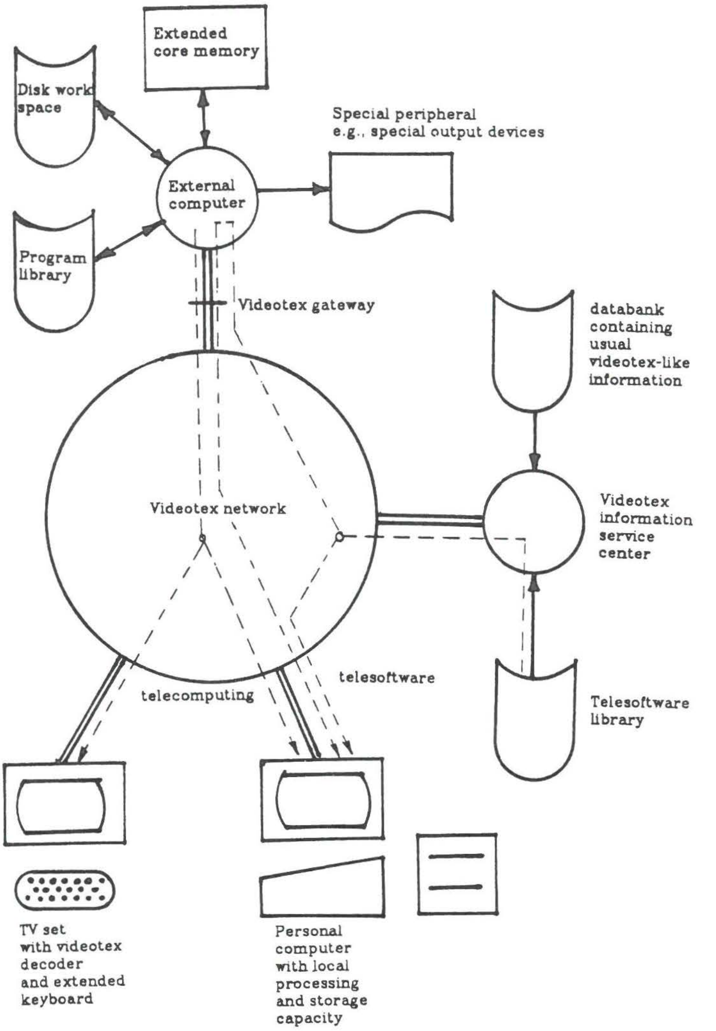

Fig. 1. Major flow of information in 'telesoftware' and 'telecomputing' through a videotex network.

cannot understand the programming-language 'dialect' of a particular type of telesoftware stored on the system, an appropriate 'precompiler' run on an external computer could modify the telesoftware into the programming-language 'dialect' required.

The main application classes of telecomputing through videotex do not differ significantly from the application categories named for telesoftware, i.e.:

- games and entertainments,
- computation and information processing for the residential market,
- computation and information processing for the business market,

- videotex-related software,
- systems software.

The key to the success of telecomputing is user-friendliness. In order to reach the mass market in supporting computing and calculation, the software of the dedicated external computers has to be extremely user-friendly. An important step toward improving the user-friendliness of computing has been made with the introduction of personal computers into the mass market. Many of the programs available on 'Apples', 'Oranges', and 'Grapes' perfectly satisfy the above requirement. Before introducing a large computational center attached to a videotex network, the lessons learned in the field of personal computer applications should be closely looked at and considered. Telecomputing will only be successful if it is easy to use and cheap.

6. Conclusion

In this paper we have argued that future videotex systems will differ significantly from the original numeric menu-driven information-retrieval- and response-page-only systems. They will include much local processing due to the use of intelligent terminals.

Those additional facilities will not only provide some of the standard services often mentioned in the literature (like direct booking, money-transfer, and enhanced graphics) but will also provide a spectrum of other possibilities which has not received much attention. Particular areas we have focused on are the areas of teleplaying, telegambling, telesoftware, and telecomputing, all of which we believe will have a substantial impact concerning both penetration and societal effect of videotex.

We have not considered in depth the legal problems that may arise in connection with some of the more unorthodox applications: some of the multi-person telegames involving the possibility of winning prizes may conflict with games-of-luck laws in some countries, and there might be numerous legal problems around telegambling; the message-sending aspect emerging in many situations may violate some postal laws; etc. Concerning such potential legal restrictions we do believe that, videotex being a new and unforeseen development, a number of laws may have to be modified to permit reasonable and useful applications of videotex. We also feel that pilot trials should be carried out while newly arising legal issues are under study.

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One-way versus two-way videotex

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Abstract: One-way and two-way videotex are often claimed to be more or less competing services, particularly if dedicated channels are used for the broadcast variety. In this paper we will try to dispel this notion. We will try to demonstrate that not only are the two services somewhat complementary in nature but that videotex will increase its potential by choosing a balanced combination of the two services.

1. Introduction

The basic idea of videotex is to add sufficient electronics to tv sets so that they can be used not only for receiving tv programs but also as terminals of a (potentially computer-supported) information system. Around the end of the 1970s videotex systems came along in two varieties: as *broadcast* or *one-way* (1W) systems and as *interactive* or *two-way* (2W) systems. In the first case, a set of information *pages ('frames')*, each identified by a number, is available. The user can select which of the information pages (usually containing textual information) he wants to look at, usually by keying in the number of the desired page using his tv remote-control unit. In the second case, the user can not only retrieve information pages, but can also send information which can be used for ordering, booking, communication and many other interactive applications.

One-way videotex can be of two types. The narrow-band version (1WN videotex) is the older, 'classical' version — first introduced as *Ceefax* by the BBC and *Oracle* by the IBA in the UK. In the same category, Austria's *Teletext* was the first nationwide 1WN videotex service and has now over 100,000 participants. Other countries have since introduced 1WN videotex on a nationwide scale, such as West Germany's *Videotext*. In all these 1WN videotex systems some few hundred information pages are sent on a rotating basis on the same channel and are simultaneously mixed with an ordinary tv program (using the vertical and horizontal blanking intervals for transmission), which has to be 'demixed' by a so-called teletext decoder to prepare the relating flow of information frames for selection. In this fashion less than ten frames of information can be transmitted per second. Hence, to avoid annoyingly long waiting times for a page specified by a user, only a moderate number of frames (some one hundred) can be sent before retransmission has to start again.

The second version of 1W videotex uses a fully 'dedicated' tv channel, usually available via cable tv (CATV) or, in countries with few programs or empty channels one could imagine a separate broadcast tv channel devoted to teletext. The basic idea of this wide-band (1WW) videotex is similar to that of 1WN except that much larger quantities of information can be sent within the same amount of time if a more powerful, faster, and more sophisticated teletext decoder be used. On average, some 50,000 frames can be offered within a few seconds.

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In contrast to the 1W videotex, in the two-way (2W) version the user has a separate channel for communicating in the other direction. The most common implementation of this idea is to use switched public telephone lines for communication in both directions. Thus the tv set acts as a simple computer terminal which is linked — via a telephone line — to the computer of the videotex center (which in turn may act as gateway to other *external* or *third-party* computers to create a videotex network or, as they call it in Germany, *Rechnerverbund*). Although the tv set as a videotex terminal has all of the functions of a

"With the falling price of integrated circuits we expect that future videotex terminals will tend to have more and more 'intelligence' and alphanumeric keyboards at ever-decreasing prices"

computer terminal, much of this potential (but in varying degrees), is not used in current videotex systems. This is partly due to very rudimentary 'keyboards' (often only the numeric keypad tv remote-control unit) available to the user, to the lack of software in the videotex centers, to the rudimentary state of the videotex network (if available at all) and to the 'primitiveness' of the terminal. However, even in the simplest variants, the feedback option of 2W videotex does offer many possibilities not available in 1W systems.

We will discuss some further special aspects of videotex systems required for comparing 1W and 2W systems in the sections to follow, but refer to studies such as [4], [12] and [15] for a broader overview. We close this section by noting that other terminal implementations of both 1W and 2W videotex systems are also feasible and are or have been experimented with: e.g., using a full radio channel for 1W videotex, using CATV with feedback channel for 2W videotex, or both using CATV (in one direction) and telephones (in the other) for 2W videotex.

2. Current and future videotex terminal technology

The most widely used types of videotex today are those based on early developments in Britain (*Ceefax, Oracle* and *Prestel*); these make use of very simple (i.e. 'dumb') terminals with very little local processing and storage and (in the simplest version) only numeric keypads. In contrast to these terminals and some of their planned successors in Switzerland, Holland, and West Germany, for example, other countries have decided to develop terminals with more local processing capability (Canada and the US), and alphanumeric keypads as standard input devices (France). Furthermore, some existing personal computers (such as the Apple II), have been made 'videotex compatible' by adding appropriate interface cards to the basic system.

With the falling price of integrated circuits we expect that future videotex terminals will tend to have more and more 'intelligence' and alphanumeric keyboards at ever-decreasing prices. Such local intelligence (which might put the future videotex terminal, or a version of it, somewhere between a videotex terminal and a personal computer of today) will make the use of videotex easier, will allow a certain amount of decentralisation and will open up the possibility for applications such as using telesoftware [11]. The availability of local storage and intelligence will also be particularly useful in connection with 1W videotex, especially in the wide-band version. (See Sections 3 and 4).

It is becoming increasingly evident that future videotex terminals will allow external attachments such as to tape recorders (already in use in Holland, for instance) and printers, to enable hard copies of frames of interest to be printed. Although one cannot expect that all households will be equipped with printers in the foreseeable future, 'semi-local' printing devices (such as one printer for a whole apartment building) could become a reality within the 1980s and could increase the impact of videotex considerably. In addition, cheap printers for personal computers are already available. In Britain, for example, Sinclair offers for its ZX81 computer a small matrix printer for less than $88.

3. Current and future 1WN (one-way narrow band) videotex

Due to the fact that only some 100 frames (corresponding to less than ten newspaper pages) can be sent in the usual 1WN videotex systems within some 20 seconds, the applicability of 1WN videotex appears to be severely limited. Typically, the 100 pages of information sent in the early days of the Austrian service (early 1980) were at most moderately useful. In a small experiment, one of the authors found that after some initial high usage due to the novelty of the service, usage dropped to less than once per user per month. An analysis of the reasons for such very limited usage has revealed two major factors: one is limited (and possibly 'wrong') information presented, and the other is the cumbersome access procedure. To find a specific piece of information, a number of index pages have to be looked up first, each look-up lasting between 0–20 seconds (which tends to seem like eternity!).

Much experimenting with the type of material and how to present it has improved 1WN videotex remarkably. The authors feel that further improvements along the same lines and using some new ideas suggested below will make it an interesting and, because of the favourable cost-benefit ratio, a permanent feature of tv.

Some of the improvements of 1W videotex which have been implemented in a number of countries such as Austria are as follows.

Rather than sending all pages with the same frequency, one new idea is to send them at widely different frequencies, and this can be used in two ways. One is to send survey and index pages more frequently to allow quick access to routing information, as is done in the West German system, for example. The other is to group pages that one suspects will be accessed as a group into 'magazines' where the pages are transmitted at, say 20 second intervals. Thus, some fifteen pages of international news could be handled in this fashion; it is possible that users will be interested in glancing through all of those pages. At present, this technique is used by almost all teletext operators. By typing one frame number the user could be presented with fifteen pages over a 5-minute period, allowing relaxed reading of all the news presented. The systematic application of the 'magazine' idea enables some 1,000 pages of information to be accommodated in the (roughly) 100 time-slots available, thus increasing the usefulness of 1WN videotex tremendously.

There are, however, some drawbacks to the magazine technique. One is that whenever a specific item of information is required from a given magazine one has to wait — sometimes five minutes (!) — until the information appears on the screen. No quick searching is possible, as one can do with a newspaper. Furthermore, the viewing rhythm is set for every magazine to allow only 'mechanical' reading of information, without any slowing down or speeding up of the frames. This again is one of the most important advantages of traditional printing media. It is possible to 'freeze' on the tv screen any teletext picture, to allow more time to be spent on reading and digesting the content of the frame, but when switching back to the normal mode of operation several other frames in the sequence were missed in the meantime, and one has to wait — sometimes another five minutes — until the next desired page of information appears on the screen.

In our observation of the Austrian system we found two extremely long magazines: one *Lesen statt hören* (Reading instead of hearing) for the handicapped, with eighteen frames of information linked to one magazine, and one with twenty frames containing a list of the Austrian ski champions at the Olympic Games and World Championships — a subject one would expect that in Austria at least would deserve a separate page each. The second problem is with the indexing of pages contained in the magazines. Due to lack of space at present, only the title of the magazine is contained in the index. However, the pages in some magazines are rather different in nature and certainly deserve central indexing, otherwise they are lost to new or inexperienced readers. But if this information were contained in a general index, there would be a problem of access, because first the magazine has to be addressed but then the only way to get the information is to wait. Thus no *direct access* to the information is possible. This could be improved in principle by introducing

" . . . teletext is also not duplicating information available from another medium"

intelligent decoders for 1WN videotex system.

Regarding the content of information, we have made comparisons between the Austrian *Teletext*, the West German *Videotext*, and the experimental Swiss *Teletext* systems. The information broadcast by the Swiss system is compiled by a consortium of major Swiss newspapers and publishers, with the clear aim of producing an 'electronic newspaper' with news, culture — even poetry — art, reviews, etc., although our personal impression is that the use of this medium for most of these purposes is of limited value. The West German *Videotext* has a separate teletext editorial office in West Berlin run by the radio and tv companies. The main trend there is to provide a tool which supplements local radio and tv stations, such as by providing details of future tv and radio programs. For example, they display frames on the detailed content of the major evening news programs *Tagesschau* and *Heute* some two hours before they are broadcast. In principle, no newspaper can compete with such a service, and teletext is also not duplicating information available from another medium. Furthermore, the 'subtitling' program (the importance of which will be explained below) is also quite advanced. The Austrian *Teletext* program is a mixture of the Swiss and the West German system, and is run by the national radio and tv authority of Austria, ORF. In addition to the above services, the ORF teletext offers an interesting online service on four pages on the status of arrivals and departures of all flights to and from Vienna airport, Schwechat, with only a 3–5 minute delay in the latest information from the Schwechat control tower. According to ORF data, the 'main headlines' on page 171 are brought up to date fifty times per day and the ORF team updates daily 100 frames of information. According to a sample taken on January 29, 1982 at 4 p.m., the Austrian system broadcast eighty-two different pages, identifiable with separate page numbers. Out of these, fifty-three frames were repeated in each broadcast cycle, and twenty-nine carried a total of 150 frames in 'magazine' fashion — as will be described in greater length below. The ORF service is subdivided in five major subject categories called 'registers':

Reg. 1. (*Service Aktuell*) contains general daily information of broad interest such as weather, exchange rates, air traffic, major events, traffic conditions, snow conditions, etc. In total, twenty-one pages (eight in 'fixed' and fifteen in 'magazine' mode containing fifty-nine frames).

Reg. 2. (*Lebenshilfe*) contains information on emergency telephone numbers for diverse cases (hospital, pharmacies, etc.), consumer advice, general information for the handicapped (twenty-seven frames!) and a language training course (nine frames). A total of ten pages (three 'fixed' and seven in 'magazine' mode with forty-eight frames).

Reg. 3. (*ORF-Program*) contains information on future radio and tv programs. In total, seventeen pages of information are broadcast, fourteen in 'fixed' and three in 'magazine' mode with seven frames.

Reg. 4. (*Unterhaltung*) contains five frames of information in 'magazine' fashion with eight frames with entertainment such as a chess corner and a zodiac.

Reg. 5. (*Nachrichten*) contains news

"This philosophy of concentrating as much routing information as possible on to a page has improved the usability of videotex considerably"

frames on national and international news, sport, the economy, etc. In total twenty-one pages, twenty of which with 'fixed' information and one page with twenty (!) frames on all Austrian ski champions in 'magazine' mode.

In addition, there are some further information frames that do not fall into the above categories; some of them are 'service' frames of teletext, such as index pages or page 199 which contains eight frames of news in English taken from the BBC's *Ceefax*, London. Thus, as mentioned above, the Austrian teletext system is a mixture of different services on 100 frames.

