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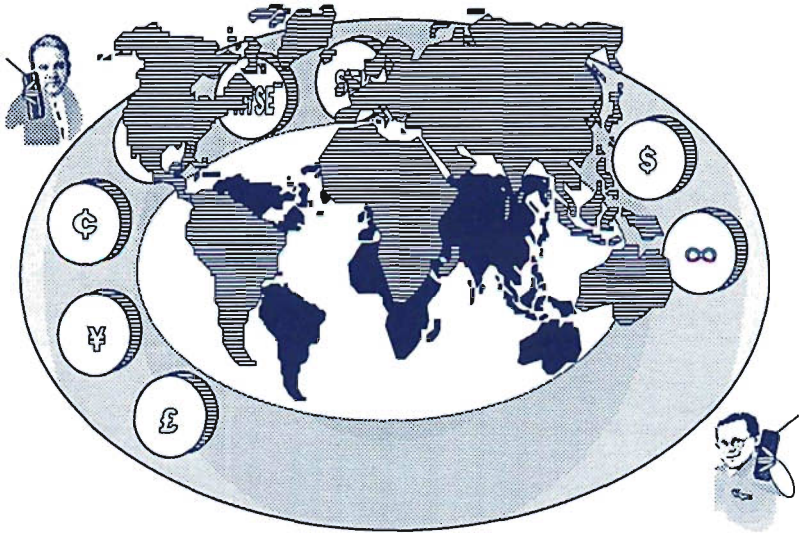
Telecommunications Use and Users
—Economic & Behavioral Aspects



Proceedings from a seminar for academicians and practitioners
in Saltsjöbaden, Sweden, November 1988

Edited by P G Holmlöv

HANDELSHÖGSKOLAN
I STOCKHOLM
STOCKHOLM SCHOOL OF ECONOMICS

Telekon
Research on TELE-ECONOMY and TELE-USAGE
supported by research grants from Swedish Telecom

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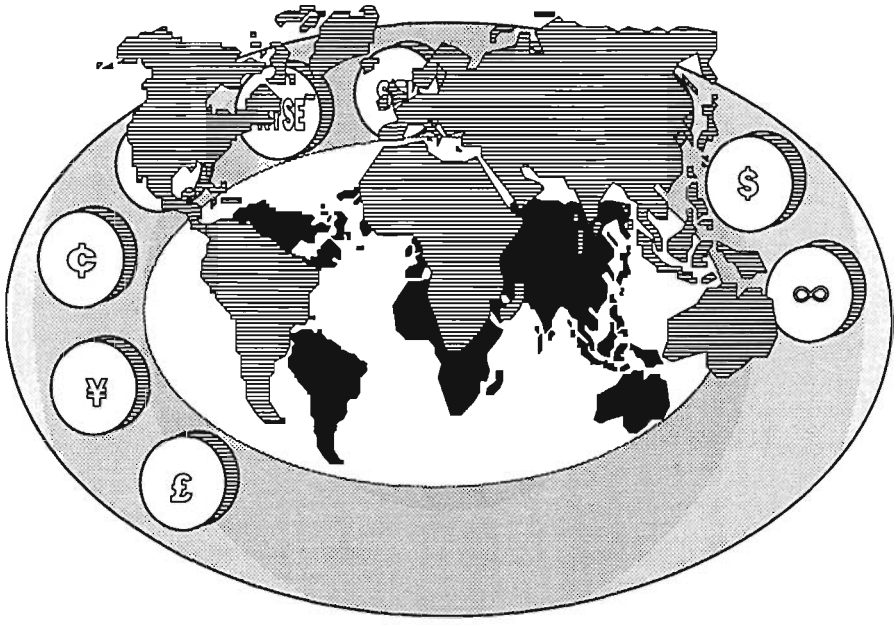

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Telekon
Forskning om TELE-EKONOMI och TELE-ANVÄNDNING
med stöd från Televerkets FoU-kommitté

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Preface and Introduction

P G Holmlöv
Stockholm School of Economics and Swedish Telecom

This is the written introduction to the transcripts from most of the proceedings of a seminar on "Telecommunications Use & Users—Economic & Behavioral Aspects" we[1] arranged in November 1988. The oral introduction to the seminar follows in Karl-Erik Wärneryd's "A Word of Welcome" (actually, that's well over 400 words of welcome).

We arranged the seminar because we had said we should—for social psychologists, market analysts, and communications researchers like ourselves, a stunning relationship between intention and actual behavior. Being with the School of Economics—Foundation for Distribution Research and Department of Psychology—we were funded by Swedish Telecom, the public telecommunications operator in Sweden, to research into the role of telecommunications in the new information society, and we suggested that we arrange a seminar to have invited researchers from all over the globe focus on some of the most crucial issues related to telecommunications use and users.

Due to time constraints and to the nature of the subject we are adressing—telecommunications and new information technology—we felt we had to approach likely speakers and presenters by fax, rather than by letter or other forms of communication that were likely to be slower. (Fax in fact, as you will find when scanning through these introductory remarks and the contents of this volume, was the object for one of the studies—ours—presented and discussed at the seminar.) Fax is such a convivial medium, I am happy to say, that we were able to round up quite a number of very impressive scholars. Unfortunately, we were too late in reaching some equally talented researchers whose fax numbers were unknown to us.

The facts and insights presented at the seminar were felt to be so interesting that we simply had to publish the transcripts in order to let others share them. (Not least, to let myself share them; when chairing the two-day event, I had to concentrate more on the clock than on the content of the presentations.) Luckily, we were able to videotape most of the sessions in November 1988, had them typed, and could induce most of the speakers to read and revise their own presentations.

November, 1988... If you were one of our students, who seem to think books printed before they were born aren't fit to read, just by looking at that time-stamp you would tend to regard these presenta-

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[1] By "we" I refer to Professor Karl-Erik Wärneryd, world's first—and long the only—professor of Economic Psychology, and to myself, Associate Professor at the Foundation for Distribution Research. We were helped immensely by the Foundation secretary Ms Christina Holm who among other chores picked the conference location and videotaped the proceedings.

tions as hopelessly *passé* and out of date. While I am cognizant of that, it is my contention that the issues and observations of these presentations are as valid, and as worthy of further study, even today as when we met in a quaint Grand Hôtel where we were almost snowed in. I would say that we—whether we are actors in the telecommunications field or mere *observateurs*—have occupied ourselves with the trends and signs pointed out in these presentations for the past ten years, and certainly will continue to do so right into the next millenium.

For example. *Liberalization* and *de-regulation*—or re-regulation, as it more accurately should be labelled—these trends in telecommunications have been talked about, legislated, carried out, and—to a lesser degree—researched at least throughout the eighties, and will continue to be so throughout the nineties. Re-regulation and related issues were addressed by Dr *Jürgen Müller* from Deutsches Institut für Wirtschaftsforschung in Berlin, who very kindly almost doubled his opening presentation—*Introduction to an Altered Global Telecommunications Economy*—to cover first base for the unfortunate illness and non-presence of another gifted speaker.

As Jürgen Müller points out, telecommunications is an astounding activity where real productivity continously seems to increase at 3—5% per year. Even though its share of the economy may be debated, telecommunications has been found to have crucial linkage effects. So, Jürgen Müller asks, Does it make economic sense to have legal or *de facto* monopolies in this sector? The short answer to this fundamental question is of course, if I may simplify his hour-long presentation, No. Jürgen Müller calls for an expansion of the market arena and an open entry to telecommunications activities, but warns for unfair cross-subsidization on the part of the former monopolists.

Jürgen Müller finds that cost reductions that may be construed as economies of scale more likely are due to technology improvement, so that in general it is wisest to let the market, rather than legislators, decide whether or not there is room for more than one player in the telecommunications field in each country. Rebalancing of tariffs, toward a cost-based or cost-related structure, is recommended, as it makes more transparent the terms of competition that new entrants to the telecommunications field will find in the long run.

As a timely comment to this observation, let me also agree with Jürgen Müller that, while the data in his Table 1—on major telecommunications tariffs in the EG countries—were not updated for this volume, telephone rates and the approaches to rebalancing still differ widely among EG and OECD countries. OECD in its Restricted Paper, drafted 24 January 1990, on Performance Indicators for Public Telecommunications Operators finds that the Netherlands, Denmark, and the UK have decreased their long distance charges relative to local call charges far more than most other OECD member countries. This is one step towards rate rebalancing. Another step, as recognized by the OECD

Working Party on Telecommunication and Information Services Policies, is being taken by the Scandinavian countries, where connection charges are high relative to usage chages. Since the actual costs for installation are much higher than what PTOs usually charge, this is a move towards a cost-based fixed charge.

As Jürgen Müller points out, while making it more expensive for householders to have phones installed and to make local phone calls—which inevitably is what rebalancing will result in—may seem to conflict with goals of equity, from an economist's point of view it is always more sensible to hand out general subsidies than to subsidize the use of a single commodity or service: commodity-specific subsidies distort the interpretation of consumer preferences. Also, there are huge, usually hidden costs related to any kind of regulation, as Jürgen Müller wittingly shows—costs that have to do with risk aversion and short-term orientation of political decision-makers.

Jürgen Müller concludes—as only one of several conclusions heavily backed up with data—that full public telecommunications operator monopoly is no longer a tenable policy in Europe. Most countries are inviting competition at a number of stages, ranging from procurement, to control, to number of network operators.

Hans-Peter Gaßmann, from the OECD's in Paris Industry and Information, Computer and Communications Policy Committee, in his talk—*Telecommunications/Information Technology Impact on Regional Development*—addresses another perennial issue in academicians' and practitioners' debate on the role of telecommunications and information technology, viz technology impact on regional development. Starting with the concept of core regions or megalopolises forming a virtual global city, Hans-Peter Gaßmann attempts to assess the transforming and enabling effects of what he calls ITC, information and telecommunications technologies.

Hans-Peter Gaßmann finds that the information society has a City address rather than sits in a rural cottage. Growth of primary information sector businesses and activities are confined to the core regions of Western countries. Here, the demand for primary information activities is acute; but even more importantly, only here are the necessary skills available for processing and interpreting information. These skills unfortunately are likely to continue to be scarce—although the skills present at our seminar, at a remote corner or Europe, were quite plentiful.

Hans-Peter Gaßmann also looks into the structure of telecommunications tariffs and makes a strong plea for flat-rate or distance-independent tariffs, such as for letters and electricity, *in lieu* of current rates that are based on distance. Tariffs independent of distance probably, he means, will make transmission to and from remote regions relatively cheap. He points out that fibre-optics seem to offer almost unlimited transmission capacity, a pleasant state of affairs that

surely will induce flat-rate tariffs also for all kinds of telecommunication. Flat-rate tariffs, however, must be introduced only gradually, so as not to rock the boat, especially as these flat rates are likely to be higher than rates currently paid by the low-usage users.

Another view of how new technology may be shaping society is offered in the presentation—*Networks of Connection Among U S Businesses*—by Dr*Gregory Schmid*, an economist by training. I can still remember my feelings of uneasiness when his colleague from the Institute for the Future, Robert Johansen, remarked that I really ought to get together with Greg at an early point in time. I was surrounded with bees while drinking my apple juice in the midday sun; and there was some confusion surrounding my coming from a School of Economics—which really is more of a business school—leading Bob to believe I would love to talk only to hard-boiled econometricians. However, Greg Schmid turned out to be more of an economic psychologist, if I may use that term, doing a great job of translating masses of socio-economic trends and indicators into exciting scenarios, glimpses of the future. Characteristically, he here uses data on structural changes in American business to challenge some of our ready-made preconceptions—misconceptions?—of the current information age.

Echoing Jürgen Müller's appreciation of the crucial role that a seemingly ever expanding telecommunications sector plays in the economy, Greg Schmid claims that manufacturing still is key to grasping American industry. Manufacturing is at the hub, purchasing goods and services from other sectors and providing wholesalers and retailers with the goods they are selling to the end-users. Second, he shows that large firms still dominate manufacturing, although most new jobs are created in smaller firms. However, Greg Schmid identifies a number of very salient changes. For one thing, large firms are getting smaller, mostly by farming out some of their work and relying more on outside expertise. Contrary to what some may believe, it also seems as if the number of suppliers is increasing. Taken together, these trends points at an escalating need for massive flows of information, between the large manufacturer in the center and the many smallewr firms at the outposts. As an example of the growing importance of controlling these flows of information, Greg Schmid in passing points at retail's responsiveness to consumer needs that is currently being increased by a better ability to catch, process, and really use these masses of data.

Contrast Hans-Per Gaßmann's neat vision of simple and fair flat-rate tariffs with the plethora of communications packages, with prices targeted for various segments and marketed by a myriad of telecommunications providers, as researched so admirably by *Moshe Ben-Akiva*. A professor at MIT, he like Greg Schmid is an economist by training, but a number-crunching econometrician of the kind that crunches

Greek letters as easily as data. Moshe Ben-Akiva doesn't exhaust his audience with everything he knows, however—he simply and in a most exciting manner in his presentation—*Choice of Telecommunications Services*—tells us how to predict what choices household and business users will make when acquiring and using telephone services.

In Moshe Ben-Akiva's States, residential users at the very least can choose between flat-rated and measured telephone service; and the difficulty they are facing is of course that they have to choose *a priori*, before usage starts. It seems that many users prefer to pay the higher flat rate although they may use their telephones very little, because they are afraid of running the risk of incurring an excessive phone bill—a nice illustration of the concept of prospect theory, where people are believed to avoid risk more than they gamble for success.

Moshe Ben-Akiva's model attempts to predict the market shares, as it were, for different kinds of telephone services, based on user demographics, users' revealed preferences—their actual behavior—and service options. Furthermore, Moshe Ben-Akiva attempts to model and predict residential demand for various CLASS, or custom calling features, such as call waiting and call forwarding. Here he has to rely both on revealed preferences and stated ones, as CLASS services are relatively new to subscribers.

Moshe Ben-Akiva also is modelling business users' demand for telephone systems and services—Centrex is a way for the small or dispersed company to purchase PABX- or switchboard-kind of services from the public switched network rather than to invest in a company PABX; and inward calling services, such as the Expanded Remote Call Forwarding (XRCF) scheme, which allows customers to make free calls to a local telephone number, where in reailty all calls go to a central exchange that may be located out-of-state. Moshe Ben-Akiva finds that demand for both Centex and inward calling services is strongly correlated to installation charges but less sensitive to recurring charges; so if a telephone operator would want to promote Centrex or XRCF, its best bet—based on Moshe Ben-Akiva's data—would be to disregard the installation fee but have higher recurring fees.

When I first met *John Carey*, inspiring teacher at NYU's Interactive Telecommunications Program and also a private consultant-cum-researcher, in a strangely furnished room at an obscure Manhattan address where the Program then was housed, I somehow got the weird impression that John was living in a garage in Brooklyn. However, much later I was invited to the clearly spacious house John Carey owns in Dobbs Ferry and was served the heavenly cheescake he and Frank Sinatra, among others, would walk miles to get, so I must confess of being partial to this guy. Here John Carey offers an exciting overview—*Consumer Adoption of New Telecommunications Services: Economic and Behavioral Components*—of variations in household penetration of various new telecommunications and media services in the United

States—a neat piece of innovation adoption research in the context of economic history, if you will.

As you would have guessed, John Carey reports that TV sets and telephones are ubiquitous. A household telephone is used for more than 20 minutes per day, a TV set for several hours. And the average US household owns two TV sets, six or seven radios, and two or three telephones!

Why are these services and others adopted by so many consumers? John Carey concludes that price has to come down for mass adoption. To be more exact, a number of electronic products—radio sets, b/w TVs and color TVs—were adopted by half the US popoulation when each gadget cost a little less than two weeks of gross wages. However, VCRs were adopted by 50% of the households when their price had dropped even more, to just about one week of gross wages, which makes John Carey deduce that a major electronic innovation probably has to cost less than $500 to reach a 50% penetration among United States households. (Incidentally, mobile phones dropped below this price in 1989!) John Carey sees this as part of a seasonal pattern of major household purchases, where electronic appliances typically are bought for Christmas (or for birthdays).

Looking at two kinks in the demand curves—first, when FM radio reached a larger share of the audience than AM does; then, when cable penetration exploded in the seventies and eighties—John Carey argues that one needs to assess what factors will act as "starter motors" for a new innovation in order "for an engine of growth to kick-in". In the future, however, he adds, innovations may not last for ever; it appears that VCR usage is droping while penetration is rising.

The average household, John Carey reports, not only waits for appliances to become inexpensive before acquiring them; a household typically spends comparatively small monthly amounts for the use of new communication services and electronic media. Most is spent on telephone services—$44 a month—but this is less than an average household pays for electricity for the house or gas for the car/cars. So, John Carey concludes, it would hardly make economic sense to a household to hear that $30 for an hour of database search is a bargain rate (which it indeed is, compared to what professional searchers have to pay)—if database services are that dear, consumers will stick to more inexpensive and convivial media.

In a short companion piece—*Consumer Adoption of New Services—Citibank's Approach to Design*—here following John Carey's long presentation,*Eileen Connell*, also a talented teacher, researcher, and consultant, and John Carey's companion, looks at how Citibank where she has been brought in as a consultant is analyzing customer response mostly to the human factors design of new services.

The Humanware group at Citibank attempts to design user interfaces that are easy to use and appealing. Group members are not bankers nor

programmers; they have a wide range of experience, not least from trials that flunked in a big way, such as large-scale videotex disasters. Mind you, technology and technological innovation is not an ancillary activity at Citibank; instead, it is viewed as a core activity, central to the bank's economic well being and future role as a global bank.

One of the Humanware principles is to rely on an old metaphor to advance diffusion of new concepts and services. The metaphor used to successfully launch a customer activated terminal was "Tilly the Teller"—a middle aged woman, very confident, who knew how to add and subtract accurately and knew you and your accounts. Users who get to try out new interfaces are asked simple questions on whether they liked and understood a specific design, and the Humanware group are seasoned enough by past experience not to put too much trust in any of these designs beforehand.

As organizers, we—Dr *P G Holmlöv, Christina Lindberg* and Dr *Karl-Erik Wärneryd*—snatched the opportunity to present our own study on adoption and use of a specific telecommunications service—*Adoption and Use of Fax in Sweden.* P G Holmlöv, Associate Professor, is with the Foundation for Distribution Research at the Stockholm School of Economics, as well as with Corporate Planning, Swedish Telecom. Christina Lindberg was a teaching and research assistant, tricked by the senior authors to stay longer at the School than she first planned to complete the study on fax. Karl-Erik Wärneryd, Professor, is Head of the Department for Economic Psychology at the School.

As the report in Swedish was not yet completed at the time, we have had to substantially revise our manuscript, cannibalizing on a subsequent paper by the same title presented at a seminar in Rome by one of the senior authors.

The background for the recent study was that fax penetration in Sweden grew from a few hundreds in 1978 to an estimated 70,000 in 1988. This induced the authors to conduct a constructive replication—with a questionnaire distributed by fax—in 1988 of a telephone interview study two of them helped conduct on the adoption and use of fax in Sweden 1978.