In the early days of videotex (1W and 2W) it was considered undesirable to 'overload' pages by putting too much on them; the readability of pages was deemed to be crucially important [1]. Such a dogmatic view has turned out to be wrong: although it is true that those pages which are supposed to be read (i.e., those with actual information) should be readable and thus not overloaded, pages which are not to be read but just to be glanced at (i.e. routing pages) could and should contain densely packed information to avoid too many routing paths. This philosophy of concentrating as much routing information as possible on to a page has improved the usability of videotex considerably. This becomes apparent by examining the alphabetic index of Austria's 1W or 2W videotex, or of *Meyer's Encyclopedia* in the 2W videotex system in West Germany.

Another important lesson gradually being learned in connection with 1WN videotex is that, as mentioned earlier, it should not be used as an electronic newspaper (reading of lengthy material on a tv screen is not satisfactory due to the poor quality and the lack of portability of the display; see [3], [4]) but should be used for up-to-date information of wide interest, for special interest groups who have to rely more on reading than other groups (such as the deaf) and, in particular, in connection with ordinary tv programs. The use of 1WN videotex for subtitling (as is gradually being introduced in a number of countries) is an ideal example. Although subtitling is currently only used in programs for the deaf it is feasible, and will hopefully be pursued in the future, to use it for translating interviews; the interview would carry the speakers' and the interviewers' words in a foreign language on the audio channel, and the subtitle would condense the translation in the viewers' language.

1WN videotex should also prove helpful for all kinds of semi-emergency information which would presumably interest such a wide segment of the population as to overload any two-way videotex service, should it be offered by them.

A number of major improvements in 1WN videotex will be made possible as terminal technology develops. As was pointed out in Section 2, it is quite realistic to assume that intelligent terminals with local storage capabilities of 20–50 pages will become widely available within the next ten years. Such terminals will upgrade 1WN videotex in at least two ways: they will allow alphabetic searching and the local storage of frames. For example, a user would be able to type in an arbitrary alphabetic keyword which would be searched for by the terminal's microprocessor (either by index pages provided, or else by searching through all the pages being received), finally resulting in the display of

"One of the most significant improvements of 1WN videotex will, however, be made by attaching printers to videotex terminals"

all frames relevant to the specific keyword. Another application of such a terminal is to allow the user to type in the page number of a magazine (in the sense mentioned above) which is then fetched (and kept up-to-date) for later convenient and fast retrieval. The use of such terminals might permit the expansion of magazines to even more pages, giving 1WN videotex the potential of an attractive 2000–4000 pages of up-to-date information.

Another way of increasing the information capacity is reported by Tydeman [2], who mentions that in some of the US teletext trials different magazines are put on the systems at different, predefined times. We feel that 1WN videotex will also gain further importance if it be combined with 2W videotex, as will be explained in Section 6.

One of the most significant improvements of 1WN videotex will, however, be made by attaching printers to videotex terminals. Although the price of such printers will drop to well below US $200–300 in the near future, we believe that the price is not of critical importance. In an apartment building, for example, a printer could be shared (as is sometimes done with laundry machines) between dozens of apartments, making even sophisticated printers feasible. Similarly, coin-operated printers could be made available in public places (as photocopying equipment is today). The availability of such printers will make facsimile newspapers, distributed via 1WN videotex, a very attractive alternative, solving the increasingly tedious and expensive problem of newspaper delivery. With new terminal technology [5, 6, 7] even the delivery of pictures of a reasonable quality (requiring about ten times longer for transmission than ordinary text frames) is possible.

The viability of the above notion is demonstrated by the following calculation based on the situation in Austria; suppose 1WN videotex be used for transmission of facsimile newspapers during the off-time of Austrian tv. e.g. for the five hours 1:00–6:00 a.m. At four pages per second, over 70,000 pages can be transmitted. Assuming seventy participating newspapers, 1000 frames (equivalent to more than forty large newspaper pages and forty pictures) are available for each newspaper, clearly more than ample room. Observe that a printer which is supposed to print more than one copy of a paper (e.g. for more than one family in an apartment building) has to use some local storage and has to print the desired number of copies of each page, before continuing to print the next page. (This will place a limit on the number of families sharing a printer).

Finally, it should be made clear that the notion of so-called 'multi-time' paper as speculated in [8] would add still a further dimension to facsimile newspaper delivery.

4. The impact of 1WW (one-way wide-band) videotex, the use of cable tv, and direct-broadcast satellites

1WW videotex can be transmitted either via a dedicated broadcast channel, or via a separate CATV channel. To the authors' knowledge, the only major experiments conducted in this direction all use CATV. Since this alternative is particularly attractive in a country with high CATV penetration, it is not surprising that Canada (where over 50% of households are already equipped with CATV) leads in this area.

Cable tv is most suitable for this type of application since on average it can carry up to about forty different channels of tv and hifi-audio programs. One major problem is to actually 'fill-out' the capacity of CATV networks with high-quality tv or audio programs or, as in our case, with other useful applications. For example, at the time of writing, the local cable tv company in Vienna, Telekabel, provides only six different programs (two Austrian, three West German, and one Swiss) and sixteen audio programs (Austrian and West German). This service — apart from those areas where the quality of local tv reception is poor — only provides a real new service in bringing to Vienna four foreign tv channels and a few Bavarian radio channels. If, however, one takes into consideration that both Switzerland and West Germany are planning to launch their direct-broadcast satellite with Swiss and German tv programs around the second half of the 1980s, then the local cable tv company will not really bring in new services to the Vienna area any more — apart from the resource-sharing effect of the central dish antenna to the direct-broadcast satellites, and the necessary frequency converter. In the long term, however, when the broadcast power and used frequency band of direct-broadcast satellites increase, then the size and cost of the dishes will come down to enable them to be installed on the roofs of houses, if desired. Therefore cable tv companies have to look for additional novel services to attract customers. We believe that 1WW videotex services (preferably using several channels) belong to this later category.

At this point we would like to comment on the use of direct-broadcast satellites for broadcasting 1WW videotex services. At present, many countries are making preparations to launch their own direct-broadcast satellite systems. Some of them, such as India, Colombia and the Arab countries, do not have their own fully developed terrestrial tv networks. Others, such as Canada and Australia, provided the vast majority of their populations with tv programs but due to the geographical peculiarities of these countries, there are huge, sparsely populated areas where the build-up of terrestrial tv networks cannot be justified financially. For these two categories of countries, direct-broadcast satellite systems as we know them today are not or will not be a luxury, but a necessity. There is, however, a third category — such as the European countries — which are smaller geographically, and in addition, possess well developed terrestrial tv networks with practically full geographic and population coverage. Most of them even have networks for distributing two to three nationwide tv programs. In these countries, the direct-broadcast satellite system arrived 25–30 years later than when would have been ideal. Nonetheless, some of them (Britain, France, West Germany, Switzerland, Luxembourg, Monaco, Italy, Austria, Yugoslavia, etc.) are planning to put their direct-broadcast satellite systems into operation soon. There are different driving forces for them to do so: some of the countries are running out of frequencies. For example, the setting up of a fourth national channel in West Germany would not be possible because of frequency congestion. Other countries, especially the small ones, are homes of commercial tv companies (e.g., RTL in Luxembourg and Tele-Monte-Carlo in Monaco) which plan to broadcast commercial programs, and especially advertisements, for audiences in neighbouring countries. RTL, for instance, would be received in Lyon and Hamburg and would thus cover half of France and three-quarters of Germany. It is therefore feared in those countries that these commercial programs would strongly compete with the national ones.

Other countries, such as Austria and Yugoslavia, see this tool as an excellent medium for conveying national culture beyond their borders. The Austrian direct-broadcast satellite system would be able to provide 55 million people both in Austria and neighboring countries with Austrian programs. In Yugoslavia — a country with six republics, two autonomous regions, and several languages — there are expectations that such a system would create closer cultural links between the republics and regions, and at the same time improve the regional service. There are still a few countries in Europe where, because of geographic difficulties, the terrestrial networks has not been completed. A typical example is Norway, where this new technology could lead to considerable savings both in time and resources. Also, a third Austrian and Swiss program — if the time comes to build it up — would be better implemented using this technology. According to [16], for example, for Norway to achieve a 95% coverage of the population would require 154 VHS transmitters and 1,000 repeaters. In addition (due to the severe climatic conditions) the annual operation cost of the network would be of the order of US $65 million. In Britain, where geographic conditions are far more favorable for terrestrial systems, the annual operating costs would be about US $10 million per tv channel. In Italy and in France, it would be around US $15 million per year, per country. According to [16],

> The annual cost per channel for a satellite-based operation network with five channel satellites would be in the order of eight to nine million US dollars. The system would consist of two satellites in orbit at any given time (one active satellite, one back-up) and related ground facilities (a telecommand telemetry station and the tv transmitting station). All elements of the system would be insured against failure. The annual cost per channel could increase to about twelve million dollars in the case of the most power-demanding mission and, on the contrary, decrease to about six million dollars for smaller coverages.
>
> A five channel satellite providing coverage of France or Italy, for instance, would lead to an annual network cost reduction per channel in the order of six million dollars, i.e., about 40% reduction over the classical terrestrial network and allowing at the same time a near 100% coverage. In the case of smaller coverage areas for Britain and Germany, the percentage reduction will be lower. It would, on the other hand, be much more for countries specially difficult to cover by terrestrial systems such as, for instance, Norway, where the savings in operation would be about fifty-four million US dollars per year. Thus, broadcast satellite systems seem to be cheaper from the operational point of view.

As to the minimum initial capital investment cost of a direct-broadcast satellite system, according to [17], the following components have to be taken into consideration:

(a) Space segment (satellite, launching, insurance)

(b) Earth segment (up-link transmitters, down-link receivers (dishes)).

Some typical cost elements for present and future direct-broadcast satellite systems are shown in Table 1.

As to the cost of up-link transmitters and down-link receivers, the higher the frequency used, the more costly the up-link transmitter. Up-links in the more preferable 14 GHz band costs are about US $500,000 at present for a transformer and transmitter, i.e., twice as much as for similar equipment in the 6 GHZ band. It is expected that these costs will drop as time passes, and will level off at around US $50,000. Down-link receivers, on the other hand, get smaller and cheaper with increasing frequency and power used by the satellite, prices depending on the system and quantity. Disks range from US $100 to 2,000 for the 12–14 GHz frequency band. As to the cost of the satellite, the higher the frequency band used and the broadcasting power, the more expensive the satellite and its launch. Nonetheless, for direct-broadcast satellite systems, where only one or two satellites and appropriate up-link transmitters servicing a large number of users with down-link receivers are employed, it is more economical to use as high frequencies as possible. This philosophy was also adopted by the ITU and World Administrative Radio Conference (WARC) which allocated in 1977 higher up-link and down-link frequencies in the 12–14 GHz band for direct broadcast purposes.

In any discussion of the role of direct-broadcast satellite systems, a key issue is the problem of program content. This is a crucial question, particularly for countries which

Table 1. *Typical cost of direct-broadcast satellite system components [17]*

1.a. Capital costs of present and planned DBS systems

System	Total Cost ($m)	Satellites* ($m each)	Launch** (Date) ($m each)	Insurance Premium (years)	Design Life	Satellite Mass	No. of transponders	Receiver costs
Average DBS System	171	25 (Q=3)	30	2	8	200-800 kg	2/4 channels	$200-500
ANIK B (Canada)	63	34 (Q=1)	29 (1978)		7	400 kg	6 channels	$500
ANIK C (Canada)	165	22.5 (Q=3)	29 (1981)	1.54	8	522 kg	16 channels 32 TV	$3300 (Q=100)
BS-1 (Japan)	116	60 (Q=2)	13 (1978)		2	352 kg	2	$100-200 (Q=100,000)
CTS (US/Canada)	82.7	72.7	10 (1975)			350 kg	2	$16,000(10ft dish) $23,000(15ft dish)
RA-6 (US)	190					1,356 kg	6 (2.5 GHz)	$1-5,000
TDF-1,TV-SAT 36 (France, Germany)	160	35 (Q=2)	30 (1984)		8	135	13	$600-800
NORDSAT (Scandinavia)	370	30 (Q=3)	30 (1985-87)	3.1		?	13	
ARABSAT (ATU)	240	60 (Q=3)	30 (plan)			?	2 DBS	(Q=5,000)
ECS/OTS (ESA) (L-SAT -PLANNING)	250	(Q=3)			7	703 kg	8	$200
INSAT (India)	225	30 (Q=2)	(1981)		7	?	2 DBS (2.5 GHz)	$400
Australia	900		(1985-87)		?			
SATCOL (Columbia)						?	1 DBS	
CONDOR (Andean Nat.)						?	12	
COMSAT DBS	146	35 (Q=3)	12	1.3	8	?	8 channels	$200-400

* see table 1.b
** see table 1.c

1.b Satellite cost breakdown

Component	Cost, $m
Design and test*	20
TTC earth facility	2
Multiplexers	1.2
Orbital positioning equipment**	
Antennae	
Solar panels and related power engineering equipment	0.5-1

* Includes digital T&C systems, some of power and communications electronics;
** Thrusters and stabilizers

1.c Feasible launch vehicles and prices

Vehicle	Cost ($m)	Orbit capacity (kg)
Delta 3914	26	907
Atlas-Centaur	40	1793
N-Rocket(Japan)	75	750
Arianne 1	16	4840
Arianne 3	11-15	4000-11000
Shuttle(US)	11-14	4000-11000

"It is only because of the widespread misunderstanding that came about because of the ill-conceived Prestel experiment in Britain . . . .that it is often assumed that 1WW and 2W videotex are rivals"

already operate tv programs on well developed terrestrial networks, because an entirely new program for the sake of a direct-broadcast satellite system seems to be wasteful and too expensive. According to [17], ten hours per day of general tv programs cost US $36.5 million per year to produce (CCIR Data Report, International Radio Consultative Committee).

According to the present allocation of WARC frequencies in Europe, Africa, and Asia, each country is allocated five specific channels (with 27 MHz bandwidth) for direct-broadcast purposes. At first this certainly brings the problem of economic utilization: a country such as Austria, for example, will find it difficult to fill its allocated channels with useful programs. However, the more channels are used, the lower will be the cost per channel for a satellite which can easily accommodate a few separate tv and radio channels. Therefore, in order to utilize fully the capacities of a modern direct-broadcast satellite, either more than one country will have to launch a common satellite for their own purposes, or one country has to utilize its channel differently. The way we are proposing is to use the 'free' direct-broadcast channels for 1WW videotex purposes. With such a service, a reasonable number of information frames can be rationally provided, as mentioned above, which can be used quite efficiently in a future information-oriented society. The use of direct broadcast satellites for 1WW videotex will, in the long run, enable small mobile dishes and mobile terminals to be used for 1WW videotex purposes by increasing the used transmission power of the satellite and the used frequency in the region of 20–30 GHz.

The amount of information that can be offered with 1WW videotex is about 500 times larger than with 1WN videotex, since the full bandwidth of a tv channel (6–8 MHz) can be utilized for teletext. Thus, offering 50,000 pages of information (or more, using a variation of the magazine idea) is no problem with 1WW. Since the 2W videotex databases currently in use do not offer more pages than of the same order of magnitude, 1WW videotex will indeed be a rival of 2W videotex as long as 2W videotex is seen mainly as an information service, where the amount of information is large but not super-large. However, considering 2W videotex in this way implies a basic misunderstanding of the true possibilities of 2W videotex. It is only because of the widespread misunderstanding that came about because of the ill-conceived *Prestel* experiment in Britain (where 2W videotex has been used primarily as an information service since 1979) that it is often assumed that 1WW and 2W videotex are rivals. They are not; 1WW will be vastly superior in performance/cost ratio to 2W videotex (assuming an appropriate CATV infrastructure) in the area of providing large, but not huge, amounts of information which will appeal to a sufficiently large segment of the population or to some extent if no infrastructure (e.g., a telephone network) for 2W videotex exists. Two way videotex is a reasonable alternative to 1WW if an adequate infrastructure for 1WW videotex be not or cannot be made available (for example, if all channels are already occupied with tv programs). If an appropriate 2W videotex infrastructure be available, it should be used for large amounts of data which are accessed only moderately often and, most important of all, for all those myriads of applications where the interaction provided by 2W videotex is essential. The above line of thought will be elaborated in depth in a second paper, to follow in the next issue of *Electronic Publishing Review*, where the penetration of videotex systems and their components such as the telecommunication infrastructure will be discussed.