Fax is used because it is perceived as fast and smooth. In 1978, companies had installed an average of two faxes, most of which were leased; in 1988, the average number of faxes per company had grown to 27, and most of these were purchased. The reported average of pages transmitted more than doubled between the years, and may be even considerably larger than the 18 pages per day reported by the 1988 respondents, perhaps 50 or 60 pages per day (according to the interpretation of independently measured traffic volumes).

Most fax users in 1978 acquired and used their fax for one specific purpose and to reach a small number of other faxes. Here, the critical mass of fax users is limited to a few users in a more or less fixed network. In 1988, faxes are purchased and used for a large—and

increasing—number of applications, and to reach what may be labelled a *general* critical mass; "everybody else" is believed to have a fax, and this has prompted a number of firms and departments to acquire their own. While fax primarily was adopted to replace a number of other means—mail, telephones, and telex—novel uses may appear at the stage users now are entering.

Svein Bergum, who completed a Master's degree at the Interactive Telecommunications Program at NYU (where he was taught by, among others, John Carey) between researching and marketing at Norwegian Telecom, combines his scholarly and his managerial interests in a presentation—*Variations of Business Use of Telecom Services in Norway*—that draws on his Master's Thesis. Svein Bergum iattempts to depict and explain variations in use of telecommunications among Norwegian managers and Norwegian corporations.

Among the interesting findings in Svein Bergum's work are the factors that seem to correlate most with business use of telecommunications. At the individual level, industry explains more of telecommunications use than the respondent's own profession. At the company level, sheer business size explains more of telecommunications use than industry. Heavy users of telephone services are also heavy users of data communications. Computed by sector, the largest telecommunications use is found in manufacturing and retail, sectors together accounting for more than half of all telecommunications subscriptions.

A case of industry use of a specific information system is illustrated in the presentation—*Information Technology and Product Delivery: One Swedish Example of EDI*—by *Odd Fredriksson,* a doctoral student at the Stockholm School of Economics and researcher with the Foundation for Distribution Research at the School. Odd Fredriksson looks at a pair of electronic interorganizational ordering systems—BASCET and Infolink—in use in the Swedish hardware industry, tracing both their history, their use, and user and owner perceptions of the systems.

The Swedish hardware industry is rather concentrated in terms of its suppliers and wholesalers, but hardware retailers are many and heterogenous, clearly catering for different customer segments. Retailers, and a few very large customers (such as large MNCs), are able to use the online BASCET system and/or the file-transfer system Infolink to order goods and ascertain whether these are inventoried.

Infolink is an outgrowth of an ordering system first offered by one of the industry's dominating wholesalers, Luna, and appeared after another huge wholesaler, Järnia, had acquired Luna. BASCET was first set up by a number of manufacturing companies in the industry. The two services were merged in 1987 and now are being offered by the BASCET Infolink company.

Users—the retailers—feel that they earn money due to their use of BASCET and/or Infolink services. As reported by Odd Fredriksson, annual average net effects may amount to 0.3—0.5% of retailers' turnover. On the whole, users seem quite happy with the systems and perceive they are able to improve the quality of their service offerings.

Suppliers feel that the adoption of BASCET Infolink services may have been slower than was expected from the outset. Although some suppliers have made huge investments to adjust their internal systems to BASCET or Infolink, many have only limited resources to use and promote the systems. Individuals in manufacturing companies as well as in wholesale and retail have found it hard to accept wide usage of an electronic ordering system. BASCET Infolink has met with a number of technical problems.

Finally, there is one presentation—*The Store of the Future*—by *P G Holmlöv*, attempting to analyze the possible future adoption by both system providers and consumers of various kinds of innovative information technology. As this presentation largely was based on the planning related to a subsequent study trip in the United States with a number of Swedish researchers and professionals, and I have since had ample time to complete the study visits and, more surprisingly, a report covering the travel, I felt I had to substantially revise this presentation, too, stealing no little from the published thoughts and findings from the actual study trip.

The rationale behind the presentation is that consumers face a number of real problems when they prepare and complete purchases of goods and services. For example, grocery shoppers are hurried yet receive little help and advice from sales staff or from store displays.

A number of concepts for new applications are listed that conceivably could ease the burden for consumers by: providing convenient from-home shopping; offering extra service in the form of an extended assortment and new shopping ideas; providing service in the form of advice and consultation; and targetting offers to consumer segments—database marketing—after having stored their revealed past preferences in databases. Applications mentioned include: grocery shopping from-home by fax and phone, and through the Prodigy videotex service; store kiosks and displays that help customers pick the shoes or hair color that fit them best; Elizabeth Arden's now discarded cosmetics computer Elizabeth, which lets a customer see how her digitized face would look in several makeups without getting her own face greasy; and IRI in Chicago who have equipped shopping carts with a video display for promoting and informing about groceries.

There are several crucial obstacles, some of which are discussed in the paper, to rapid diffusion of these systems. Retailers seem to be opposed to several of the applications, not least to from-home shopping. It takes certain kinds of consumers, and certain kinds of merchandise, for electronic retailing to be trully accepted. The existing

technology base may not be sufficient. However, it is my contention that some of these concepts, and others, eventually will succeed in some sense of that word as real-life applications in stores and in consumer homes. That will transform parts of the economy.

These, then, are the presentations that form the major part of this volume. A few welcoming and concluding remarks have also been included.

As is not unusual, however, not all our invitees were able to go through the pains of revising the transcripts of their own talks at the seminar and therefore chose to withdraw their presentations from these proceddings. Some of the speakers we had hoped would come had to cancel their appearances at the last minute. Several interesting and valuable *ad hoc* statements were not caught on tape, while some presenters have opted to include in their transcripts a number of useful suggestions from the audience.

Still, as I am sure you will all agree, what is jotted down from the seminar forms fascinating reading and valuable information. I now leave you to it.

A Word of Welcome

Karl-Erik Wärneryd
Stockholm School of Economics

You are all very welcome to this seminar. It is the hope of us who have invited you that the two days you are going to spend here will give rise to fruitful discussions and valuable thoughts that will be of use to us and possibly to you in the future.

The purpose of the seminar is to arouse interest in doing research on problems related to telecommunications. Let me quote from a pamphlete published by the Commission of the European Communities:

> "Telecommunications pose a major challenge for the completion of the single European market by 1992. Rapid technological change has turned this sector into a spearhead of market growth and of our future prosperity.
>
> Modernizing telecommunications increases productivity throughout the economy and makes a range of services more marketable; it requires enormous investment, both in infrastructure and in high value-added telecommunications services. Telecommunications, along with space technology, will receive the major share of European civil investment in new technology."
>
> (European File, October, 1988, no. 15: Telecommunications: the new highways for the single European market)

The text stresses that the combination of telecommunications and computers will be a powerful factor in economic and social development.

Research related to telecommunications serves three purposes, apart from pure technical research:

- Providing data on uses, not only on what new information technology replaces, but rather on new uses, unforeseen uses of new communication media, as early as possible so that forecasts and product development can be based on realistic assumptions.
- Providing data on users so that advantages of new media can be exploited and disadvantages overcome.
- Training researchers so that there will be people around who are capable of structuring problems in a meaningful way for policy discussions. There will and certainly should always be policy discussions in connection with new media.

Many people talk about a revolution in the use of information. I do not think there will be any real revolution, involving a whole country at one single point in time. Many of the changes will quickly become part of our everyday life and we will accept them as pure routine. Looking back we may be able to see that there have been substantial changes, but the changes may be perceived as rather small, even trivial when we actually first face them.

It is important to start research early, even before any change is introduced so that we have benchmarks with which we can compare future events and phenomena. The theme of this seminar involves social and behavioral research. This type of research is essential and must not lag behind the actual introduction of new technology. That is the reason why this seminar is consequential and a beginning.

Introduction to an Altered Global Telecommunications Economy

Jürgen Müller
Deutsches Institut für Wirtschaftsforschung, and INSEAD

1 Introduction

Well, what I want to do is to report on some research which we did in Berlin together with colleagues at the University of Newcastle, in a project which is now appearing as a book.[1] The study was aimed at looking at the alternative effects of telecommunications regulations.

I'll quickly describe my institution and my own background.

You've already heard that I've travelled. I think that is something to do with where one is located. Furthermore, I'm an economist. So to go back to your question as far as research focus is concerned—you know, where do we see our role: An economist looks at the resource allocation process from the point of trying to find out what role institutions play in this process and what role technology plays, and how the two interact.

The Institute which I work with in Berlin is called the Deutsches Institut für Wirtschaftsforschung, which is one of the five large research institutes mainly carryting out work on macro-economics. But they also have a group which does micro-economics, for example a large group which does transportation. It was in that group that I started telecommunications work in Berlin.

Our DIW motto is: "to be dependent on no-one, to be of service to everyone". So even though we are publicly financed, we try to be relatively independent. We have a strict internal review process for things we do for the outside; we also try to publish everything we do. You usually find us in roles when there's a Government disagreement on something: they might then give a contract to us, and say: "You know what the economic issues are, what are the pros and cons; can you give us your position," and so on. This was also the way I came into telecommunications economics, because it was the Monopolies Com-

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[1] This paper results of work initiated by a research grant from the Anglo-German Foundation to analyze the effects of differing regulatory structures in the UK and West Germany. With the aid of the EC's FAST program, Alcatel NV, and the German Federal Ministry for Research and Technology, and the collaboration from other country experts, the study was extended to include eight additional European countries (see James Foreman-Peck and Jürgen Müller, Eds, "European Telecommunication Organisations", Nomos 1989, for details). The main findings of this study will be published in James Foreman-Peck and Jürgen Müller, "Liberalising European Telecommunications", 1989. Furthermore, see also Jürgen Müller, "The Benefits of Completing the Internal Market for Telecommunication — Equipment and Services in the Community" in: "Research on the 'Cost of Non-Europe' — Basic Findings", Vol 10, Brussels, Luxemburg 1988 ("Cecchini Report").

mission which had asked us to look at the role of competition in telecommunication. That was rather early, in 1978, when the whole notion of Einheitstechnik (the concept of unitary technology, of uniform network) was still very important in Germany, and when we asked this "dangerous" question of could there be more than one network operator, people just laughed at us. Now we've learnt quite a lot in the process and I think the companies and the Bundespost have also learnt from us. As a consequence of this earlier study the Post Office has set up its own research institute (WIK), mainly staffed by economists and business administration people. You can see that the Bundespost is being affected by this debate. By doing this sort of policy-relevant research you can raise the intellectual level of the debate. First of all you bring in arguments which make it necessary for the other side to try to understand your different framework. Economics tools can be brought in and I think the established institutions have had to react; the current debate about how to reorganize the Bundespost also shows this to some extent.