Regarding terminals to be used for 1WW videotex, preferably an intelligent videotex decoder should be used, one similar to what has been referred to earlier for 1WN videotex systems.

5. The role of 2W (two-way) videotex

In the initial period of a developed 2W videotex development it was often claimed that its main advantage over 1W videotex was the facility to store unlimited amounts of information. Although 2W videotex does allow the storage of large amounts of data (a fact not only necessary for certain types of information such as nationwide phone directories or large encyclopedias, but also of 'philosophical' importance, since it eliminates the need to select information, i.e., to exert some kind of censorship), its main importance lies not in its capability as an information service, but its transactional and communication potential. Before going into detail on the latter points, it is worthwhile mentioning that even in the information-providing sense, 2W videotex provides potentials not possible with 1W, or even 1WW videotex.

One such instance is the electronic telephone directory. Even in a small country such as Austria, such a directory would have some two million entries, requiring an estimated 300,000 videotex frames. This is beyond the capabilities of 1WW videotex.

Another example is the idea of offering a fully fledged encyclopedia via videotex. Ignoring the fact that other technologies such as videodiscs [8] may be preferable in such instances, and assuming that modern videotex systems can handle good quality pictures (as is the case in systems such as *Telidon* [5], AT&T [6], *Picture-Prestel* and MUPID [7], hence obviating the need for locally-stored pictures as proposed in [9]), a twenty-four volume encyclopedia would require some 240,000 videotex frames for text, and another 160,000 frames for pictures. As in the case of an electronic nationwide phone directory or electronic super-directory as proposed in [10], such amounts of information cannot be handled by 1WW videotex. They can be handled by 2W videotex and indeed in a commercially viable way, provided a sufficiently large segment of the population participates. Consider, for example, the situation in West Germany: by 1990, some five million 2W videotex customers are predicted. Assuming that 2% of all videotex users are willing to subscribe to an electronic encyclopedia for a fee of US $50 per year (this would compare favorably with the US $1000 buying price for each of the two major German encyclopedias *Meyer* and *Brockhaus*), this would amount to a total revenue of US $5 million per year. Assuming US $2.50 storage charge per page per year (corresponding to the current charges in Austria), $1 million would be required for storage. Based on current experiments, a staff of about forty would be sufficient to keep the encyclopedia up to date. At a cost of $30,000 per man year, $2.6 million per year would remain for the acquisition of material, overheads and earnings.

Despite the fact that we believe that 2W videotex might be a viable alternative for super-large sets of information (provided the number of users be sufficiently large) we would like to emphasize that this is not the most important aspect. (As a matter of fact, due to other more attractive alternatives, videotex may never be used this way at all [8].) The importance of 2W videotex lies in its transactional and communication capability. It would be repetitive to list once more the abundance of potential applications of 2W videotex described in many recent studies, e.g., [4], [12]; rather, we prefer to make a number of general remarks on what we consider most important.

First of all, we would like to clarify some 2W videotex applications whose significance is often overlooked: we want to distinguish between *answer-type* and *interactive-type* systems. Classical transactional applications of videotex are often only of the answer type. For example, when teleshopping, the user looks up some goods in a catalogue and then

" . . . for many applications for which direct access to the information provider's computer is often considered necessary, considerably less is sufficient: . . . "

fills out an order form which is sent (electronically) to the information provider. No further interaction takes place between user and information provider, and hence no online connection between the two is necessary (this is the reason why, for teleshopping, Prestel-type answer pages are quite satisfactory; access to the information provider's computer is more a luxury than a necessity). Note that even telebanking, the often mentioned standard example of the need for online connection between user and information provider, is really of the answer type; the user retrieves the current status of his account (which could well be done even in 1W mode, by assigning to each account one frame in the videotex computer which is only accessible to authorized users) or carries out fund transfers by filling out an appropriate form. In both cases, contrary to often heard views, no online connection between user and information provider is necessary. Thus, the much emphasized online dialog between the user and the bank's computer is not essential for such basic applications. The only component which is essential is an efficient message service.

We do not want to claim that videotex networking with interactive access to third-party computers is not important. It definitely is, for certain kinds of truly interactive applications to which we will turn below. What we do claim is that for many applications for which direct access to the information provider's computer is often considered necessary, considerably less is sufficient: an efficient and safe message service [10].

Indeed, we would like to claim that the value of message services in videotex is grossly underestimated by most people. Such services can be used for transactions (as explained above); for electronic mail; for communication with the deaf; for teleplaying [11]; and for a number of other applications, which form the basis of an important and still virtually unexploited notion of resource-sharing via videotex. We would like to elaborate briefly on the idea of resource-sharing by means of an example: suppose a user of videotex wants a number of frames of videotex in printed form, or as high-quality slides. Despite the fact that he may not have adequate equipment himself, he can request the desired output via the message system from a company offering that kind of service.

We would like to turn our attention now to truly interactive-type applications of 2W videotex. Despite the fact that such applications are virtually non-existent in 2W videotex systems at present, we believe that they will be developed rapidly and gain increasing importance.

In a truly interactive-type application, online access to a third-party computer is essential. This is the case where such a computer is used to run a sophisticated program, a game program, or to perform computation [11]. It is also important in booking situations when rapid confirmation is required. It will play a prominent role in all kinds of teaching applications of videotex, when the instantaneous evaluation of the student's input is essential, and in applications where a third-party computer is used to verify the user's input (e.g. by checking his spelling). A host of other applications is clear to anyone who cares to think of all the ways in which we use computer terminals interactively through computer networks today. After all, 2W videotex terminals are exactly that: inexpensive, simple computer terminals which will eventually permit access to large computer networks. It is this fact that makes 2W videotex significant beyond what 1WN videotex

"The second-generation videotex network which will go into operation in West Germany towards the end of 1983 is based on the assumption that 10% of the information is requested 90% of the time"

can ever achieve. With 2W videotex the notion of omni-present access to computer networks is slowly turning from fiction into reality.

We conclude this section by mentioning that 2W videotex will gain much by the introduction of intelligent terminals: not only will these allow more convenient searching procedures (e.g., permitting access by alphabetic keyboards and by relational queries in terms of a request form [14]) and the local storage of information, the notion of down-loading and executing software [11], so called 'telesoftware', will also increase the flexibility of 2W videotex tremendously.

6. The combination of 1W and 2W videotex

In the preceding sections we have argued that each of 1WN, 1WW and 2W videotex are best suited for some applications, but not for all; hence the future coexistence of all three varieties seems a definite possibility. Assuming the widespread penetration of intelligent videotex terminals, such coexistence may well turn into a fruitful cooperation, a notion first mentioned in [13]. The processing power and local storage of an intelligent terminal may greatly increase the attractiveness of 1W videotex (see Sections 3 and 4), while some applications may be split between 1W and 2W videotex. For example, consider the currency exchange services offered in West Germany via third-party computers: the user accesses a bank offering such a service via the gateway of videotex; he enters two currencies A and B and an amount m; the bank's computer computes the equivalent of m units of currency A in currency B and sends the result n back to the user.

In a way, such applications are, from a long-term point of view, abuses of the gateway notion rather than reasonable applications of them. Such trivial computations should be carried out in the user's intelligent terminal rather than overburdening (by thousands of simple requests) a third-party computer. A typical scenario of the future for such an application could be: the user down-loads a (short) program for such currency exchange calculations from 2W videotex; this program fetches one frame of current exchange rates from 1W videotex (where such information is offered anyway) and then performs the desired calculations. Rather than going through 2W videotex gateways and performing some calculations on a third party computer, one page each is retrieved from 2W and 1W videotex, much reducing the load on the 2W videotex system and the third party computer.

From a technical point of view, the combination of 1WW and 2W videotex could and should be carried much further except that, in some countries, developments have perhaps already gone too far to make such solutions likely.

The second-generation videotex network which will go into operation in West Germany towards the end of 1983 is based on the assumption that 10% of the information is requested 90% of the time. Hence it seems feasible to use many comparatively small regional videotex centers (for only the 10% of frequently requested information) and a single large center which will send additional frames to the regional centers as requested. Observe that the function of the regional centers could be further reduced (thus decreasing the cost of each of the large number of such centers) if that same 10% of information were distributed via 1WW videotex. The user would not even be aware of this fact: his intelligent terminal would check for the required information in the 1WW videotex system only when failing to retrieve it from 2W videotex. Considering that 1WW videotex usually depends on the availability of a free channel on terrestrial networks or direct-broadcast satellite systems, or on the state of the CATV network, the above proposal will only be meaningful in countries where this is available or CATV penetration is high prior to the introduction of nationwide 2W videotex. This latter point is perhaps not true in some West European countries, but may apply especially to North America, the Eastern block countries, and the developing world.

The combination of 1W and 2W videotex systems in a given country is not only a technical possibility but also a necessity. Thus a country with an underdeveloped telephone infrastructure which is one of the present carriers of 2W videotex has to put its videotex services on 1WW broadcast videotex to the maximum extent possible, since it is quicker, easier, and cheaper to develop a necessary infrastructure based on a broadcast medium.

In Figure 1 we have compiled the presently known main videotex application classes and show which application should be mostly supported by 1WN, 1WW and 2W videotex systems. In our example, we have made the assumption that all these services are equally available to all users.

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Videotex Applications	*Videotex* 1WN (normal teletext)	1WW (full channel teletext)	2W (viewdata)
Information retrieval			
— very high simultaneous request by users	X	X	
— high simultaneous request		X	
— medium simultaneous request		X	X
— low simultaneous request			X
— information related to tv broadcast (e.g., upcoming programs)	X		
Games/entertainment			
— games without interactivity		X	
— games with interactivity			X
— downloading of game programs			X
— promotion of tv broadcast (e.g. subtitling)	X		
Transactions/teleshopping			
— financial information		X	X
— advertisements		X	
— classified ads			X
— sale catalogues			X
— online ordering			X
— banking transaction			X
Electronic messaging			
— important instand broadcast messages	X	X	
— general broadcast messages of broad interests		X	
— group messages			X
— individual messages			X
— voting			X
Data processing			
— downloading of computer programs		X	X
— access to computers with time sharing service for computation			X
— storage of user data			X
Telemonitoring/home management			
— emergency messages	X	X	
— fire, burglar, medical alarm			X
Education			
— most frequent educational courses		X	
— specialized educational courses			X
— test, examination			X

Figure 1. *Suitable videotex applications for 1W and 2W videotex systems*

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Some aspects of the market penetration of 1W and 2W videotex

H.A. Maurer and I. Sebestyen

The few studies dealing with penetration of videotex systems so far have mainly focused on the penetration of teletext (1WN videotex) and videotex terminals (2W videotex) into the domestic and business market of a given country or region. For example, within the framework of a study done for the Eurodata Foundation by the British consulting firm Logica in 1979 [7], it was predicted that the number of home videotex terminals would grow from virtually zero in 1979 to 2.7 million in 1987 in Western Europe alone.

Since the prediction of videotex penetration in different markets is most complex — and as we will show later, perhaps too complex — and requires a broad systems approach, we would like to introduce some new philosophical aspects not looked at so far, thus adding new views to this complicated problem. First of all, videotex has many different aspects to be looked at from the market penetration point of view:

(a) Technological aspects

Within technological aspects, the following videotex components have to be considered:

- penetration of telecommunication media used for carrying videotex services
- penetration of videotex terminals including personal computers and intelligent videotex terminals for receiving and processing videotex services
- penetration of host, switching and gateway computers for providing and channelling various videotex services
- penetration of different videotex service applications offered

(b) Historical and economic aspects

Historical aspects concerning the state of telecommunications, broadcasting and computer infrastructures play a very important role not looked at in depth so far. For example, a developing country with virtually no telephone infrastructure but modest tv broadcast facilities may build its videotex services primarily in a 1WW videotex fashion within a reasonable time horizon. Economic aspects such as consumer spending patterns play another important role in determining the pace of market penetration both into offices and into homes, not to mention other likely categories of videotex applications.

One of the lessons that can be learned is that within a reasonable time horizon, only the richest countries can expect 2W videotex to enter the domestic and business markets; medium-developed countries may expect 1W videotex systems to enter both home and business markets, whereas 2W videotex systems are probable only in the business market. For less developed countries only 1W videotex could have an impact on the business market

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within a reasonable time horizon, such as the next decade.

(c) Human and social aspects

The human and social aspects of videotex penetration are also important. Videotex as known is conceived to be the mass utility tool of the information-oriented society of the future. This, at least in the most developed countries, is expected to happen before long. One of the basic aims is to provide every household and business unit — not yet computerized — with a videotex terminal linked to a videotex network to enable the mass application of computers and computing at low cost. Through this technology everybody — housewife, student, farmer, cook or city dweller — is expected to be able to use his or her own terminal. There are major problems in user acceptance, education, and training even for the traditional computer and telecommunications systems which are primarily used in the business world. However, the magnitude of training and educational problems in widespread home computing systems is at present unknown. If we did assume that videotex techology had full market penetration from the technical point of view tomorrow, how many people would be able to use it within a reasonably short time? Also, what would the absorption capacity of the people of a given country be, assuming appropriate training facilities both in quantity and quality existed? Few precise answers to these questions can be given at present, but it probably would take decades even for the most developed societies to take full advantage of what a perfectly developed videotex system could offer. Thus, what should be the desired speed of market penetration from the human and social point of view? We are afraid that this most important question will not be answered in this paper, but we are aware of the fact that it has to be answered in a future study: this question seems to be one of the corner points of a future information society.

(d) Legal and regulatory aspects

Legal and regulatory issues may — and in some countries will — significantly influence the market penetration of videotex. In some countries, at present 1W videotex services can be operated only by certain organizations such as the national radio and tv broadcasting authorities, whereas the content of the service is provided by another organization — such as a national news agency. 2W videotex is operated on an exclusive basis by a third organization, in most cases by the national telecommunications authorities, carrying information provided by many independent users (information providers). In most cases the two different videotex system operators regard each other as competitors or, at best, as operators of two completely different services, and do not fight each other. There is at present no country known to us which would have a favourable legislative environment to support mixed 1W and 2W videotex services. In addition, close coordination of 1W and 2W videotex standards would be needed. A prohibiting factor at present is that most effort is made on the standardization in the field of 2W videotex systems. However, in 1WN-1WW videotex, much standardization development work has to be done first, before standardization efforts of 1W and 2W videotex systems can be harmonized as well.

Videotex systems, as mentioned before, are built from the technological point of view on different components such as

- videotex telecommunication infrastructure to carry information
- videotex hardware and software components
- applications (software)

We will examine the first two components from the historical and economic points of view. The possible market penetration of different videotex applications (such as information retrieval, games, transactions, messaging, data processing, home management, etc.) will not be dealt with separately in this study, since this complicated issue represents a broad field of study certainly beyond the scope of this paper. Nonetheless, references to applications will be made throughout, because we believe that one cannot separate videotex telecommunications infrastructure, hardware and software from applications.

Telecommunications infrastructure for 1W and 2W videotex

Videotex systems (1W and 2W) as we presently know them are based on different telecommunication infrastructures. 1WN videotex is piggy-backed on the broadcast facilities of tv, but one could imagine that it could also be placed on a dedicated radio channel. At present, 1WW videotex systems are only in their infancy; only one or two North American cable tv experiments along this line are known to us. Nevertheless, market penetration of cable systems is an interesting phenomenon in this connection. 2W videotex systems as we presently know them are based on telephone and packet-switching computer networks, and whereas not too many historical statistics exist about market penetration of packet-switching computer networks, extensive and fascinating data are available on the telephone network and its usage. From this, we believe that useful results can be drawn to predict the market penetration of 2W videotex networks, especially from the telecommunications point of view.

Now let us go into the details of some characteristic statistics and curves. In Figure 1 penetration curves of different media such as radio, telephone, black and white tv, color tv and cable tv into US households are shown. The US figures are significant also from the point of view that they represent a country in the forefront of technical development, and in many respects countries with a time lag between development and market penetration can make a sample for the potential way of their own domestic development. Figure 1 shows the following interesting trends. Although the USA at present has one of the most developed telephone infrastructures, full market penetration of US households with telephones (we have regarded 80% as full penetration) has taken about 72 years, a surprisingly long period. It can be seen that the development of the telephone infrastructure is linearly proportional to the wealth of the country. Figure 2 reflects the well known fact that the number of telephones per 1000 population is closely related to the GNP per capita of any country. The GNP figures in the diagrams are expressed in constant 1958 US dollars in order to exclude the effects of inflation on the curve. As it can be seen, all data follow a single diagonal line; the developing countries with low monetary resources and thus limited telephone infrastructures are at the lower end of the curve. Austria and Japan lie somewhere in the middle, whereas the richest countries such as the USA, Canada, Sweden and Switzerland are at the upper end of the curve. Surprisingly, some rich Arab countries are still not within this group, due to the fact that in order to have a widespread, well-developed telephone network of US standards, it is not enough to be rich, but one has to be rich for a long time, without any disturbance, such as war*.

In Figure 2 it is striking to follow the development pattern of the US. It is remarkable that between the two world wars at the time of economic crisis, recession and growing population, there was a long period with practically no strong upward trends. Only from the time that preparations for World War II began, can one see some improvement. During the war, obviously no major investment in the telephone network was made, although the GNP per capita increased because of increased industrial output needed for the military hardware. Constant development can be observed, however — again along a diagonal line — after World War II. Now Figure 3; one may state that the development curves of individual countries are more or less parallel to each other with the exception of the US, which developed rapidly between 1890 and 1910. In general, richer countries are ahead of poorer countries and the development of the telephone network requires a long time period. It is also remarkable how one can follow the history of each country along the line of its telephone development: the recession in the early 1930s in the USA and Canada, the Civil war in Spain between 1936 and 1939, the impact of World War II on Poland, etc.

One lesson for the developing countries with less developed telecommunications infrastructures is that if they want to copy the present type of telephone network of the developed countries it will take a very long

* *Along the same lines, Figure 3 which shows the development curve of the telephone network for some selected countries, provides more evidence of this.*

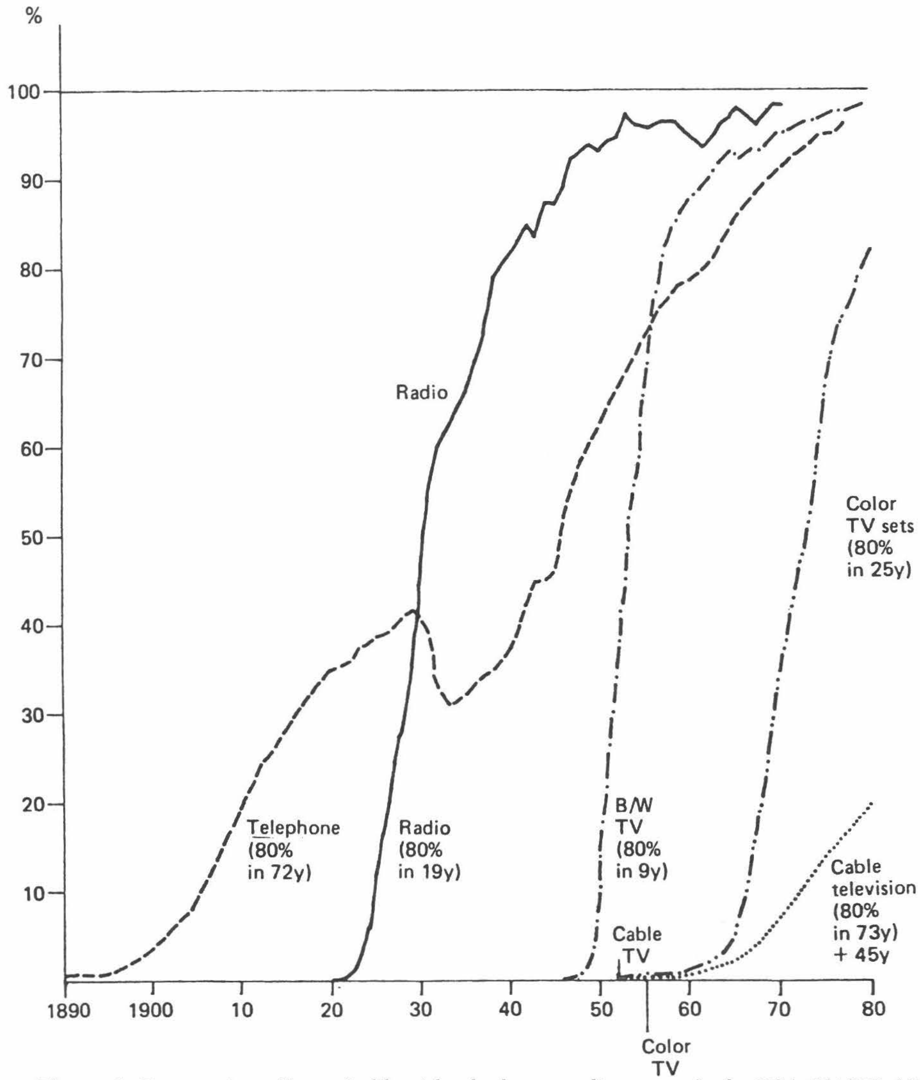

Figure 1. *Penetration of households with telephone, radio, tv sets in the USA (%)* [10, 11]

time to build, and huge resources will be required. From the philosophical point of view, it is questionable to start to build up a telecommunication infrastructure now, based on a wired analog telephone network.

One can observe from Figure 1 that the well known 'S'-shape of telephone network development started to grow in the first decade of this century, and then in the 1930s because of the economic crisis — families had to cancel their telephone subscriptions. Then, with the wartime economic boom, the growth of telephone penetration increased. Apparently, the economic difficulties of the 1930s led to a delay of 8–10 years in the penetration of telephone in US households.

A similar type of development pattern seems to be true for cable tv networks, which only emerged in the USA in the early 1950s. If the present trend continues, then an 80% penetration of cable tv in the US can only be expected in about 70–75 years, so that the

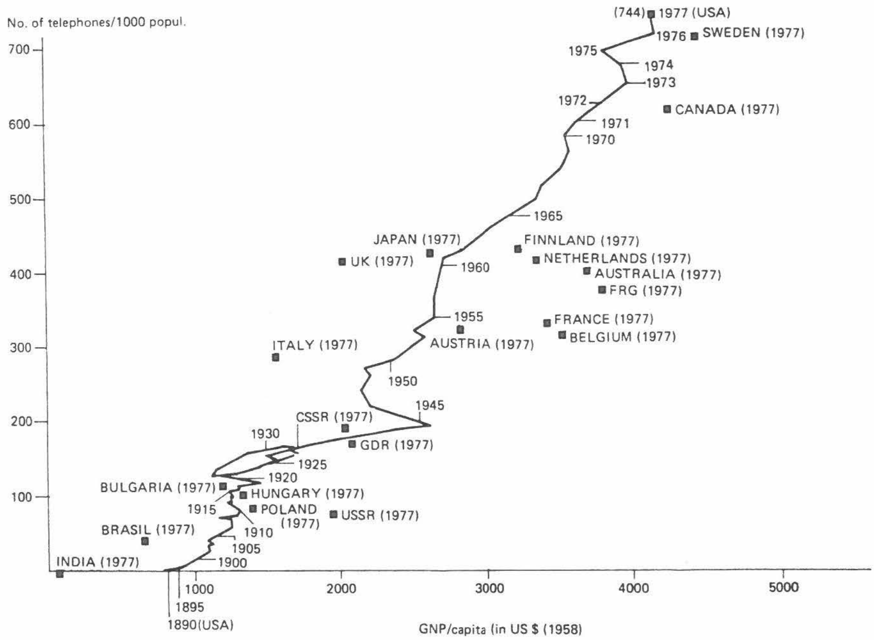

Figure 2. *Number of telephones per 1,000 population in 1977 for selected countries and for the USA between 1890 and 1977* [9, 10, 13]

development pattern of this other terrestrial network is quite similar to that of the telephone. The exceptional geographical situation of a country such as Canada, where, as mentioned previously, the penetration of cable tv has reached about 50% of households, seems to be a contradiction. But this fact can be ascribed to some specific Canadian aspects, such as similar culture, the same predominating language, the fact that the majority of the Canadian population lives in cities close to the US border, but not close enough to receive US tv broadcasts directly, etc. Consequently, the Canadian cable tv development curve is steeper than that of the US. With regard to cable tv network development, some other factors have to be taken into consideration. An important factor which will probably influence the market penetration of cable tv is that the role of cable tv is changing. During the first 30 years of its existence, its major role was to bring tv broadcasts of high quality to homes, but now it is becoming the backbone of broadband communication allowing, for example, 1WW videotex (with reverse channel possibly even 2W) and other innovative types of applications which no one thought of at the time these cable tv services were first introduced. In a sense we see the same phenomenon happening to 1W and 2W videotex. At present we are still in the learning phase, when these media are changing and developing, and providing new services, and thus in turn having a major impact on the market penetration process. This phenomenon is relatively unique. We do not see it in the development of telephone, radio and tv broadcast services, whose primary service functions have not changed over time.

One of the most important observations one can make on the basis of Figure 1 is the fast market penetration of radio, black and white, and color tv services. The fastest was achieved by black and white tv: in about nine years a market penetration of around 80% was achieved in the US, one of the shortest man-

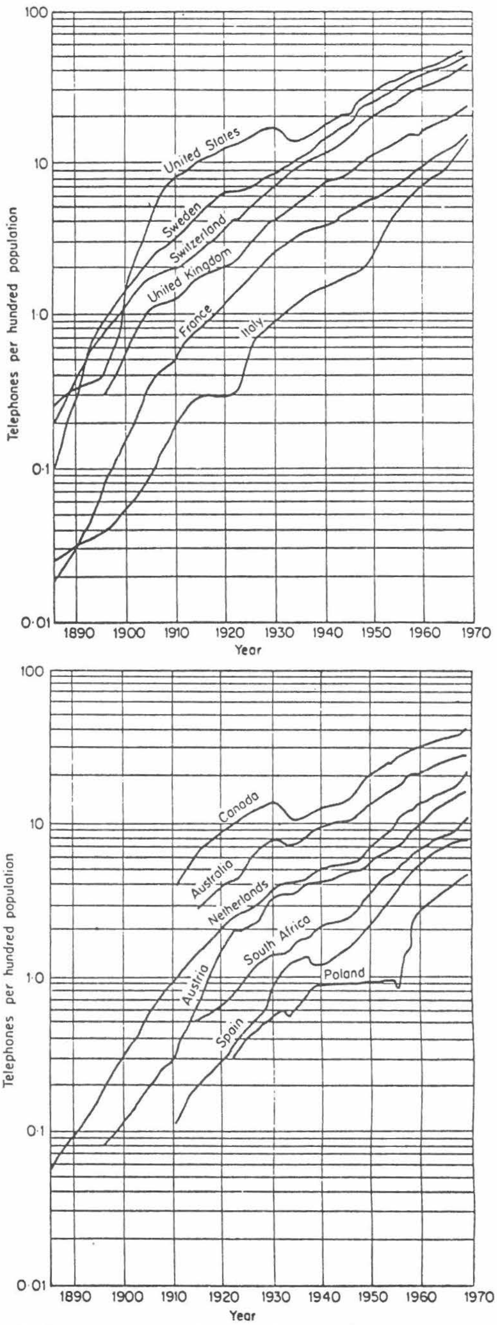

Figure 3a and 3b. *Telephones (stations) per 100 population in various countries (Groups A and B)* [12]

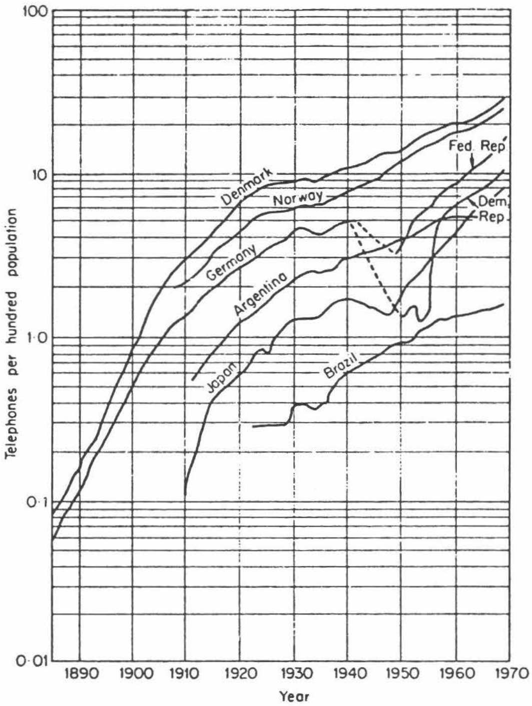

Figure 3c: *Telephones (stations) per 100 population in various countries (Group C)* [12]

kind has ever experienced. Strangely enough, a similar figure was achieved in the last decade by pocket calculators, too. However, such rapid market penetration patterns are unusual even in the information and microelectronics industry. For videotex, lower figures can certainly be expected, as we will show later. There is one very important aspect of the similarity of radio and tv penetrations: their telecommunications infrastructure is based on ether broadcast technology, and thus no time and resource consuming cabling was needed when it had to be put into operation. Another reason for the success of these two media is, we believe, that when they entered the market they offered a completely new type of service with practically no competitors, so that the substitution effect was negligible. Tv had some competition from movies in the entertainment category, which was easily won by television, as all statistics prove.

With the telephone, this was not quite the case. This medium belongs to the category of individual communications such as telegraph and mail services, which did indeed compete with each other to a certain extent.

In the beginning, radio certainly had some strong competition from newspapers in the field of news delivery; it proved to be more useful when news had to be provided instantaneously, whereas newspapers were better at bringing full details on news, analytical articles, etc. There was obviously no competition in the field of audio information such as music. A type of competition does exist to a certain extent between tv and radio, for example, in bringing news on events where no pictorial information is available, or where it is of secondary importance. Nonetheless, looking at historical statistics, in no country did the introduction of tv have a serious influence on the popularity of radio. In the US, in the early 1950s, a brief drop in radio sales was observed, but this was the period when in homes new investments in consumer electronics were placed in buying tv equipment. A short decline (we would call it rather a 'disturbance') of radio penetration was reported after 1960, but this was during a period when radio as such could be regarded as fully penetrated into the domestic market. In connection with the market penetration of radio in the US, it has to be mentioned that, according to Figure 1, its penetration was not significantly influenced by the economic crisis of the 1930s nor by World War II.