So we are mainly carrying out academic research with public policy and private applications. Our collaborators on this project were from the University of Newcastle where too a lot of telecommunications research is now located as a consequence of extra funding within the Social Sciences Research Council in the UK.

2 How do we regulate telecommunications?

Now something more specifically about the first project. Our theme was to look at the spectrum of alternative arrangements in the institutional environment of telecommunications in Europe. First of all, we had to look at what the current environment is and what the likely changes are. And then the aim was to link the policies between the PTOs, the users and the economy as a whole and to try to forecast what would happen as a consequence of this interaction.

We looked at this very much within an economist's framework, trying to follow three major themes.

One theme is to look at telecommunications not only from a national government's point of view, but from the view of an international economy.

Then there is the question of how far we can use competition as a discovery process. In other words what are the limits of the market within the telecommunication sector and where do we need corrective state institutions and where not?

Third, especially with Europe 1992, what are the dynamic effects of trade and how will they affect the sector?

Well, first to the question of how far we can expand the competitive arena. If you ask this question you have to first find out what are the reasons for government intervention, where do you want to limit it and what are the costs and benefits of government intervention, and what are the trade-offs.

When I went to graduate school it was usually said, "Well, now we have a case of market failure and then the government takes over", and that was when the professors went on to the next point. But I think here we really have to look specifically at how government regulation works, and not only to recognize that the explicit costs of running regulations are important, i.e. paying for the cost of the actual agencies, the cost of the firms doing business with the agencies, filling out forms, spending time in hearings, etc. I think what we have increasingly learnt to recognize is that there are also very high implicit costs of regulation which originate because regulation becomes part of the political process.

The Commission wanted to know how far we can go with respect to liberalization—i.e., how narrowly do we delineate the areas of non-competition. Our idea was to keep them as small as possible. But also in the so-called liberalized areas, the question was not only to advocate liberalization in a strictly laissez-faire way, but also to see what the necessary policies of re-regulation are. So the question is not to deregulate completely, but how to re-regulate and to specify certain market parameters which have not been specified before, or which might have been specified within a different regulatory administration. Examples are the question of how to allow access to the network, the question of spectrum allocation, etc., parameters which were previously usually set within an administration and which now had to be set separately in a new regulatory environment.

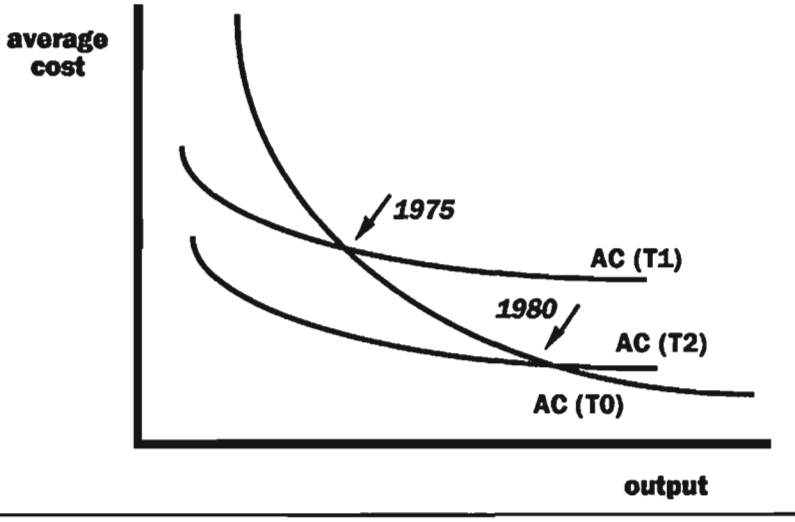
3 Network monopoly

Now let's look at the reasons for government intervention which we looked at in our study. One of them was the question of natural monopoly. We spent quite a lot of time trying to estimate cost-function for the telephone network to see if there was really a natural monopoly. But we found that the data which we had at hand was time series data, and that the network was really built up over time with various technology layers. Therefore, the data as such did not allow us to answer the question fully. The results were that the economies of scale were quite large. But when we looked at it more in detail we found that some of the scale effects which we had measured were really related to technology effect. Let me show you how this looks in Figure 1.

What we are trying to do is find a long-run cost curve. We have the cost per access on the vertical axis and the output on the horizontal axis. The problem was this. We found some data points for 1975 and some data points for 1980, indicating that there were some economies of scale as indicated by line AC (T_0). But what was really happening was that initially there was little demand for the network, so the initial cost curves may have been up at curve AC (T_1) and the cost curve later on may have been down at curve AC (T_2) because they invested later on a larger scale and with a different technology, so the shift in technology

really changed the scale parameters. We tried very hard to find better measures of technical change, and I must say that this was not conclusive, but at least it allowed us to review the existing literature and show that economies of scales studies as such cannot really be used to see if the telecommunications sector is a natural monopoly.

Figure 1: Bias in Scale Economy Estimates from Underestimating Technical Progress



We then also used comparative studies where we looked at the countries which had been deregulated, for example the US and to some extent the UK and Japan. There of course you find entry of smaller firms into telephone network provision, which would signal that there might be few economies of scale which are larger than the size of the market. But again the question is not answered conclusively because entry is also related to the existing price levels and the prevailing pricing structure. I'll come back to that in a minute.

So basically what we concluded is that even if there are some national monopoly elements in the provision of telecommunication services, econometric studies do not give us conclusive evidence for this. Technology tends to be much more important. Thus even if there is a natural monopoly element in network provision, there should not be a legal entry barrier, so one can at least allow some market forces to check if this is still the case or not.

The second point we looked at was the question of externalities, especially the public good aspect. This refers to the effect on others when you join a telecommunications network. The option that somebody who is already on the network could call somebody else who is not on the network is worth something. So there are some externality effects by being inside or outside the network which affects the pricing

position. But this is already quite wellknown and reflected in the typical pricing policy that access to the network is subsidized by higher call charges. The question is actually more important, not for traditional networks but for new networks which we are starting to build up, for example when new services are introduced. The question is then how much to subsidize them initially, how to price them, and so on

But again we find that the existence of externality is a reason for excluding the market in this area because these externalities can be internalized through pricing. We see this already by the pricing policies of some companies who offer network services, that they try themselves to take account of this externality.

4 Equity and tariff policy

The last point against network competition is the question of equity. Equity is important because we find that most European countries emphasize uniformity of network access, in other words they try to achieve universal access as far as possible, with a more or less universal price.

Now let me show you how this universal price looks in reality. Table 1 is a comparison of telephone rates across Europe. First of all we see that these charges (which are all in ECUs, similar to dollars) for a local call, for a connection, etc., already show huge variations across Europe. Most of the access charges are essentially under-priced, indicating that firms are taking care of the externality effects of people who want to join the network. Some of the costs of being connected to the network are borne by the people who are on the network or by higher traffic charges. But you also see quite a bit of the variation across countries.

The second observation is that some countries have some discrimination between households and business access. The reason is that when connection charges and rental charges are below price, and firms want to move tariffs closer to costs, price discrimination occurs between households and businesses, with business connections priced closer to cost.

The other interesting observation is that on local calls you can see a huge variation in tariffs, and the interesting thing is then if you compare these two ratios of trunk call charges to local call charges you see that they range from 1:3 to 1:32 for trunk calls of Distance 1, and from 1:3 to almost 1:40 for trunk calls of Distance 2.

What is behind this picture is that for a long time firms used what we call value-based pricing, where they tried to charge a very high price for "highly valued services" like long-distance, and have tried to subsidize local calls with the profit associated with that.

Now what you see in tariffs is reflected by the equity principle. Companies want to make sure that local calls are relatively cheap, that access to the telephone is cheap to increase network penetration, and to pay for this with value of service pricing on long-distance calls.

Table 1: Major Tariff Variables in the EEC (1986)
(in ECU, includes VAT charges where applicated)

Country	Connections	Monthly Rentals Households	Business	Local Call Tariffs (LC) (3 min)	Call Area Size[1]
Great Britain	150	9.00	14.02	0.21	221
Italy	151	4.48	11.54	0.20	9
Belgium	116	10.50	10.50	0.14	78
Ireland	235	11.20	15.10	0.14	78
Luxembourg	58	5.78	5.78	0.12	n.a.
France	36	5.67	13.82	0.11	120
West Germany	31	10.80	10.80	0.11	135
Denmark	189	9.88	9.88	0.10	n.a.
Netherlands	97	9.81	9.81	0.06	5
Portugal	66	7.98	7.98	0.05	1
Greece	199	2.23	2.23	0.03	5
Spain	83	6.66	7.03	0.03	n.a.