This phenomenon is, however, not quite true for less wealthy countries, as we will show on the basis of some Hungarian statistics. In Hungary (Figure 4), radio started to penetrate the domestic market in 1925, and growth was exponential up to 1930. Between 1930 and 1940, due to the severe economic situation of the country, only low growth figures were achieved. No figures are available for the period of World War II. After the war, the radio service in Hungary had to start right from the beginning, most of the radio receivers having been destroyed, and the number of radio licenses exceeded the pre-war level only after 1948. From then on, however, the penetration of radio simply followed the normal 'S' type of growth curve, similar to that

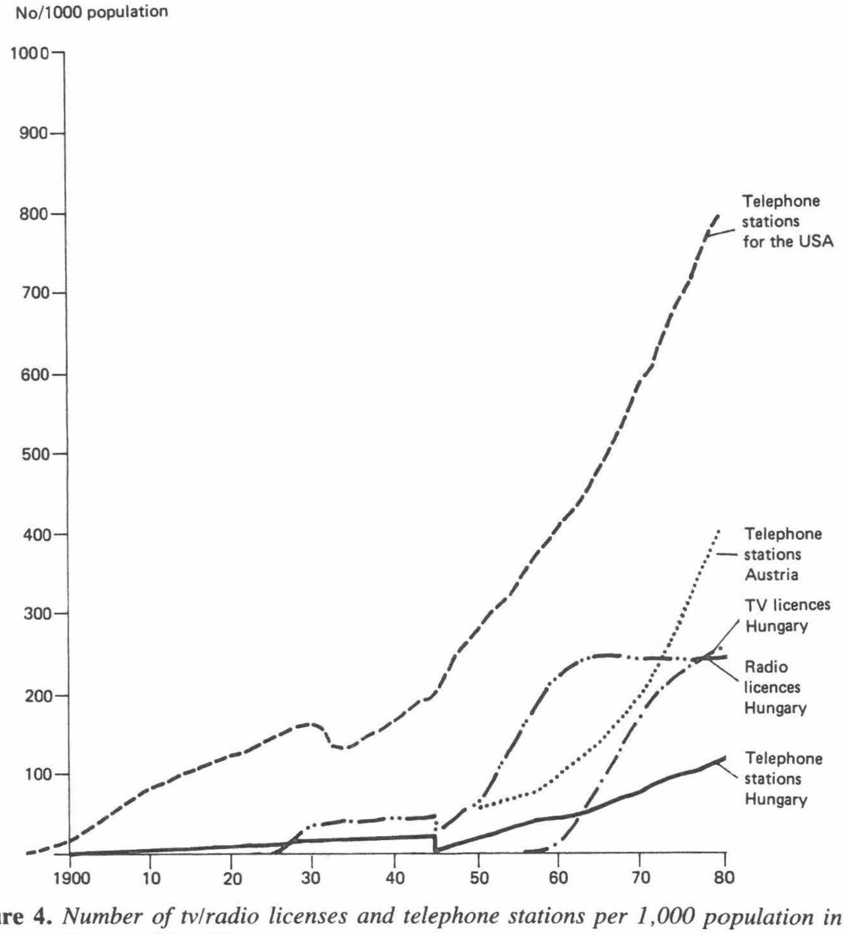

Figure 4. *Number of tv/radio licenses and telephone stations per 1,000 population in Hungary* [17, 18]

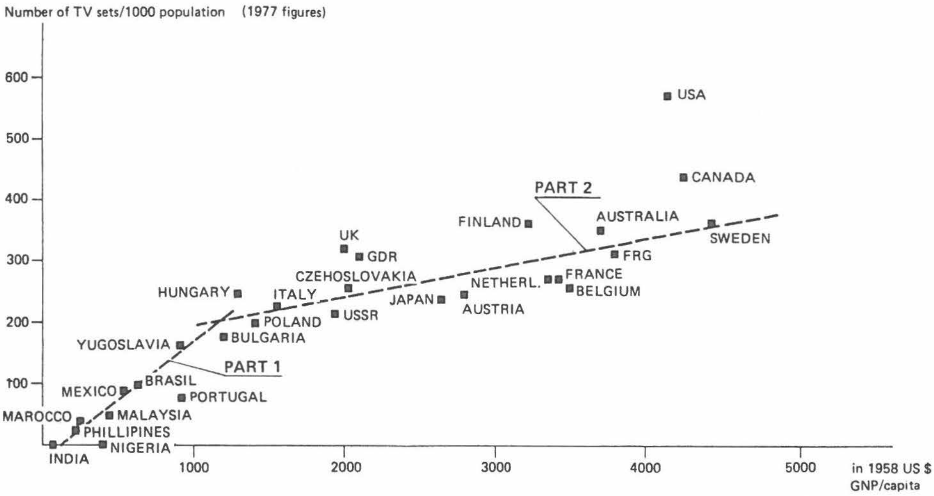

Figure 5. *Number of tv sets per 1000 population in selected countries according to 1977 figures*

shown for the USA in Figure 1. Thus, without an economic crisis or war in Hungary, an 80% penetration could have been achieved in about 18 years. However, due to the above mentioned events, a delay of approximately 17 years (!) was observed. Thus, not only technology, market forces and legislative factors count!

With regard to tv penetration in Hungary, a development curve similar to that of the US can be observed. There was a time delay of only nine years, but the maximum penetration level in Hungary was also achieved roughly within 20 years, similar to the US. No detailed statistics have yet been published on the penetration of color tv in Hungary. Color tv broadcasting on an experimental basis started around 1968, while in the US this stage was reached in the late 1950s. The US color tv market penetration curve closely follows that for radio and black and white tv services, as can be seen from Figure 1. In 1980, the level of penetration in the US had reached 80%, making it one of the few countries where a full penetration has been achieved. If the Hungarian color tv curve follows the same pattern to 1980 this would be around 15%, and this, we believe, is not very far away from the truth. This rather long explanation is needed in order to introduce Figure 5, which shows the number of tv sets per 1000 population in relation to the wealth of the country — the GNP per capita, again expressed in constant 1958 US dollars. The curve has two different parts: part 1, in the region of lower GNP per capita (this is the region of developing countries), shows a stronger dependence of tv sets on the GNP per capita figure. This first phase changes rather rapidly. In part 2 of the curve (representing developed countries), practically all households can afford to buy tv sets, and have already done so. The question in the higher GNP per capita region is whether families should buy their second and third tv sets or not, and what to do with the first one. In the US and Canada, most households have second and third tv sets. This situation is obviously connected with the average housing style (large family houses) of these countries, and the fact that used tv sets have practically no resale value.

With regard to 1W and 2W videotex the main lesson to be learned from the above considerations is as follows:

The communications infrastructure needed for 1WN and 1WW videotex can be built relatively cheaply and quickly since narrow- and broad-band teletext only require a radio or tv channel, a radio or tv broadcast station, and appropriate tv sets with a teletext decoder. Since the price of a single teletext decoder is low in comparison with that of a tv set, it is expected that all households can buy the necessary equipment in one form, or another, and it is expected that households in developing countries will also be able more and more to have their own teletext-equipped tv sets. Thus from this point of view of the developing world, 1WN and 1WW videotex should become more viable and, we believe, be of greater importance in the domestic and small business market than 2W videotex, as we will show below.

With regard to the telephone network, which at present represents the telecommunications basis for 2W videotex systems, some further observations can be made.

As mentioned above, mail, telegram, telex, telephone and more recently, teletex, are individual types of communications forms. They differ by nature significantly, but in some application areas they overlap each other; often, telegrams can be replaced by telephone calls, mail by telex, letters by telephone calls. We have also shown in [4] that there will be a great potential for 2W videotex systems to replace mail and telephone. This interdependence and substitution pattern can also be observed on these historical statistics which we have taken here as examples. Figure 6 shows the situation for the United Kingdom between 1840 and 1980. First of all, the total amount of individual communication by a person within a given year increased considerably. During the last century, when the telephone was not yet invented, individual communication was done, first of all, by mail and, in urgent cases, by telegrams (in our figure, obviously direct person to person communiction — i.e., personal discussion — could not be taken into consideration). The number of letters and telegrams per person grew accordingly.

Around the 1880s the first telephone systems were put into operation. One of the impacts of the telephone service was that for

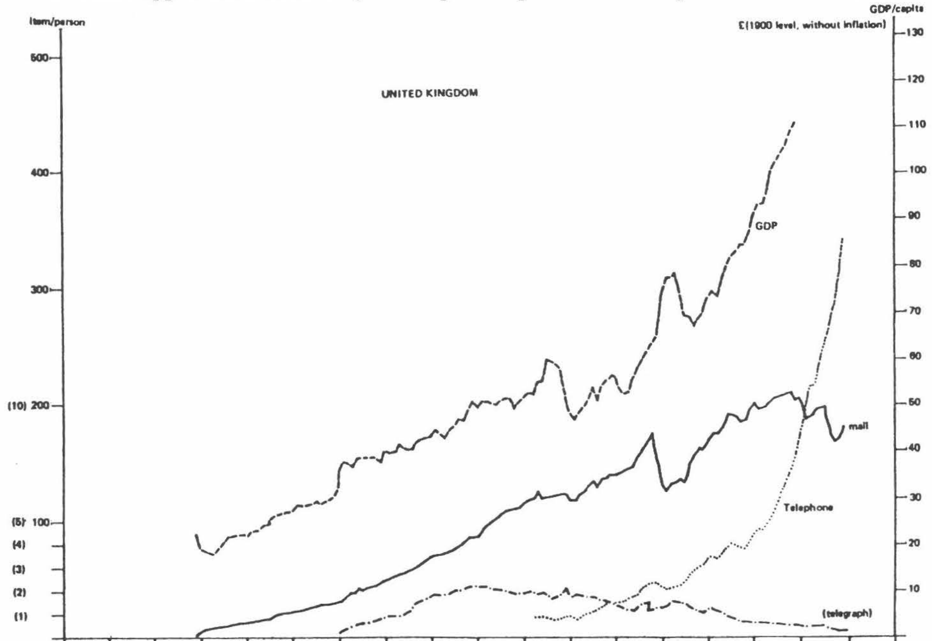

Figure 6. *GDP per capita curve and number of mail, telephone calls, telegraph messages per person in Britain, 1840–1980* [14, 15]

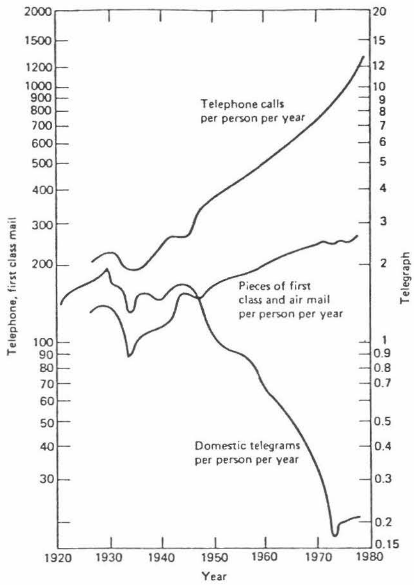

Figure 7. *Number of telephone calls, pieces of first class mail and airmail, and telegrams per persons per year in the US* [10, 11]

handling urgent messages the use of the telegraph service started to decline. The peak of the telegram service in Britain was about 1900, and has declined rapidly since then. Some temporary peaks can be observed during periods such as the two world wars, the reasons for which are obvious, but overall, the number of telephone calls per person increased exponentially. The third category, mail traffic per capita, increased slowly but steadily between 1840 and 1968 except for war periods where, in Britain, it fell back. In 1968 mail traffic apparently reached its height and now it is very likely that it will fall. What happened? First of all, one part of the mail traffic was taken over by the telephone calls, and in addition, computer-mediated message traffic began to increase. In the early 1970s, first long-distance computer–computer connections went into service, resulting in a great deal of the corporate traffic of major organizations being put on data lines. In addition, financial transactions are increasingly being pursued in dedicated banking computer networks such as Swift. In the long term, it is expected that videotex will have an effect on mail traffic, and that this will lead to savings of energy, material, manpower, etc., and that it will improve the quality of the somewhat deteriorating mail service. According to the statistics of the PTTs themselves [e.g., in 17] the mail service worsened during the last decades because of its inability to handle so many mail items. Regarding mail traffic, the historical figures both for the US (Figure 7) and Hungary (Figure 8) show the same trend. In the US, the telephone has always played a larger role than letters, so that the number of telephone calls per person has been always higher than that of letters, even in the 1920s. Today the discrepancy between these two is still growing. In the US, one person makes six times as many telephone calls as writing letters, whereas in Britain (in 1979) only twice as many, and in Hungary only about 1.2.

Hungary's historical statistics show — as mentioned before — the same trends, but they also show some other interesting features. First, due to the lower level of development of the telecommunications infrastructure of the telephone network in Hungary, mail has

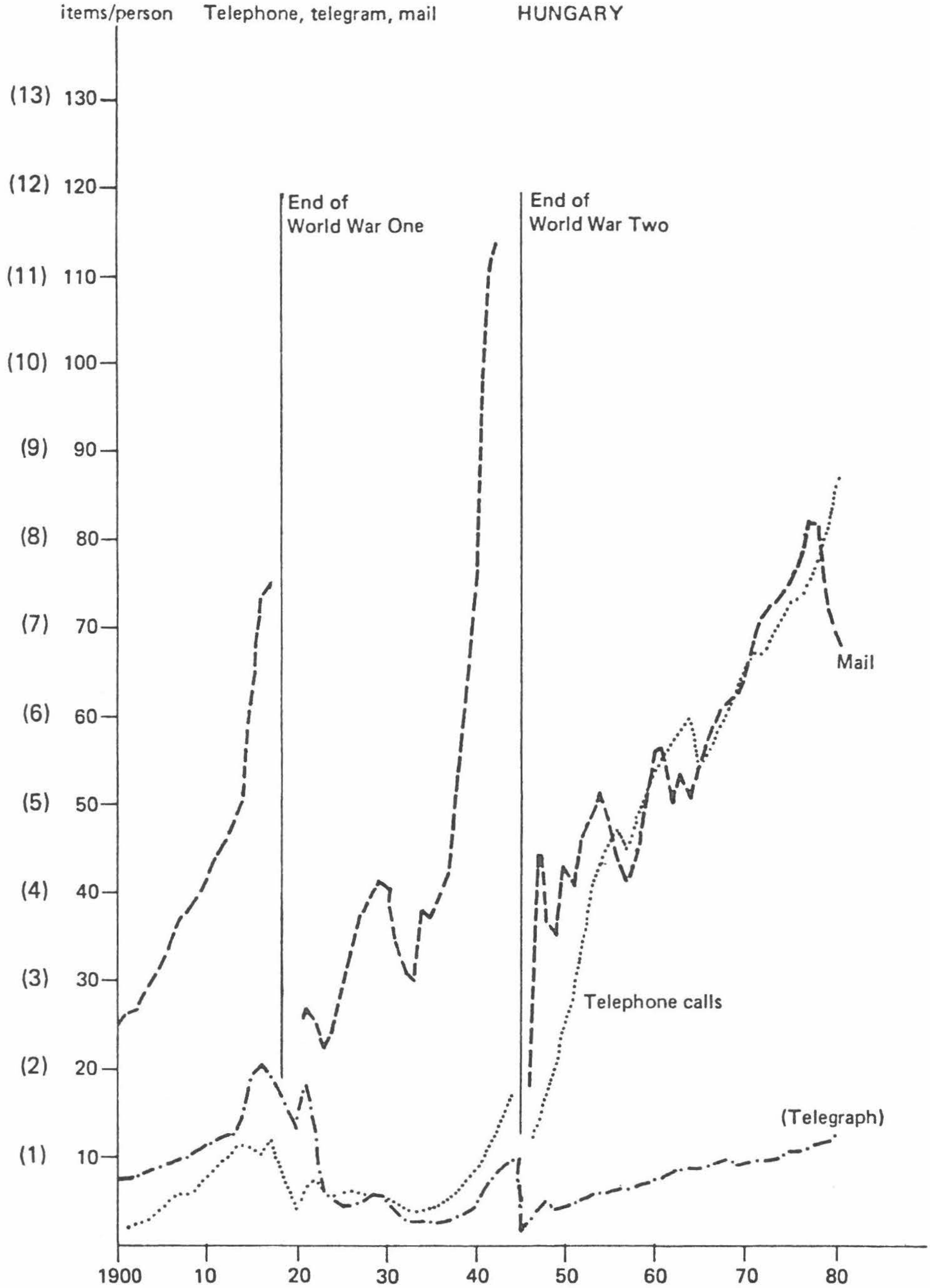

Figure 8. *Number of mail, telephone calls, telegraph messages sent per person in Hungary between 1900 and 1980* [14, 15]

maintained its predominance. In times of war, mail traffic increased dramatically (who knows why to that extent?). After each war — needless to say that both were lost and the country was in a state of chaos — the entire mail, telephone and telegram system collapsed, as is well reflected in Figure 8. In 1977–78, seemingly, the peak of letter traffic was reached. Now the mail item per capita figure — similar to Britain — is falling back.

Secondly, the telegraph still plays an important role. Its traffic clearly increased during wars but even today there is still a continuous growth trend, mainly because the quality of the mail service has worsened and the telephone network is not as developed as it should be, not to mention the quality of service.

Thirdly, the development of the telephone shows an interesting picture as well. It is well known, that Hungary was in the forefront of telephone development in the last century. The first telephone exchange, for example, was designed by a Hungarian, Tivadar Puskas, and in Budapest, the second telephone exchange in the world was built. Up to World War I the development of the telephone followed a normal — but slow — exponential growth curve, but as a result of losing the war, and the financial crisis of the 1930s, the service deteriorated, and in 1944–45 it completely collapsed. Later, high growth levels were achieved by 1950. Then, due to government investment policies, this rate went down slightly, and only after another change in government policy in 1970 did it start to increase more rapidly again. Finally, in 1979–80, more telephone calls per person were placed in Hungary than letters written. Nevertheless, Figure 4 allows comparison between the growth curves of the US, Austrian and Hungarian telephone networks. In spite of the considerable developments of the Hungarian network after 1945, its pace in comparison to the US and the Austrian system is still slow. If the present trend continues, and due to the present economic situation, there is little hope for Hungary to have a reasonable telephone network penetration for the next decades. With regard to this fact, it would seem advisable to seek for other telecommunications media such as 1WW videotex, and perhaps 2W videotex, to ease the situation in the future.

The historical statistics for these different countries show that in the mail services dramatic changes can be expected in the next couple of decades. It seems that, from the technical, economic, and labor viewpoints, mail services are approaching their limits, and are more and more likely to be taken over by other electronic services. The recognition of this trend is certainly not new, but it is useful to support this claim with some historical statistical data. Therefore, there are great potentials for 1W and 2W videotex systems to take over some portion of the telephone and the mail traffic as indicated in [4], where it has been shown that about 50% of the telephone traffic could be taken over by 2W videotex. As pointed out in [4], the electronic message sending function of 1WW and 2W videotex could in addition, take over much of the mail traffic which could be transferred electronically. Table 1 (based on data from West Germany [1]) gives a short overview of the types of mail communication that in principle could be taken over by 1WW and 2W videotex systems.

It can be seen from Table 1 that, theoretically, most of the present mail traffic could be tansferred to either 1WW or 2W videotex, or both. If the appropriate infrastructure for 1WW or 2W videotex existed in a country, one could channel individual mail traffic to 2W videotex, and broadcast (receive only) type of traffic such as mass printed matter to 1W videotex. A country with an underdeveloped telephone infrastructure, however, would not be able to put too much or any traffic on a telephone/computer-network-based 2W public videotex system. As pointed out earlier, the build-up of an appropriate terrestrial system would take decades. In such cases it would be possible in principle to put mail traffic on 2W broadcast videotex systems, working on pocket radio principle. Such systems do not exist at present and no plans for implementation are known to us. It is also feasible that only incoming mail traffic

Table 1. *Type of mail in West Germany in 1973* [1]

Type of mail	*Billion items*	*%*	*In principle transferable to 1W videotex*[1]	*2W videotex*
Letters	5.63	58.6	X	XXX
Printed matter (letters)	0.35	3.7	X	XXX
Other printed matter (journals, books, brochures, etc.)	0.86	9.0		X
Postcards	0.78	8.1	X	XXX
"Mass" printed matter (advertisements)	1.45	15.0	XXX	XX
Miscellaneous (book parcels, samples, parcels, etc.)	0.54	5.6		
Total	9.61	100.00		

XXX suitable
XX feasible
X in principle feasible, especially for 1WW, but rather "unorthodox"
1 only to receive mail

would be received through 1WW broadcast videotex. One question which certainly arises with message sending through broadcast videotex is data (or, more precisely, message) security, although this problem could be solved relatively easily with the help of so-called public-key cryptosystems. Such systems would work [2] with an individual encryption for each subscriber, which would not thereby reveal the corresponding individual description key, defined and solely owned by each subscriber who wants to receive the messages. The encryption key, however, would be 'announced' publicly and put as information on the broadcast videotex systems. Methods for generating corresponding encryption systems are known in the literature. The definition handling of such encryption keys at the user's site would obviously require an intelligent videotex decoder with local processing capabilities.

Such systems, however, are a long way off. As to channelling voice telephone traffic to videotex, transferable telephone calls would appear as electronic messages as well, which could be handled mainly by 2W videotex systems, but also a limited way with 1W mode. As to the implementation of 2W videotex delivering electronic mail systems, these are already in use in Britain. In late 1981 Prestel introduced such a new software system, and Austria is planning to follow the British example soon.

Also for 2W videotex delivering electronic mail, Butler, Cox [6] expect a rapid growth of different electronic mail terminals in Western Europe (Table 2). They expect that 2W videotex terminals will be the majority of all electronic mail terminals, including telex, in Western Europe by 1983.

Videotex hardware and software system components

Computer hardware, and in particular the availability of videotex terminals, is the next factor to be examined with regard to the limits of market penetration of 1W and 2W videotex technology. As mentioned earlier, microelectronics and computer technology are used for different components of videotex technology. For example, host computers for storing and processing all kinds of information; the present 2W videotex network itself is built upon telecommunications switching computers. These

Table 2. *Electronic mail terminals in users in Western Europe, 1979–83* [6] *(installed based in thousands)*

Terminals	*1979*	*1980*	*1981*	*1982*	*1983*
Viewdata	5	45	175	355	855
Facsimile	35	47	70	103	151
Telex	378	408	441	476	513
Word processors	75	95	122	154	194

allow the desired data traffic between users and information service centers, or to any other type of videotex service computers such as for electronic mail, teleshopping, telecomputing purposes, etc. In the case of presently known 2W videotex networks — as mentioned before — the backbone of the computer network is often the national packet-switching network. Videotex switching centers tend to play the same switching role between videotex users and host computers — linked either directly or through the national packet-switching network — as the node computers of any computer network would do. All in all, for the computer communications component of videotex, 'heavy' computer technolgy is needed, especially for large 2W videotex networks. Moreover computer technology has to be applied in an increasingly sophisticated way at the user's end as well. Nowadays, even the simplest videotex decoders are based on microprocessors; there is a growing tendency to provide more and more local intelligence to videotex terminals which will eventually become a sort of personal computer (intelligent videotex decoder) dedicated to videotex purposes [3]. As to the average early growth rates of selected technological developments, Table 3, compiled by SRI [8], shows some characteristic figures. Computer technology has shown an extremely high growth rate during the first twenty years of its history — even than that of tv which, as pointed out earlier, had one of the quickest market penetrations ever. The high growth rate for computers, however, received a further impetus during the early 1970s by the introduction of microprocessors and large-scale integration of electronic components. Because of this new revolution, although it is already out of the time span of Table 3, the growth rate of the computer technology did not slow down — which is quite unique in any innovation process. Thus it appears that the

Table 3. *Average annual rates of early growth for selected technological developments (Source: Stanford Research Institute* [8])

		Growth rate (percent)				
	Years	*First year*	*First 2 years*	*First 5 years*	*First 10 years*	*First 20 years*
Telephone	1876–96	300	200	80	50	28
Telegraph	1867–87	10	17	12	13	11
Television	1948–66	75	370	320	190	58
Microwave	1948–68	0	42	43	33	23*
Automobile	1900–20	85	70	60	50	41
Computers	1951–71	700	400	300	20	84*

* Estimates

bottleneck in the market penetration process of 1W and 2W videotex will not be created by computer technology as such rather than by the telecommunications component. This trend is true in all regions of the world, but naturally, the penetration of the microelectronics component is delayed in time and speed in the less developed regions.

In addition, videotex technology is based on the assumption of the availability of a cheap, mass-produced technology. In order to secure mass production and low costs, the complexity of videotex systems is aimed to be less sophisticated than the traditional computer networks and systems.

If one looks around at the present videotex scene, countries such as Finland and Hungary — who are not in the forefront of information technology development — have been able to develop their own videotex systems in a surprisingly short time and to put them on the market at about the same time as many of the highly developed countries. The cheap and simple technology, in fact, provides an opportunity for the developing countries too, which up to now have had to rely on more sophisticated computer hardware and software imported from developed countries, at very high prices.

With regard to the market penetration of videotex terminals, so much has been speculated and forecast that we do not want to launch new scenarios to predict possible outcomes. One of the major problems we see in predicting videotex development is that the potential of this new medium is simply too complex, and there are too many participants with different interests in the field (such as the PTTs, information and service providers), legislative bodies, domestic and business users, etc.). In addition, there are too many technology components and options (broadcasting, wired telecommunications, information gathering, processing, transaction, dissemination, etc.), and the scope of potential application classes which will basically determine the failure or success of this new technology is unusually broad; in this respect, no comparison with radio, tv, or telephone can be made. Finally, there are the potential users of videotex who must be prepared to accept these new, more sophisticated services. Will they be able to master it? If so, how fast?

If one compares videotex with other media such as telephone, tv or radio, as we did in a sense in the previous section, one can observe a basic difference. In the case of these three media, after the first period of a year or so of service it became quite clear what each medium was good for, and how it could be used. Since its earliest days (and still today) the telephone is basically used for remote voice communication between individuals; radio to broadcast audio programs for a large audience; tv to broadcast moving pictures. The fundamental uses of these media have not changed significantly since their launches, but they did strongly influence our lives. To make forecasts for these types of service is much easier. It is quite clear which needs they can and will fulfil, what is the actual demand for these needs, how much it will cost, how quickly the demand can be satisfied, etc., by the industry, and what legislative or industry policy measures have to be taken. With videotex, be it 1W or 2W, the situation is different; the medium is still changing. Our notion of the needs videotex can or should fulfil was different a year ago and could be somewhat different next year. We see this new medium as a carrier of potential services, but our perception of the potential usage of videotex is still changing.

Under these circumstances it is difficult to make a firmly based forecast of market penetration, since the assumptions for different scenarios are too diverse. The first set of scenarios which exists today is based on the notion of first generation videotex systems, i.e., narrowband teletext (1WN) and Prestel-type 2W videotex used primarily for information retrieval and simple transactions. The second set of scenarios could be based on the notion of the second-generation videotex systems, i.e., narrowband teletext and cabletext (1WN) and 2W videotex with the concept of the cheap computer network supporting a full range of different network applications. It should be noted that not too much forecasting work has been done for this generation of

Assumptions	*Minus*	*Reference*	*Plus*
Set price	high (200 EUAs)	medium (125 EUAs)	low (23 EUAs)
Set penetration	low, partial	50%	tending to 100%
Usage price	low	low	low/high
Usage volume	low	medium	high
Eurochip standard	no	yes	yes
Set suppliers	some tv manufacturers, some sets	all tv manufacturers, all sets	all tv manufacturers, plus newcomers
Information, service suppliers	defensive publishers	major publishers, service suppliers, few newcomers	mass entry publishers, service suppliers, plus new suppliers
Functions	information retrieval	information retrieval plus some new	information retrieval plus many new
Regulations	not applicable or restraining	neutral	enabling facilitating

Figure 9. *Assumptions for each of the three scenarios according to* [9]

videotex systems yet, even though these services will probably be introduced in many countries in the next few years. However, as described in this paper, we can already see the emergence of third-generation videotex systems which will basically include a new concept: the planned and conscious increase of local intelligence at the user's end mainly through dedicated personal computers [3] and intelligent videotex decoders, and then in fourth-generation videotex systems the convergence and symbiosis of 1W and 2W videotex systems. According to our present knowledge, no penetration forecast has been made on the set of third- and fourth-generation videotex system scenarios.

As an example on what has been done for a 2W videotex market penetration forecast for the European Communities, Figure 9 presents some published scenario assumption results of Scholz [9].

They obviously take for granted that a well-developed telecommunications infrastructure (packet-switching network) exists — which is, or will be, basically true for the EEC, but is not true for most other countries, especially in the developing world. The assumption for set penetration is, in our judgement, not a free choice, but depends on many other assumptions which follow on the list such as functions (range of services), costs and many others (such as friendliness of the system, level of computer education, etc.) which are left out, but probably should have been taken into consideration. Concerning usage price in the minus scenario, perhaps higher prices should be assumed which would seem to be more realistic. Some further assumptions which we feel should also be considered were neglected from the list. For example, a most important factor in the penetration process of videotex is existence of clear government information policy regarding videotex. The backing and support of government, or a decision to let market forces decide, will probably fundamentally influence the market penetration process in any given country. If, for example, a government decided that videotex should play a basic role in the education system of the country (by enabling modern teaching facili-

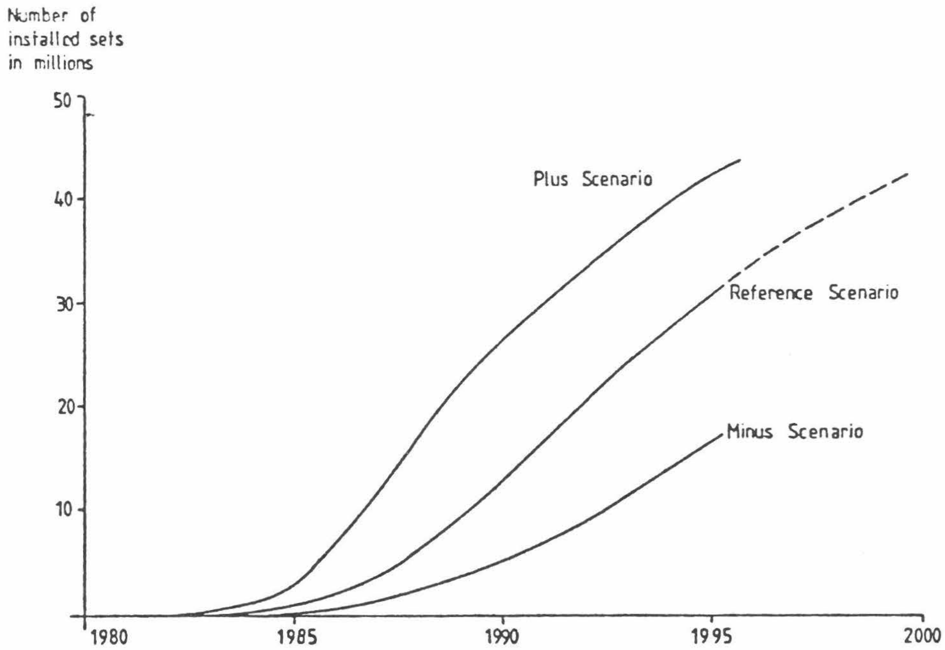

Figure 10. *Videotex sets installed in the EEC* [9]

ties to be brought to remote mountain villages or farms and thus give increased educational equality), then it could restructure its educational policy and invest substantial resources in subsidizing videotex terminals and take away resources, let us say, for textbooks. Apart from the goodwill of the government towards subsidizing videotex in principle, the availability of government funds — especially in economically and politically difficult times — is crucial. All in all, we feel that the list of assumptions for the three scenarios in [9] is too narrow. With regard to the minus scenario, it should be added that from the technological point of view it refers to first-generation 2W videotex systems and the plus scenario to second-generation videotex systems. Now let us come to the results of the forecast. Figure 10 shows the forecast for 2W videotex terminals to be installed in the EEC countries, and Figure 11, their usage forecast. Taking into account the above (rather narrow) list of assumptions, the predicted options are extremely broad.

On the videotex transaction forecast in Figure 11 — which we believe is one of the most important indications from the user impact point of view — the three different scenarios suggest that practically anything may happen. If one also took some additional factors, such as government support, user acceptance, pricing policy for competing services, etc., into consideration, the options would become even more diffuse. If one considered third-generation videotex systems, the situation would become ever more complicated and the variety of options would increase even more. Is there an easy way to overcome these difficulties by traditional forecasting and modelling methods? Let us leave the answer to this question to the modellers.

Nonetheless, and here we are coming back to the line of thought followed at the beginning of this section, in spite of the potential diversity of videotex market penetration, there are certain physical limits which will constrain the market penetration of this new medium. One constant, as pointed out, is the state of the telecommunications infrastructure and its potential development. If no proper telephone facilities be available in a country, then for a long time it would be unrealistic to plan a 2W videotex system based on the telephone network. Quite obvious . . . ! For 1W narrow- or broadband videotex, a much faster market penetration could be achieved in principle since we believe that such a telecommunications infrastructure could be built within a decade or so. We would guess that the maximum speed of market penetration for these services would be similar to those of radio and tv if the long list of preconditions mentioned earlier are fulfilled. Thus between 15–20 years for full penetration will be required as a minimum. Electronics components such as microprocessors, personal computers, switching computers, videotex terminals, etc., do not seem to be limiting factors. A limiting or, better still, a slowing down factor could be the present telecommunications infrastructure in the developed countries, where massive previous investments (such as in the telephone network) have to bear their returns, negatively affecting, for example, the build-up of a new telecommunications infrastructure more suitable for certain videotex applications (such as the use of both cable tv or a dedicated satellite broadcast channel for 1WW videotex).