	Tariff for Trunk Calls up to 100 Km (TC1)	max. Dist.(3min) (TC2)	Intern. Calls (3 min)[2] From	TO	Intern. Leased Lines[3]	TC1 LC	TC2 LC
Great Britain	0.56	0.56	1.94	2.12	1162	2.7	2.7
Italy	1.62	1.72	2.92	2.16	3500	8.1	8.6
Belgium	0.69	0.69	2.22	2.10	1625	4.9	4.9
Ireland	1.26	1.26	2.88	2.30	1878	9.0	9.0
Luxembourg	-.--	-.--	1.41	2.10	1702	-	-
France	0.85	1.59	1.85	2.10	1541	7.7	14.5
West Germany	1.00	1.66	1.67	2.13	2352	9.1	15.1
Denmark	0.36	-.--	1.37	2.31	1312	3.6	3.6
Netherlands	0.26	-.--	1.75	2.09	1743	4.3	4.3
Portugal	1.19	-.--	2.88	2.40	2889	23.8	23.8
Greece	0.97	1.15	2.73	2.33	2582	32.3	38.3
Spain	0.60	1.07	3.15	3.15	2481	20.0	35.6

[1] measured in thousands of exchange lines
[2] average peak charges from a country to EC members and vice versa
[3] monthly rental and connection charge in $ for eight private circuits to adjacent country and two transatlantic.

Source: Telefonica, Revista T, No 16, Oct. 1987; DIW for International Leased Lines, IBM 1987 for International Calls: Eurc,ean Commission, XIII 1178 (1988)

But then if you want at the same time to propose competition, then of course you have to limit the introduction of competition, because it will make entry into the highly priced segment of the market artificially attractive.

And what is the actual cost of connecting a telephone? In dollars?

Audience: —It depends how you calculate it.

Jürgen Müller: —But on average—let's take a city of 50,000 to 500,000—then your actual costs are going to be in the neighborhood of let's say 400 dollars. So you can see what I mean, that even the UK and let's say Ireland with a very high rate are not covering the connection costs, so you can see how much of the cost is being covered later on by usage fees and by cross-subsidization. And also if you look at the cost for local calls, you see, you cannot make a three-minute local call for three cents.

There is some debate as to whether the UK is overcharging on local calls, and that's why I think it's important to see to what extent we can use even better, let's say accounting data to find out how to bring tariffs closer to costs, and also some signals of competition through firms who try to enter.

Audience: —Just an explanation for the high cost of Great Britain: later on you will see I have similar charges which actually are very complementary to yours. In the UK you have metered calls, and they meter by one minute, and obviously if you have here a local call of three minutes, that's three times as much, and that's the reason.

Jürgen Müller: —Yes, there are some problems which are hidden behind the data. If you know that the average length of a local phone call is between three and four minutes, and for example in Germany the first calling charge is eight minutes, there are some problems of how to do this comparison. But all I wanted to do with this is to show what tariff variations we have at the moment and if we really wanted to apply this principle of seeing how far can we go with allowing market forces, we see that one of the problems is that the current tariff policy does not allow this. And the reason is because we want to have commodity-specific subsidies, which invite "skimming off the cream".

This policy has two drawbacks. First of all, general income or region-specific support policy is superior to commodity-specific subsidy. The reason is what we call static allocative inefficiencies. If prices diverge very much from costs, then you just don't allocate resources properly. Second, and we often ignore this, there is the dynamic effect because this policy distorts the working of the price process and it requires entry barriers. As a consequence, you have a "political monopoly" where you might not have had a legal monopoly before. And this is especially important in the dynamic context, because there are now certain applications which are under-priced and subsidized and you then don't have an incentive to try to innovate. For the activities that are over-priced, you block activity or discourage it from taking place by erecting barriers to entry. You lose innovative activities on both types of activities.

But there is a tariff proposal which is more flexible that might avoid this problem. I am at the moment sitting on one of the committees of the EEC on tariff reform, and one proposal which was made was to allow competition in what is called the reserved services. You may remember that the EEC had proposed to differentiate between non-reserved services for which there should be competition and reserved services, especially voice, where there should be none. Now imagine that there is competition in reserved services where those who are able to enter in long-distance trunk calls, where the tariffs are quite high, transfer the internal subsidy contained in these high tariffs to the PTO. So anybody who enters this market and offers this service has to pay internal subsidy into a sort of fund which is then used to re-distribute funds for special infrastructure tasks. So instead of prohibiting entrance you can use a taxing mechanism. The PTO receives the subsidy contained in the services it loses, while a competitor who is more efficient, still has a chance to enter.

This is an idea which we had already proposed in 1978, and although you see its recognition has taken a very long time, its implementation may take much longer. Our idea was: don't just erect barriers, try to make it flexible, so you get extra indicators and reactions in the market. I don't think the Bundespost has thought this through completely, but the fact that they are willing to discuss this at an international bargaining procedure, let's say within the EEC, shows that the initial prodding does have some effect.

You see that although equity is an important policy issue, it often has a very perverse effect on the flexibility in the market. From our viewpoint, distributive and equity issues are therefore not a good reason to limit entry and the size of the competitive arena.

But the question then is: If these equity and distribution issues are legitimate concerns, how do we make sure that disadvantaged regions are not disadvantaged further, while at the same time utilising the flexibility of the market place? So how can we solve this problem? First of all, there are regional subsidy funds, income-specific funds and so on. Recent work in the US also shows that when you are really worried about the distributive and regional effects of re-adjusting tariffs, there are much more complex tariff procedures which can be used, including optional tariffs, lifeline tariffs, etc., rather than the simple tariff menu approach which we have in Europe. The basic idea is that if you want to extend the competitive arena, and there are some other policies which conflict with that, you need to first of all look at what these policies achieve. Do they really achieve their aims, and are there no alternative policies which can do it better?

5 The political economy of deregulation

Now let me talk a little bit more about the fact of re-regulation, which is sometimes forgotten when we speak about deregulation.

The first point is the cost of regulation. Government intervention in

the non-competitive areas is not cost-free, but the cost of regulation is often underestimated. We all know the static administrative cost, but we often ignore the dynamic costs of regulation. And we also forget the lower dynamic flexibilities of administrative bureaucratic processes, and the dynamic cost of bureaucratic processes.

Now let me try to use three slogans to illustrate this point. The first one is that the incentive for innovation is more limited, and the reason for that is quite clearly that innovation for a bureaucrat is always quite risky, because we know that success has a thousand fathers, so if something goes well everybody says: oh yes, I was involved in that. But failure has one, and if you are caught, that's the end of you, so you want to be on the safe side. And so the first point to recognize is that there is risk in innovation which makes bureaucrats wary of it.

The second one is that if innovation leads to failure, then the projects are often continued beyond the initial point where you recognize that there is a failure, because to admit a failure in public can be quite costly for a bureaucrat. One way out can be to prolong a project rather than to stop it. But then you need further cross-subsidization and often further barriers to entry, which might again lead to an extension of a "political monopoly". And there are plenty of cases to illustrate that point.

The third point is that of political influence. You see, regulatory authorities have a tendency to support the status quo. One of the reasons is because the losers are often better organized than the winners. You see, losers—if we talk about the regulation/deregulation debate in telecommunications—can for example be identified in terms of equipment suppliers, because they are threatened by a more competitive market, they are the workers because they are threatened by faster internal adjustment to technical progress, etc. On this point, maybe I should mention one interesting quote which I heard in Norway when I analysed their on-going reform. We asked them how fast they were able to introduce new electronic switches and what rhythm manpower savings from the introduction of digital switching they hoped to achieve, and they said "Well at the moment we don't have any, because we have actually an increase in manpower needs because the old ones cannot all be retrained and we cannot fire them, and we have to hire new engineers to deal with this equipment." And so you see, you can do that in a monopoly, because basically nobody is threatening you through entry if your production costs are high, so you say "We pride ourselves on making a socially acceptable adjustment to technical change, we try to retrain as many of the personnel as possible within our institutional framework."

But when you are in a competitive situation this is much more difficult. Again, an example from Norway. The Norwegians put their telecommunications terminal equipment market into a competitive framework. The carrier participated with a separate private firm. And of course as soon as the market was de facto liberalized, competition in

the customer premise equipment market increased, and the new firm (TBK) had not learnt how to survive in a directly competitive market, as can be seen by the price war which followed. TBK had to release some workers because the pressure to adjust under competition was much harder than they had expected. So you see, as long as we can have a monopoly umbrella over the problem of adjustment to competitive forces, adjustment will happen much more slowly.

The other point to note is that some groups are more easily mobilized than others, and will therefore play a larger role in policy-making. But this leads to an over-emphasis of protecting existing positions rather than investing in future benefits.

The last point to note is the short-term orientation of policy-makers. You see, public decision making often exhibits impatience. The decision makers will typically ignore many of the long-term gains because they cannot be appropriated by them. If we look at the publicly elected officials, they are in government for four to five years before facing re-election. But sometimes you have to make much longer-term solutions, instead of concentrating on short-term 'quick-fix' solutions where they can say I did that and I achieved that during my term in office.

All these points are not new, but if you think of them altogether you have

- the politics of risk aversion and the problems of political monopoly in order to avoid project disaster;
- the politics of group intervention; and
- the impatience of regulatory institutions and governments.

All are factors which together tend to raise the cost of regulation. So if you remember how I initially asked "how far can we expand the arena of competition?", we have to account properly for these effects, and we should sometimes take a policy where we want to err not on the safe side but where we would like to err on taking a bit more of a risk, because there is an inherent bias to decide in favor of too much regulation.