Conclusions

(1) As shown in Figure 12, after the present first-generation videotex systems based on 1WN (teletext) and 2W videotex, with simple numerical keypads and both with the main function of information retrieval, we are entering the phase of the second-generation 2W videotex systems with full alphanumeric keyboards, gateway functions, and a wide range of applications which go significantly beyond simple information retrieval. Such applications include message sending, simple forms of transactions, simple computations through third-party computers, etc. In the foreseeable future we will witness the emergence of third-generation videotex systems which will be triggered off by the appearance of intelli-

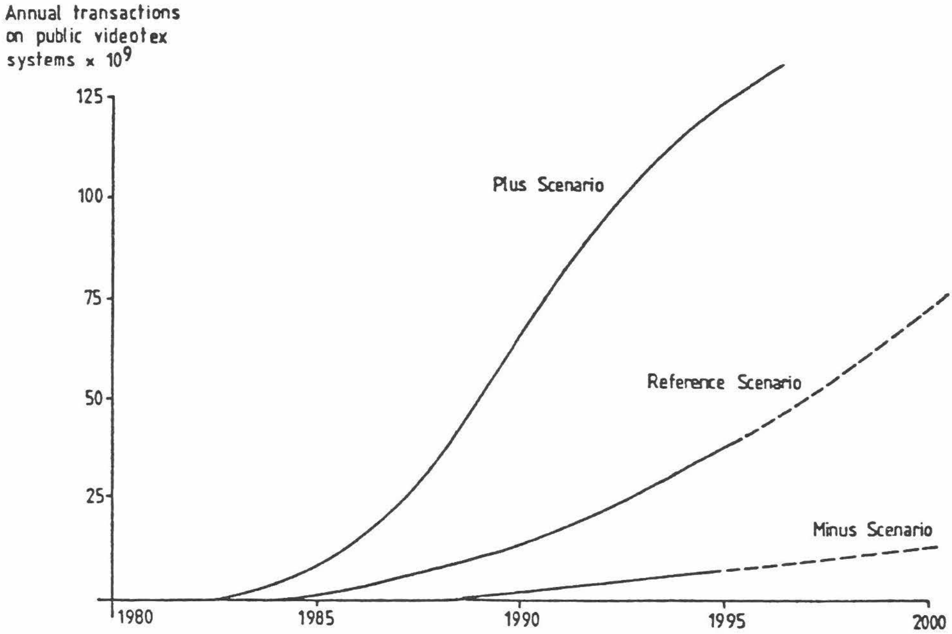

Figure 11. *Videotex usage in the EEC* [9]

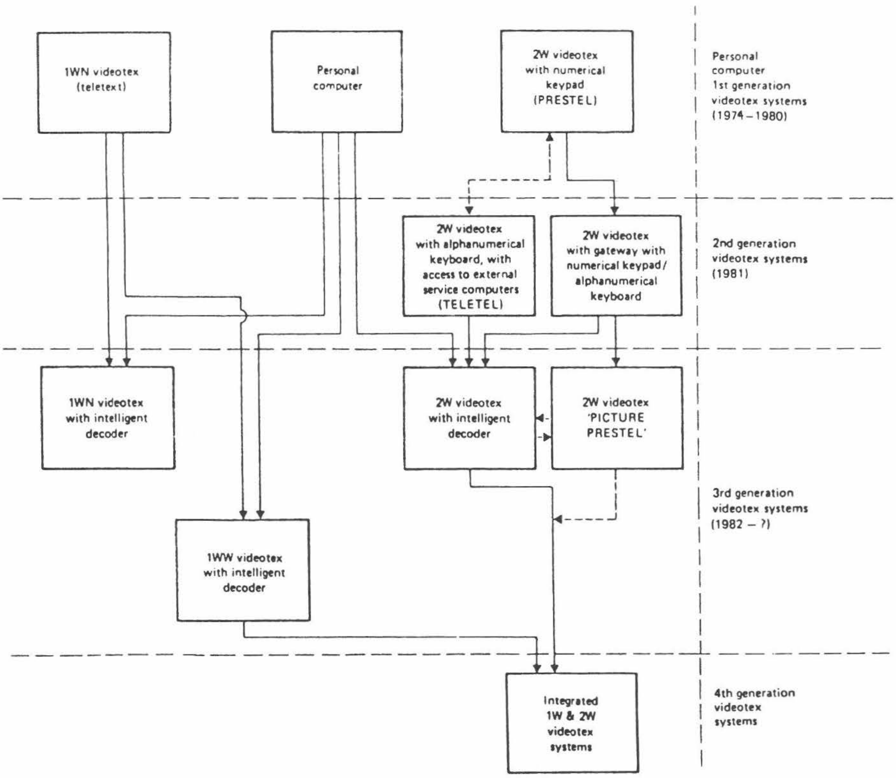

Figure 12. *Evolution of videotex system generations*

gent videotex decoders which will allow the concentration of more intelligence locally, taking the burden from the videotex network and third-party computers. The use of intelligent decoders will open the way to a broad range of new videotex applications, such as telesoftware, more sophisticated transactions, improved information retrieval functions, etc. The emergence of intelligent videotex decoders will enable full-channel (1WW) videotex systems to be developed, where the amount of accessible information frames will grow by three–four orders of magnitude. With the present type of teletext decoders, such large amounts of information cannot be handled, probably not even in the most rudimentary way, as is used in the present 1WN videotex systems. The main significant characteristic of fourth-generation videotex systems will be that the convergence of 1W and 2W videotex systems will be observed.

(2) The converging 1W and 2W videotex systems will not compete with each other. On the contrary, they will economize the widespread use of videotex services in a way that even mass applications of this technology will become feasible. In general, 1WN videotex systems will be seen primarily as supporting and upgrading the usual tv programs and, in addition, some information retrieval/distribution capabilities of very limited, general, or emerging nature. 1WW videotex (or full-channel

teletext) systems are likely to emerge. Their information capacity of 50,000–100,000 rotating videotex frame will enable general, but broader, information to be made available to the public and businesses, such as that provided by governments or local authorities. It can be expected that not only information retrieval and message sending but also the educational use of such systems will become of major importance. Two-way videotex systems will be applied primarily in those areas where two-way interaction with a central computer is necessary. Message sending, teleshopping, financial and other types of transaction belong to this category, as well as access to time-sharing and other third-party computers for computations and other real interactive applications. Two-way videotex will also continue to support information retrieval in those areas where access to information by the user community is relatively rare and it would be a waste of resources to put such information on continuous availability, which is the case with 1W videotex systems.

(3) As to the implementation of 1WW videotex systems, two alternatives seem to be feasible at present: to use a dedicated cable tv channel, or to use a spare channel of a direct-broadcast satellite system. As to the choice of the above two telecommunications media, the state of cable tv infrastructure, future development plans, the availability of three direct-broadcast satellite system channels, and corresponding government policy will play a major role.

(4) The penetration of 1W and 2W videotex systems, can be summarized as follows. Microelectronics and information technology components will not be a barrier in the market penetration process. Both the videotex service computer as well as the terminal side can be satisfied according to the emerging demands. The state of the telecommunications infrastructure for a given country might become a barrier for future videotex systems. Historical statistics show that the development of a fully wired telecommunications infrastructure takes considerably longer than the build up of media based on broadcasting. Therefore, when creating national information and telecommunications policy concerning future 1W and 2W videotex systems, these factors have to be taken into consideration. Roughly speaking, one may say that for developing countries with little or no telecommunications infrastructure, it is better to put as much videotex service on the broadcast media as possible. For developed countries with congested broadcast frequencies and well-developed terrestrial infrastructures, it is possible to put 1W and 2W videotex on cable tv, the telephone, and the national packet-switching network.

(5) It can be expected that the penetration of videotex will take decades and will certainly be slower than either radio or tv. Factors such as information and telecommunications policy ("subsidize or not subsidize videotex, back it or not") will be of decisive importance. For this and other reasons we believe that it is complex and difficult to predict the path of videotex penetration. As to barriers of other kinds, such as organizational, legal and human aspects of videotex penetration, further studies have to be undertaken.

(6) Finally, it is believed that 1W and 2W videotex systems will play a significant role in a future information-oriented society and we hope they will assist in overcoming some presently unsolved problems of society, such as the scarcity of energy and mineral resources, environmental pollution, urbanization problems, problems of food supply and industrialization, and finally, will improve the quality of life.

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This paper and its conclusions is best studied in conjunction with One Way versus Two Way Videotex, by the same author, that appeared in the previous issue of Electronic Publishing Review (Vol. 2, No. 4, December 1982).

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Perspective of policy development in the field of informatics: the example of videotex technology *

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There is little doubt that the technological requirements of a future information society are given in its elements (e.g. videotex). If it comes about, it will happen with a time-lag between well and less well developed countries. This has advantages and disadvantages for both sides, since the future information society is not yet fully understood and might have some negative effects on society if not provided for in good time. Issues to be answered range from employment and computer education to transborder data flow and vulnerability of society. It can only be hoped that all these problems will be solved, allowing the future information society to be of maximum benefit to mankind.

Keywords: Information society; videotex; information policy; transborder data flow; vulnerability; information economy; employment.

From the technological point of view: it can be done

"The Information Society is just around the corner"—is the essence of numerous studies and papers appearing in the press, many of them, for example, claiming that the role of printing is changing and that our society is witnessing the emergence of the so-called "electronic publishing industry". The fact that all these studies and papers still come out in printed form, using the good old paper printing technology, seems to be a bit contradictory and controversial; but, all in all, it can be claimed—and we should accept here and now the following general statement—that from the technological point of view all the pre-conditions can be fulfilled to build up an information-based and -dominated society, and this within a reasonable time horizon—at least in the most developed countries.

* This paper was presented at the Informatics Session of the International Information Industry Conference which was held in Québec City, June 1–3, 1982. The paper represented the general view of the author on the important public policy issues raised by the emerging information society, and showed how the information society comes about in countries with different development status and policies, and those areas where future research is needed.

The time-lag

There is no doubt that the impact of the microelectronics revolution is being felt first in the most developed countries, but there can be no doubt either that this technology will in an increasing manner also penetrate the medium- to less developed countries. This—and here one has to be realistic—would occur with a certain time delay, as with any previous industrial technology. An example is the steel industry, where the actual time lag between penetration in the most industrialized and in the developing countries was about a hundred years. This delay is important as it now creates serious production, marketing, and sales problems for many highly industrialized countries, such as West Germany, the United Kingdom, or even the US.

In the case of microelectronics and the new information technologies it is desirable to minimize, or better to optimize, the time-lag, a term often confused in my view with "technology gap". As to the speed of technology penetration, it is well known that the growth figures for the microelectronic and new information technologies—both for the most developed and less developed countries—far exceed the figures for any other technologies. It is quite clear also that, in the course of development, the most developed countries are about to arrive at a turning-point, where microelectronics and the new information technologies will significantly influence daily life. Let us call this turning-point the beginning of the 'information society'. If the most developed countries do well and manage to keep a good control over the technology—which I believe they can and will—they will have the privilege to enjoy first the fruits or the curses of the new 'information society'.

Another society with a Janus-face?

The information society will offer many new challenges and opportunities, but I also believe, if not managed well, it might cause much damage to people and to society. Think only about the tremendous opportunity of microelectronics and new information technologies in military applications: cheap, mass-produced super-intelligent microprocessors applied to missile and torpedo control; sophisticated image analyzing and processing methods for handling information provided by remote sensing military satellites; complex cryptography systems built on new information technologies for military purposes—only to mention a few.

The employment issue

The impact of the microelectronic and new information technology revolution on employment is not clearly and satisfactorily answered yet, and it is in my opinion an open question as to what society will do about those people who are going to lose their jobs. The usual response to this point is that in previous societies, such as in the agricultural society when agriculture became industrialized, ample opportunity was provided by the emerging industrial society, i.e., job opportunities in industry. Later, when mass production was introduced more and more into industry, the third, so-called 'service', type occupations were developed, which significantly contributed to the provision of a sufficient number of job opportunities. During the last couple of years, there has been much discussion of whether besides agriculture, industry, and services there is also a fourth economic sector—the so-called 'information sector'—which includes all activities and industries that are linked to information production, information processing, information distribution, and the provision of an information infrastructure. Several studies have shown—some of them triggered off by the OECD [2]—that in the most developed countries the information sector has become or soon will become the leading employer (figs. 1 and 2).

According to figs. 2 and 3, however, there seems to be a non-negligible time-lag, even for the most developed countries (cf. 25 years for the USA and Japan). Unfortunately, no equivalent curves are known for the developing world yet, but it can be assumed that the time-lag is tremendous. The similar behavior of the employment growth curves for the information sector suggests that their relatively slow growth pattern will be true for the rest of the world. The reasons for this are surely not only technological, but also to be found in economical, cultural, and labor aspects.

There is, however, still a strong fear that if the information society is coming about—which as I mentioned at the beginning is just (but still) "around the corner"—this might have a serious impact on the present employment pattern.

The industrial sector could be seriously affected by the penetration of robots in manufacturing; parts of the service sector could be affected as well (e.g., the increasing replacement of transport by communication); and the information sector itself could be seriously affected (e.g., the lower staffing requirements of a 'perfect' electronic office). Where could all these jobs move to?

It is said that to a great extent they could be absorbed by the information sector. But is it really certain that the information sector can offer more new jobs than are being lost from all sectors? Is our society well prepared to take over such jobs?

The zero economic sector

Although many authors speak about only four economic sectors, in my view a new one—the unemployment or 'zero' sector—should also be introduced. It is this non-productive but still consumptive sector that causes most problems in any society, although it should not be blamed for that. In fig. 1 we have also included the curve of the zero sector as percentage of the total working population. Whenever the curve goes up—even for relatively short periods—the society usually comes to a serious crisis. What has to be avoided under any circumstances is that the unemployment sector reaches a new 'breaking point' in the information society. I personally do not see the emergence of a new, 'fifth economic sector', which could absorb unemployment if the information sector seriously affected jobs. As an alternative, we should certainly consider reducing working time while keeping full employment. But what is a reasonable lower limit for weekly working time?

Computer illiterates in the information society?

The next major question: has or will our society have received an adequate education for a future information society? If the most developed countries are certain that from the technological point of view they will be able to provide a solid basis for the information society within the next decades, then do they already take into consideration that the present upgrowing new generation has to live and work in this new type of society? I think the answer to this last question is a clear "No". Thus, what is going to happen with the majority of the present and 'near future' working generation, which is clearly 'illiterate' in the 'informatics' disciplines? Can an information society be built on a working population with the given structure and skills? The clear answer, I think again, is "No", and I must say that the present or 'near future' working population cannot be blamed for the fact that they are illiterate in 'informatics' disciplines, and that they lack the skills that are needed in an information society. On this point, certainly, governmental action is required.

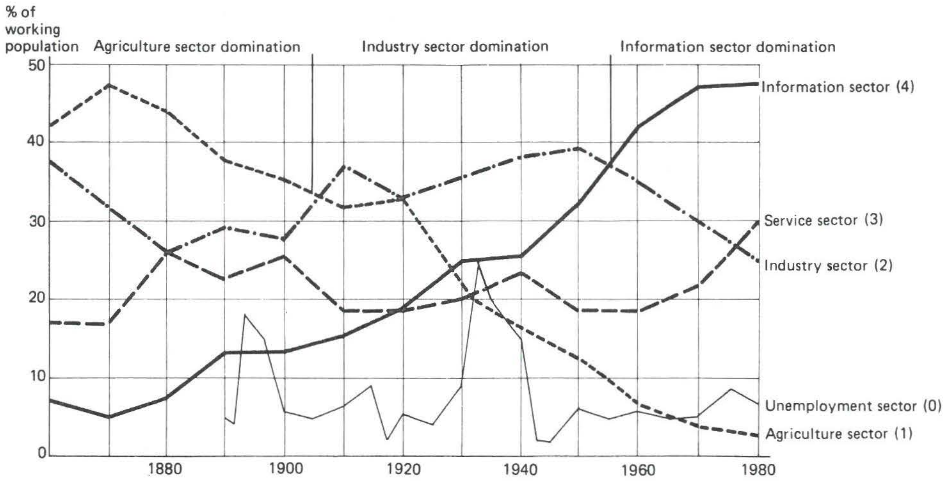


Fig. 1. Employment in the four productive economic sectors and the unemployment sector in the USA between 1860 and 1980 (data taken from [1, 4, 5]).