6 Re-regulation

As a first summary, our recommendation is to try to expand the size of the market arena as far as possible, but also to make sure that there is proper re-regulation. One has to make sure that regulated activities are properly interfaced with competitive activities. And it is especially important that an exploitation of economies of scope is possible which might exist for example for network carriers who also want to offer other telecommunications services, to sell equipment, to offer VAN grant services, and so on. One has to make sure that when economies of scope exist they can be exploited, but at the same time you must make sure that unfair cross-subsidization is prevented from monopoly

activities to competitive activities. On this point, we can learn from institutional comparisons of the US with its Computer II and III decision. The FCC has shown how to make mistakes and how to correct them. And there are various ways of avoiding this open subsidization, and I'll come back to that in a minute.

Another important point to notice is that even in areas in which there might be market failure we can use competition as a regulatory tool. By pursuing this policy, we at least tend to get at least some signals of how else to do it, and what technology and what prices might result if entry is facilitated.

For example, in terms of network competition, even if we do not allow real network competition, we might allow the other existing physical networks the limited possibility to compete and use these network services as reflections of alternative cost and production structures.

All-in-all, it goes back to the question of re-regulation, so if you want to extend the area of competition you can't just say "liberalization", but you have to do some re-regulation. This also means an extension of the anti-trust laws for the telephone authorities and of course, back to the point which I mentioned earlier, as far as pricing policies are concerned, implicit product subsidies should be reduced as much as possible.

7 Industrial restructuring

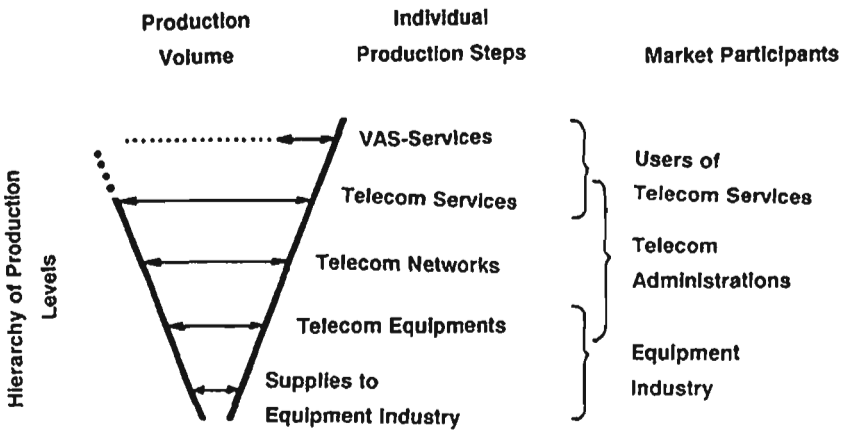
Now let's try to look at the industry a little bit more in perspective.

You see in Figure 2 a value-added chain, in which we start with component production at the bottom, followed by telecoms equipment, network services and finally value-added services. As you move up the chain, more value is being added so you get a broadening of the cone. And of course when we think of the 7% contribution of the telecom sector to GNP, a figure which the EEC has mentioned, then of course the cone ought really to become broader all the time.

Now I have never been able to find out how the EEC got to the 7%, since at the moment telecom is responsible for about 2% of GNP, thus my question: where does the other 5% come from? But you see, once someone uses the 7% figure, you can sort of raise public interest in the sector. And I think to that extent one could use the 7% which the EEC used in its Green Book. Now at the same time, we must recognize that the Green Book was much more an exercise in policy-making. You see, they were trying to draw attention to an area we ought to be concerned about, and I think the Commission to some extent has been quite successful with that. They have been able to increase manpower and resources in this activity to a considerable extent by very cleverly using such figures and preparing nice press releases. I think this is really politics at its best, because if you look back at where they were six to seven years ago, they have to package their message accordingly. I think we as economists can of course be sceptical about some points: that's why we

worry about the 7%. But what is quite clear is that telecommunications services as such have a much larger effect on the rest of the economy. So the question is only how do you measure them. If you want to get a complicated message across to many people, you have to simplify it.

Figure 2: Hierarchical Production Chain of Telecom Markets



So back to this point. We don't know exactly if this is 7% at the end, or if it's only 2%, but it's quite clear that over time and with the non-voice segment increasing significantly this cone is broadening, is widening, over time.

Next, I want to draw your attention to how these sectors are organized. You see, the market participants are quite differently organized. We have the equipment industry, which is semi-competitively organized. I say semi-competitively because usually we have preferred purchasing agreements when we have somewhat closed national markets. We see a lot of restructuring at the moment in this area because the value added in the industry is being reduced per given unit of output, as productivity increases. Equipment prices are being considerably reduced and so if these firms want to stay in business they have to add value elsewhere. Furthermore, component suppliers are increasingly adding value and they want to move up in this area, and it is quite clear that some of them would like to move into the network services and the VAN area. Now to some extent this is movement blocked because in the middle you have a monopoly section which is the telecommunications administration. On top you have users and so-called resellers, repackagers, in the terms of value-added services.

Now the point here is to make sure that the interfaces between these different levels are transparent and become more flexible. Now that's also one of the ideas of the on-going telecommunications reform, the

ideas of the Commission, et cetera, to try to make sure that on the one hand the economies of scope between administrations, and between administrations and equipment producers can be explained, but also to have flexibility for equipment and component producers so they are able to move all the way up to telecommunications services and VANs.

Now to implement this in practice is not so easy. I had a talk a couple of days ago with Siemens representatives about mobile telecommunications services. Even the Germans are going to allow a second mobile carrier. But the Bundespost seems to have insisted that Siemens would not be allowed to offer mobile services because they would then be vertically integrated, while the Bundespost, which is the other competitor, would not. You can see that all sorts of arguments are used to maintain current restrictions, which from an economic viewpoint don't make sense, but are gaining political support at least from a fairness viewpoint.

There are therefore still some institutional barriers that maintain the traditional distinction between the various levels for those who want to move up and down.

What I think is also important, however, is to look at some policies which might lead to a widening of the cone. First of all, there is an income effect as countries become richer and there is a tendency to use more telecommunication services. Second, as prices of telecommunications services are reduced, there is an incentive to use more of them. Third, there is a substitution effect—because of lower prices, things which we have done physically before are now done with telecommunications. Then you have also the complementary effect that activities which you did before are now stimulated with increased telecommunications use. And then of course you have the dynamic effects of increased competition between previously distant markets, which became integrated with, for example, better and cheaper telecommunications facilities, as larger markets.

When we examine real price trends using a typical basket of household calls from Siemens data which we have from 1973 to 1988 and then have deflated by national price indices, we see a reduction of between 30 and 60% in real telephone costs. So we have an activity in which productivity is continuously increasing in real terms at the rate of 3—5% a year. And most countries are moving along this path.

Now let me, just before we end the discussion about restructuring on the equipment side, mention a few things about the financing of R&D in the industry.

What we found in our study is that financing of R&D is often not necessarily related to R&D opportunities but to other issues as well. You have a strong relation to what we call industrial policy objectives such as employment policies, maintaining national champions, etc., but if you are trying to maintain employment in the industry, you cannot react fast enough. Often, however, restructuring is not allowed

to take place: in addition to the Norwegian example which I mentioned before, governments generally want to avoid politically embarrassing redundancies.

Now if you go back to the earlier picture in Figure 2, you can see quite clearly why this is happening. You see in a way we have rationalization which is taking place in the equipment industry down here, because this is basically emerging as a competitive market, and if you look at the number of job changes, job specification changes, et cetera, in the equipment industry, you can see that these are of a much larger magnitude than those of the telecoms administrations. The reason is essentially that this is a monopoly area where firms do not have to react as fast. And sometimes governments hold the protective shield as well over the equipment industry through the selective procurement act, so that adjustment here slows down, too.

So the basic point is that only if we increase the competitive pressure at the next higher market level, for example allowing service competition, that such protective policies are untenable. And if you look at the UK over the last couple of years you can see that BT's behavior for example in procurement and manning has been quite different and that as a consequence has increased the competitive pressure on its equipment providers. But the problem for the equipment industry is that you have a prisoner's dilemma, and it is easy to see how difficult it is to adjust in an area in which each nation wants to make sure that it maintains at least one or two centres of technological excellence, even though you have an industry in which economies of scale are quite large and you can only have a few firms producing such equipment.

As a consequence of this policy impact, some of the economies of scale in production and integration which are theoretically possible are not exploited fully and the question of how we exploit this better within the EEC remains. One way is to give further financial incentive to encourage R&D combined with the competitive supply policy, independent of where the producers are located. Of course this makes it much more difficult to see where this then leaves the people who are outside the EEC, like the Swedes or the Japanese who would also like to participate in an integrated European market.

8 Restructuring the service industry

Now let me next look at the potential for competition in the network itself. You see there are the natural monopoly elements in the local loop; in the inter-city network this has been much reduced and I have already talked about the equity issues, which nevertheless limit competition from taking place there. And if you remember the threat to employment because of the resulting restructuring and the political influence, governments are often not able to allow competition in both of these areas and try to limit competition only to the service market.

Now if you look around you can see that in some countries, for example in the US, Japan and UK, the inter-city market has been

opened up to competition. But in order to do this properly one has to regulate the interface between the monopoly section of the local loop and competitive long-distance market, one must have policies about pricing access to the local loop, one must have an interconnect policy, and one must ensure open standards in such a way that the networks can be interconnected effectively.

What are the results of allowing network competition, at least in the inter-city network? It's quite clear that in both the US and Japan, we have seen more investment in this sector rather than less. In general we see higher performance, but we also see a variety in performance and increased options for the users. We certainly find much more product variety compared to standardized networks. To some extent, we allow markets to tell us how many networks we should have. So you have basically no longer just the engineers deciding what seems technologically optimal, but you have much more of a trade-off coming from users, including those people who want to run their own network, not so much for cost considerations but for security considerations, control over network, etc.

Now I cannot emphasize enough the role of proper interfacing and pricing of access to the local loop. In the US there has been much discussion about inefficient by-pass. In other words, when for equity reasons you tend to set prices on long-distance too high, entry will take place. Even if a company like Televerket or the Bundespost might be able to compete on cost, it would not be allowed to lower price (and thereby deter entry) for political reasons. Now the effect of this policy is quite clear. With continuous entry, one can no longer maintain uniform tariffs, and pursue equity policies through tariffs. Eventually also, subsidization must stop, local rates must be raised and long-distance tariffs lowered. But as a consequence of such network competition, you also have increased pressure on the equipment manufacturers and what I think is quite interesting is that you also have pressure on the politicians to allow tariffs to move to a more cost-oriented approach. The main reason is that because of entry and the associated cream-skimming, there is no longer much cream to be distributed. So then the politicians have to look for other sources of surplus which they can distribute.

Now what's happening on the telephone networks themselves? We see that with rising income and falling real prices, a high telephone penetration is achieved (in most countries). You see that many of the PTOs are now looking more actively for additional areas of activities, like value-added services, cable TV, data services. As a consequence, the universality of service application is actually reduced, in other words many of these new services are no longer introduced as universal services, they are market and sector-specific. There will be more specialized service offerings and of course many more specialized customers asking for customer-specific applications. There are likely to be more interactions with data processing and value-added networks,

distributive data processing, etc. Now one reason that such an evolution, to more specialized customers and more specialized services, is possible is that the economies of scale of networks and service provision are being reduced, especially if you compare them to the size of the market. If we have a demand curve which is very much near the origin, you can see that it is best to have only one network, but prices have dropped significantly over time, disposable income has also risen, so demand has moved far out and there is generally much more room for more than one network.

It is now also possible to have customized networks from off-the-shelf products, which are more tailor-made, less universal, more intramodal, etc. And of course essentially we can also have what is called flexible intelligent networks which sort of interact, between software-related networks on the one hand, and the core network on the other.

Now if you take this trend further, you can see quite clearly that integration via ISDN and optical fibre networks will work against this trend, at least at the network level, but perhaps not so much as what you do with the network. These developments may lead again to the utilization of economies of scale in the network. On the other hand you see also that the customer premise equipment portion of the network is increasing and this means also that there is a greater threat of entry from data processing companies which work on this end. And if you look at mobile services you already see that this threat is being increased. The question which remains is how large the "core network" is that needs to be maintained, let's say as a minimal infrastructure base on which you want to allow competition to take place. This is a question which we could not answer in our study, but which is something for the Commission to think about in the future, as the implication of the Green Paper proceeds.

The other point to notice is that total telecoms use at the firm level is increasing, so already firms are reaching what we may call a decision-sensitive threshold, where more senior management are now paying attention to what the firm actually does in the communications field and how it reacts to the options being offered. Such firms not only appoint a telecoms manager but they also put much more pressure on telecoms policy. Consequently, there is also a willingness for the business community to look for more alternative network arrangements and support network restructuring, when the opportunity presents itself.

9 National restructuring

Now let me just show you what is the state of this restructuring in Europe by showing you Table 2. Norway is included here not because it is part of the EEC, but we use it as an interesting comparison and also Norway was one of the first to reorganize its telecommunications sector by setting up separate competitive activities. On the left side of

Table 2, I have listed the number of policy objectives which play a role in the restructuring.

Table 2: **The Institutional Spectrum in the European Telecommunications Market (1987)**

Policy Options	DE	BE	DK	GB	FR	NL	IT	NO	ES	AT
Complete State Ownership	●	●	—[1]	—	●	●[2]	—[3]	●	—	●
Separate Post and Giro services	—	●	●	●	—	—	●	—	●	●
Separate Regulatory Institutions	—	—	—	●	●	—	—	●	partly	—
Separate Subsidiaries in Competitive Markets	—[6]	—	—	—	●	●	●	●	●	—[2]
Strong Network Monopoly	●	—[4]	—[4,1]	—	—[4]	—[4]	—	●[5]	—	●
Change in Telecom Monopoly Envisaged	88/89	88/89	—	—	88	88/89	89/90	87	87/88	—
Distorted tariffs	●	●	●	less	●	●	●	●	●	●
Unrestricted Use of Leased Lines for VAS services	—[10,12]	—	—	—[11]	—[10]	—[10]	—	—	—	—[9]
Extensive CPE Monopoly	●	●[10]	●[1]	—	—	●	●	—	●[10]	●[10]
Industrial-Policy Goals in Procurement	●	●	—	—	●	●	●	—	●	●
No of Network Operators	1	1	4	3[6]	2[7]	1	3	1	1	1

1) Regional — 2) Some private shareholdings envisaged — 3) ASST owned by the state — 4) Open for CATV networks — 5) Private local networks possible — 6) BT, Mercury, and Hull Telephone — 7) DGT and TDF — 8) Beginning activities through DETECON — 9) Radio Austria possible exception for some VAS — 10) Further liberalisation envisaged — 11) Unrestricted sale prohibited at least until 1988 — 12) Shared use possible, also some interconnection of public network

Starting from the top, industrial policy goals in procurement are important. A ●—short for "Yes"—tells us how much domestic industry is being protected from more international procurement.

Complete state ownership shows the direct degree of governmental control, i.e. how easy it is to allow competition or not. If you already have private ownership then it is easier to allow competition than if you first have to change the basic law as you have in Germany.

The question of separate post and giro services is important because in some countries this tends to be an important source of cross-subsidization. The question of a strong legal network monopoly is actually similar to the question of state monopoly. It's a question of what legal changes you have to have before network competition becomes feasible. The number of network operators is important because if you already have one or two network operators, even though they might be acting separately in regionally defined areas, not competing with each other, the fact that you have more than one operator makes it much easier to eventually talk about some form of competition.

- The point of separate regulatory institutions is important because it allows you to make sure that the judge and the player are no longer the same, and you can separate these two effects.
- You see that already in most countries a change in telecommunications institutions is envisaged soon or already in place.
- Some PTOs have already set up separate subsidiaries in competitive markets, others have not.
- What is very interesting is that as far as value-added service is concerned, none of the countries as yet allows unrestricted use of leased lines which would really be needed to use the maximum flexibility for service-based competition.

I think the table shows that full PTO monopoly is actually now no longer tenable policy. I think most countries see quite clearly that they no longer need to prohibit competition completely.

Now there are various roles which the PTOs can play in this situation. For example, they can take an increasing or a decreasing role in manufacturing, i.e. in the form of joint ventures as we see for example in Italy, or fully-owned subsidiaries—again the Italian example of STET and SIP comes to mind, also the UK example, where British Telecom for example took over Mitel, after joint R&D activities. So PTOs can be active or they can be passive, for example through cost-conscious short-term procurement policy; they can play a very crucial role in the VAN market, for the PABX market via Centrex.

Now I don't know how many of you know this term Centrex, so I should maybe stop here for a minute just to explain. Centrex is nothing more than doing PABX-type services (Private Area Branch Exchange) from the central office in the public network rather than via a PABX which you normally have in your office. Instead of having this PABX within your building you can have all the wires from your office going to the local exchange, and doing all the switching in the local exchange. The benefit of this is that it is much easier to add extra features, economies of scale to the extent that they exist, can be incorporated. As an extra cost you just have extra longer wires.

Now let me tell you what is now happening with respect to Centrex. Normally the economist would say: well, they are two different techno-

logies, one is centralized and the other one is decentralized, let the market decide which one is the better one, and the customers who after all have the choice can choose between two options. In the US we see that Centrex recently became much more popular because the Bell operating companies were no longer very active in customer premises equipment, and Centrex in a way was one way for them to get part of this business back.

Now in the European countries, Centrex is not very much of an issue because PTOs do not have this sort of artificial restriction which happened in the US with the break-up of AT&T. But in the Norwegian case it's quite interesting that all the customer premises equipment activities were put into a separate competitive company, TBK. And now Centrex comes along and then the monopoly network operator NTA says: "But this is something we could use", and then TBK, the new competitive company of the Norwegian telephone companies says: "We are already selling PABXs, why do you want to create competition with us?".

So you can see, given this political context it is not always easy to allow the market forces to decide. The question for us here is to make sure that one has a proper interface in such a way that cross-subsidization does not distort the process and really allows the market to decide such questions.

Audience: —Does the cross-subsidy originate from the other network services or not, or is it part of the network?

Jürgen Müller: —Well this is a topological question.

Audience: —But how do you differentiate between Basic and VAN services?

Jürgen Müller: —I think that the whole question of how to separate basic and value-added is a very artificial question. I don't think you can separate them. We see what difficulties Judge Green had in making a decision in his reviews of the AT&T consent decree. And I wouldn't be worried about this as long as we can make sure that we have a non-distortive interface arrangement. You don't want to have any fixed boundaries, you want to make sure that if there is a benefit of extending the extra intelligence from the network to the customer at a reasonable price, that he can get the benefits even though there might be a boundary. The boundary then must not be in terms of yes or no, but to make sure that there is no negative effect on entry (for example, via predatory behavior or through cross-subsidization, through better accounting rules). Then you also have to have a set of anti-trust procedures which allow you to check against predatory behavior.

I don't think there is a very easy answer, for example in areas where this has been applied both within the EEC with Article 85/86, or let's

say within Germany with the so-called concept of "Missbrauchs-aufsicht", it has not been easy to implement that, but these problems should not say that we should shy away from solving that. If you lay down some clear rules, you can say either that you want to be on the conservative side or on the sort of risky side. But you must make sure that both of these frameworks can then be allowed to evolve.