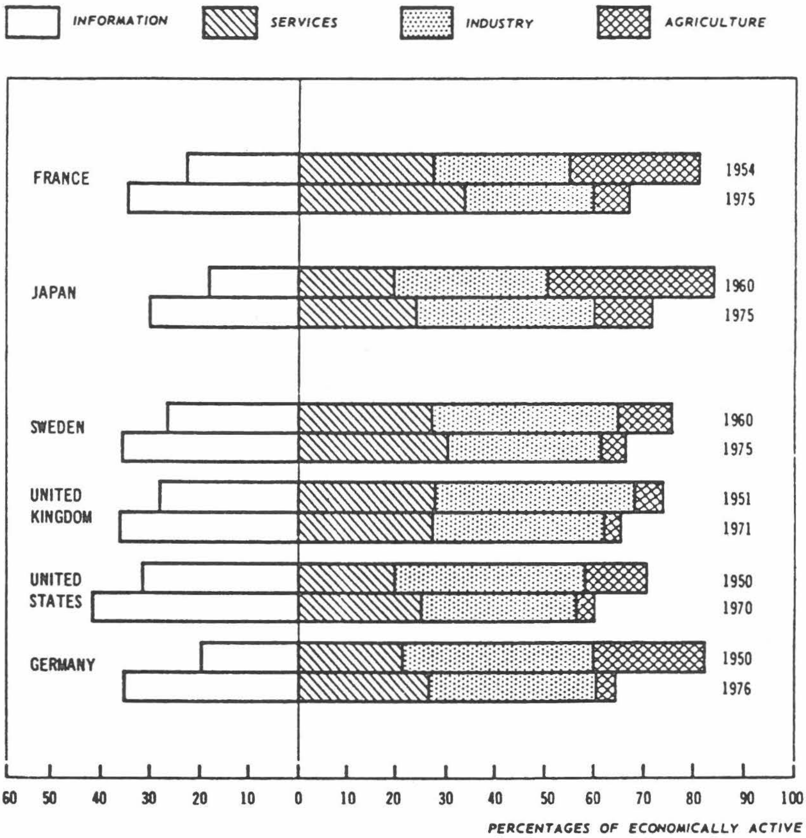
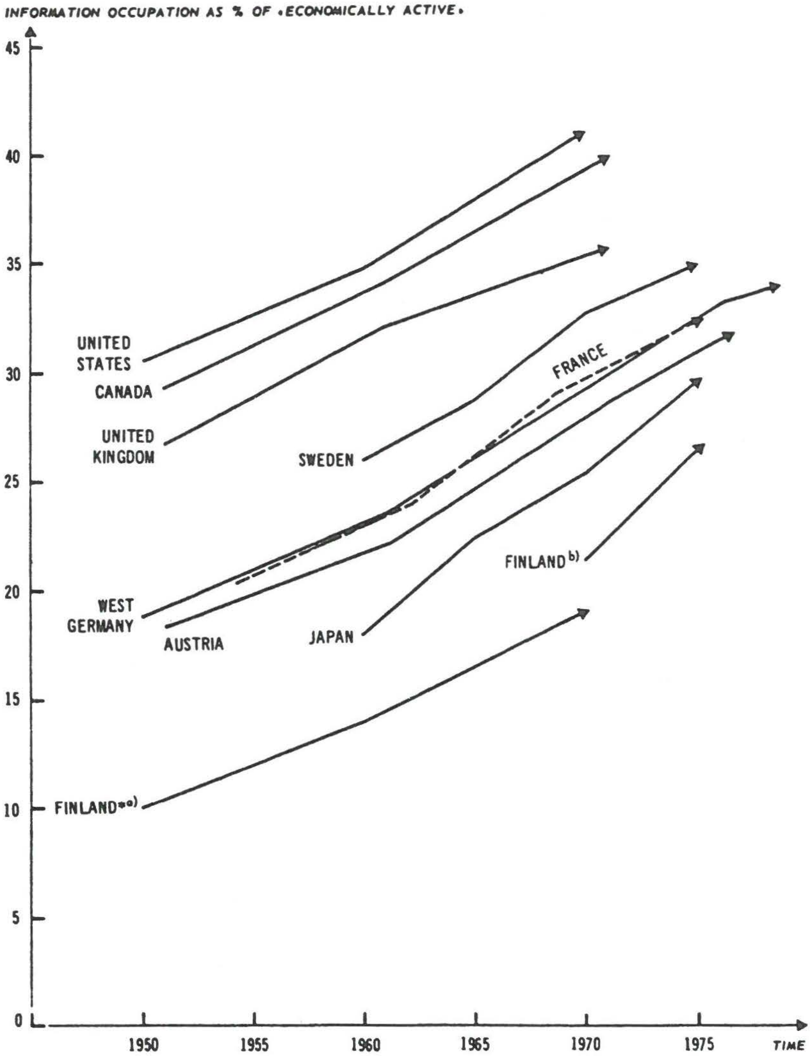


Fig. 2. Four productive sector aggregations [2].

The wealth-creating information society

Let us now turn to the potential positive effects of an information society, which in my opinion are still as 'unclear' as the negative effects, but which are at least promising. Historically, in each type of society there were factors that one could call 'wealth-creating'. In an industrial society, for example, mass manufacturing and also mass consumption were regarded, among others, as such 'wealth-creating' factors. But what will be the wealth-creating factor in an information society? I do not know, but I believe that the information society could provide those tools—and this could be regarded as one of the wealth-creating factors of the information society—that might help to resolve some of the major problems of our present society. I think one of the biggest problems that the present industrial societies face (and on this point there is no difference between 'capita-



* Data for Finland was derived from two separate sources : (a) I. Pietarinen ; (b) The Central Statistical Office of Finland, both sources using a rather more restricted definition of «information occupations»

Fig. 3. Changes in the share of 'information occupations' in all productive sectors over the postwar period [2].

list' and 'communist' ideologies) is that no single ideology takes properly into account the fact that our world has several limits: first of all physical, geographical limits; then limits on resources; limits to the earth's resilience (see environmental problems and resilience of nature); and limits on population (see food and urbanizational problems). We recognized these problems more than a decade ago, but we have not come any closer to solving them. Energy is still a scarce resource and is becoming more and more expensive, and probably has to be. The environmental quality of the earth has gradually worsened (e.g., nowadays all better hotels in the Caribbean and on the coast of Florida offer to their clients the 'excellent' services of their 'tar stations' after swimming, or in West Germany and Austria seemingly nothing can stop the dying out of pine forests due to acid rain damage). The problem of hunger in the developing world can also not be solved. It seems as though the classical type of industrialization is gradually destroying the earth's environment. For this reason, industrial countries probably have to change their industrial strategies, and the developing countries probably have to aim at new industrial strategies, which are less energy- and resource-consuming, pollute the environment less, but provide enough job opportunities.

I do believe that the above-mentioned revolution in microelectronics and new information technologies will provide global tools to manage and better to control the use of energy and other natural resources, will lead to the use of methods and technologies that will reduce the pollution of the environment, and yet better satisfy basic human needs. For example, I believe that communication could gradually replace transport where it is possible; commuting to work, or business visits, by whatever means of transport, which is not only consuming time and energy but also contributes considerably to the pollution of the environment, could be reduced by 'teleworking' and 'teleconferencing' supported by new telecommunication and computerization services. 'Electronic publishing' and the 'paperless office'—which will come about gradually and only to a limited extent —will have definite impacts on the paper and forest industries that are positive from an environmental point of view. I believe, thus, that the information society will bring along those opportunities and chances that can help to solve the current serious world problems. It is up to our society to take advantage of these opportunities. As we see the world today, not too many chances will be given to mankind during the decade to come; therefore it is of the utmost importance that the chances provided by the information society should not be missed.

Transborder data flows

The nature of transborder data flow problems—in my view—is going to change in the coming years. The 'technological basis' of the present transborder data flow discussion still assumes the technology of the seventies, which was based on the potential of massive concentration and the centralization of data and processing power, with 'electronic' or 'physical' delivery of information. The technology of the eighties, however, is bringing basically new elements into the picture, which can be characterized by decentralization and distribution of data and processing power at the user's site. In addition, the cost and penetration of the telecommunication component needed is considerably slower than of data handling and processing components. This means in the longer run that the nature of transborder data flow will be basically either 'real transaction' (such as message sending, financial transactions, or travel reservations) or the bulk exchange and transfer of data to be stored and processed locally. By that time some of the present problems in this field—such as access to public databases in foreign countries or databases stored in foreign countries—will most likely have disappeared. However, new problems, mainly due to the penetration of the information and telecommunication technologies into daily life, can be expected.

The 'time-lag' between the developed and developing world will always create some problems in transborder data flows; nevertheless, the world must find a new transborder data flow order which satisfies all parties to the maximum extent possible yet involves least costs and risks.

National data flows

The emerging information society will bring about many new internal policy issues for a given country. The new information and telecommunication technologies—as flexible tools—allow both increased centralization of control and decision-taking by governments as well as mass distribution of the same control and decision process. Each country has to find the right balance between the two extremes, which is best adjusted to its national environment. Issues such as privacy and teledemocracy also fall into this category.

Vulnerability

Much discussion is going on about vulnerability of a computerized society. As with any society, the information society will be vulnerable to a certain degree ("life is dangerous"). The basic question is how to 'design' and 'implement' an information society in which the vulnerability of the new society is reduced to an acceptable level of risk—and this at acceptable costs—while preserving all its advantages. Assessing the risks before 'design' and after putting into 'operation' will always be a key issue in order to allow adjustments.

My answer to the question whether the elements (hardware, software, data, manpower) of an information society are of strategic importance to a given country—keeping in mind the present political situation of the world—is unfortunately "Yes". This reduces the possibility of resource and labor sharing between nations, reduces the advantages of the economies of scale, reduces the possibilities of cooperation, and also the possibility that nations get to know each other better.

Nevertheless, a correct balance between national security and cooperation has to be achieved.

In my view, much research has still to be done on the vulnerability issue, but in principle I do not see any reason why a properly designed information society should not work.

Technology is not everything

To take the right steps and decisions when necessary, however, requires a full understanding of the issues in a future information society, and, as mentioned, in this field much research still has to be done.

The center of our present studies is still mainly around the technology of the future information society. And this is understandable, because first the technology has to be understood and solved, and only then can assessments be made about what the economical, labor, political, cultural, etc., impacts of this new technology will be. Moreover, our present society is still very much technology-driven, and the major interest of industry—one of the major driving forces in research—is, and perhaps has to be, technology-oriented. Therefore, the focus of most of the present studies is still the technology: what can be done, how can it be done and at what costs and profits, on what time horizon, and finally is there any market for it? The answers to these questions are not easy to find: this is one of the reasons why it keeps our research potential so occupied. But while studying the technology and the economics of a future information society one should not forget the wide range of other aspects—such as labor, quality of life, culture or politics—on which the technology and economics of a future information society might have a serious impact. These must also be looked at seriously.

The videotex example

Our studies at the International Institute for Applied Systems Analysis have so far focussed primarily on the technology and economics: we have studied and analyzed some of the new microelectronics applications and new information technologies that we believe will create the basis of the future information society. We have carried out studies on subjects such as computer networks, videotex and teletext systems, office automation and video discs to mention but a few. To give a typical example of a study done by our institute, we have presented a background paper to this conference, the IIASA study "One-way Versus Two-way Videotex" [3].

As is known, the basic idea of videotex is to add sufficient electronics to TV sets so that they can be used not only for receiving TV programs but also as terminals of a computer-supported information and transaction system. Videotex came along in two varieties: as broadcast or one-way systems (called also 'teletext') and as interactive or two-way systems (called also 'viewdata').

The paper which I have mentioned describes in an inter-disciplinary way—rather on the technical, economical and historical surface—the past, present and possible future of videotex and the range of applications it might fulfill. This technology is believed to be capable of becoming an important factor in a future information society.

It became evident from the study that:

• The microelectronic and information technology components of videotex systems will not be a barrier in the market penetration process.

• The state of the telecommunications infrastructure for a given country might, however, become a barrier for future systems. Historical statistics show that the development of a fully wired telecommunications infrastructure takes considerably longer than the build-up of media based on broadcasting. Therefore, when creating national information and telecommunications policy concerning future videotex systems, these factors have to be taken into consideration. Roughly speaking, one may say that for developing countries with little or no telecommunications infrastructure, it is better to put as much videotex service on the broadcast media as possible. For the developed countries with congested broadcast frequencies and well developed terrestrial infrastructures, it is preferable to put full-channel teletext and interactive videotex on cable TV, the telephone, and the national packet-switching network.

• It can be expected that the penetration of videotex will take decades and will certainly be slower than either radio or TV.

• Factors such as governmental information and telecommunications policy (to subsidize or not to subsidize videotex, to back it or not) will be of decisive importance.

• For this and other reasons, we believe that it is most complex and difficult to predict the path of videotex penetration. As to other kinds of barriers, such as organizational, legal, and human aspects of videotex penetration, further studies have to be undertaken.

• For industry, the mass application of information and telecommunication technology will open new opportunities, similar to the process that happened in the automotive industry after the introduction of the 'model-T Ford' concept at the beginning of the century.

• It is believed that videotex systems will play a significant role in a future information-oriented society, and it is hoped that they will assist in overcoming some presently unsolved problems of society, such as the previously mentioned scarcity of energy and mineral resources, environmental pollution, urbanization problems, problems of food supply and industrialization, and finally that they will improve the quality of life.

• One of the major conclusions that can be drawn from the study is that there is no single governmental information policy on videotex; these policies may have differed, and probably have to differ, from country to country, and they also may be different in the same country at different times.

• Videotex actually offers different opportunities to different countries, and herein lies its chance. In the most developed countries, it will enable the mass penetration of the new information and telecommunication culture; in the less developed and developing countries—due to its simplicity and its relative cheapness—it will offer real opportunities to lay the basis for a 'computer culture'.

The time-lag—an opportunity?

Returning to the above-mentioned long 'time-lag' between the most developed countries and the rest of the world, it seems to be neither realistic nor desirable that the growth rates in the rest of the world in general can and should be significantly increased in order to catch up with the most developed countries within the next ten years or so (countries where practically nothing has been done so far are obviously excluded from this statement). There should be a limit in growth rates not only for technological but also for economical, labor, cultural and political reasons. It is my feeling that it is not worthwhile to force the pace of growth beyond a certain point, because the benefits obtained will not be in proportion to the magnitude of the efforts. It can be assumed that the—not over-forced, but still high—growth rates in the medium- and less developed countries will also cause enough 'infantile disorders', which have to be overcome one by one.

Nonetheless, because of this time-lag there still can and will be a forum and space for any cooperation in the field of microelectronics and information/telecommunication technologies between the two worlds: in a form of collaboration in which both sides can reap major benefits. For the developing countries the opportunity of collaborating among each other—due to having the same development level—will be enormous.

And last but not least—thanks to the time-lag—there will be one advantage for the medium- and less developed countries: the information society with its 'blossoms' and 'thorns' will first come about in the most developed countries and affect them. The most developed countries have no other choice but to take the risk. The role of an 'observer' in this process is not necessarily an unpleasant one, since one can learn without paying the tuition fee. In this respect, the disadvantage of being less developed can be turned into a chance. I hope that at that time the right lessons will be learned and only those elements will be taken over in the 'information society' of the medium- and less developed countries that will be for their prosperity.

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