Well so that's what we then see happening, that already in some countries we see a reduction of the legal monopoly area to the core of the network. We see liberalising CPE markets, dual supply of mobile services, etc. Separation of certification and regulation from operating function of the PTO is now more or less accepted. And I guess that here again there is an interesting question. You see, some countries are worried that when you separate these two you have an increase in actual manpower needs, that you have duplication of activities, and I think here the Swedish example, if I understand it correctly, is quite interesting. One has not taken certification and regulation outside of Televerket, but one has instituted the role of an Ombudsman. So again you have an auditor who makes sure that the economies of scale, if they exist in certification, can be kept there, but that you follow due process and do not disadvantage people who are then competing as customer premise equipment suppliers with the PTO. We see the number of specialized networks growing larger and increased use of specialized networks for own use. More combination with VAN services becomes realistic, subject only to these restrictions which I mentioned earlier, of no re-sale and shared use.

Now these institutional changes are taking place at different speeds and in different forms in the individual countries. There is more willingness by the Anglo-Saxon countries to do a trial-and-error approach of liberalization, using the common law tradition. In other words, these administrations are willing to take a risk and, even if they make a mistake, then they will try to correct it afterwards. And so they tend to be more radical, more ideological, while the rest of the European countries and also Japan to some extent use a much more consensus-coordinated approach. Sometimes there is a very slow search to find a blueprint for the restructuring, for example if you look at how long it has taken in Germany to bring about only minimal changes. The examples to be followed were first Norway and the Netherlands, while Germany, Belgium, Italy, Spain, Portugal and Denmark are still debating. But we see similar reasons for the changes in all the countries—the convergence of telecoms and data processing, diversification or specialization of demand, pressure to reduce cross-subsidization, especially from business users, to simplify the regulatory structure and the need for more transparencies when PTOs compete with private firms. And also I think we have seen a significant change in the political climate with a move towards governments which believe more in the workings of the market.

Now the PTOs are not always happy with this, and we can see quite

clearly that some of them see liberalization as something which endangers their old monopoly power, the volume of business overall, and their expansion into certain areas, which now becomes much more difficult. It also increases the uncertainty regarding employment. Before they could tell their workers: "You have safe jobs, you never have to worry, we'll take care of you". Now there is increased uncertainty.

The same point can be seen with procurement practices. PTOs might have to switch suppliers quicker because of the threat of competition. They have less control over the network, they have to have open access, with the question of open network provision (ONP) falling under this.

In addition, depreciation and technical change might happen much faster under competition than before under monopoly control. So for all these reasons there is a resistance from PTOs and a search for what you would call the minimum amount of institutional change, similar to what I think is represented by the Dutch-Norwegian solution. There will also be a policy to try to keep the regulatory framework a little bit ill-defined—I mean a little bit fuzzy—to still maintain as much control as possible.

But once these things are changing it's quite difficult to keep the competition at the level at which the PTOs want it. We see that actually some countries are moving further because you have international comparisons, you have the role and lobbying pressure of expert groups and the knowledge of how things could be done differently is becoming more widespread.

So let me sum up. Even though telecoms is not 7% of the economy and is small in size, it has crucial linkage effects. We therefore need to make sure that the on-going PTO reforms are a success. The main aim should be to have more open access, less friction, and more ease of entry. In other words, try to avoid all the entry barriers that are there at the moment. And for this reason we need to separate technology policy, industrial policy, and social and regional policy, in other words: use other tools if we want to aim for a more competitive framework for telecom services.

As a consequence, the open trade policy which might be associated with such a policy should not be seen as a threat but as a potential. First, because it allows one to increase market size and to increase the degree of competition. Second, to develop specialized services which could not be offered before in a single country because the market was too small, and which could then be offered in a larger, let's say European-wide, framework. And also to stimulate competitive pressure, because now there are more players in the larger geographic region which compete with each other. So of course there is a price to pay in terms of the actual structural adjustment, both by the firms who supply the equipment, by the PTOs, by their workers and by their users. But the price may well be worth it.

Thank you.

Chair: —Thank you, Dr Müller. Thank you for an insightful overview of the situation now facing most of the communications players and in particular of course the PTOs in Europe and elsewhere.

It was in response to my prayer that you did stretch the presentation a little. I'm very thankful for that ...

Jürgen Müller: —Well, I don't know if the audience is...

Chair: —I was coming to that. I know that some of you are probably dying to hear the next speaker, some of you will be dying for a smoke, or to stretch your legs, and some of you are dying to comment or question some of what Dr Müller has said. I can't allow all these things to happen. I'm sorry—we have to move to the next speaker.

Telecommunications/ Information Technology Impact on Regional Development

Hans-Peter Gassmann
OECD

In December 1987, the OECD Industry and Information, Computer and Communications Policy (ICCP) Committee organized a joint seminar on the role of information technology and telecommunications for regional development in Athens. The main conclusions of this seminar, by Professor Goddard from Newcastle University (UK), are available as a document.

In November 1988, the OECD's ICCP Committee held a workshop on international comparisons of tariff methodologies for telephone tariffs in the various countries.

The following is based on the results of these two seminars, and I will add some of my own considerations.

1 Large vs Small Cities

If we look at regional and national economic development, we find that there was in all countries a historic migration of population, coming from the village to the small and medium-sized cities, from there increasingly to metropolis, and then to megalopolis.

A new phrase, the "global city", is in increasing use now. Obviously there is no migration of people to the global city; they stop, so to speak, at megalopolis. But it is certainly a fact that the various megalopoles, which we see in the various countries, are increasingly linked up by efficient air transportation, and also by increasingly efficient telecommunications systems. I always mention these two technologies together, because I think they really are very complementary.

This linking up of the various megalopoles in a way forms the "global city". Whether the Stockholm area falls into the category of metropolis or megalopolis depends on one's viewpoint. If you look at it from an international point of view, it falls into the metropolis category, because the Stockholm area—with two million inhabitants—is still below the threshold of a megalopolis. I live in a city where there are ten million inhabitants—la région Parisienne—and I think there are several million too many. It is increasingly difficult to live in such large cities. A city which is two to three million is about the optimum for a large city. Everything which is beyond that is really making life more and more difficult.

But if you consider the Stockholm area from a Swedish perspective, obviously Stockholm is a megalopolis, because for a country of eight and a half million inhabitants a city of two million is twenty-five

percent of the total population. The Stockholm area is part of the global city, because you have airline and telecommunications connections to all the capitals of the world.

Now if we look at economic activities in these cities, we see that in the small and medium-sized cities the classic employment is in manufacturing industry, and some private sector services activities such as local services, retail distribution and banking services. There are also some local government services, such as police, education and health care.

In a metropolis or the megalopolis, central government services need to be added. (With some exceptions: some countries prefer to have even the central government services in relatively medium-sized cities like Ottawa in Canada or Canberra in Australia.) There are of course many private sector services, with headquarters and branches of large multinational firms and banks. Typically in all the countries they tend to be in the larger cities.

Today there seem to be forces reinforcing centralization trends, and this has to do with the creation of service jobs. This apparently occurs much more in the larger cities and megalopolis than in the small cities or even out in the country. It is just a fact of life—wherever you go in our member countries, service jobs are created mostly in large cities. There are some cases where this trend is exacerbated, such as in the Tokyo-Osaka megalopolis, or in the United States in the eastern "corridor" between Boston-New York and Washington; similarly, in the London and Paris region.

One of the attractions of large cities seems to be the availability of cultural services. That is why a lot of people like to live there. These megalopoles have many cultural services—theatre, arts, all kinds of recreational cultural services—which are attractive to educated people.

And last but not least, we have also the climatic factor—I don't need to tell you here in Sweden, you know it's obvious. In all the Scandinavian countries you have the capital always in the south—Oslo, Stockholm, Helsinki—but also in Canada you have Vancouver, Toronto, Montreal—they are all at the southern border. On the other hand, these climactic factors also play in the other sense, if you look for instance at Italy or Spain, where in summer it gets too hot in Madrid or Rome, therefore the classical industrial activity is taking place in Barcelona for Spain and in Milano and its region for Italy, with concomitant growth of services related to this industrial activity.

There are some other factors which may favor decentralization, on the other hand. In education services;—we have many examples where universities are in smaller cities—and they have been used to attract new industrial activities, and as science parks like in Cambridge, for instance, or Umeå in Sweden. And of course also leisure activities certainly attract science-based industrial or research activities—golfing in Scotland or sailing in Brittany in France are good examples.

2 The Role of ITC Technologies

Now, what role do information and telecommunications technologies (ITC) have in this general trend? They certainly are transforming, enabling technologies which have often been referred to as new engines for growth. Sometimes a parallel is drawn between the development of telecommunications, especially now fibre-optics, as an infrastructure, and the inter-state highways or the autobahn which were developed just before the Second World War. These have created new possibilities for cars, and the cars have made it possible to go in the suburban areas, and for about until 1973 there has been a virtual circle of investment which actually affected other industries. Some people say we have a similar phenomenon with information and communications today. The telecommunications infrastructure, especially with its new services, is enabling all kinds of other services to grow, and that is a virtual circle.

But on the other hand it is a very highly competitive process, as we have heard this morning, and I fully agree with that.

Now, it is quite likely that these new technologies are mainly benefitting advanced regions. Why are they benefitting advanced regions? Because there is clustering of service activities, and these new ITC technologies are heavily needed for these service jobs.

The growth of what is called the primary information sector is mostly confined to core regions. This is an area there is not enough evidence yet; at the Athens seminar mentioned above, Professor Goddard from Newcastle-on-Tyne presented a paper in which he discussed the creation of value-added network services in the UK. There was evidence that 87% of all the new VAN services were created actually in the London area, nearby the London area, and only 13% in Northern England. And that there might even be a problem, in that by delivering these VAN services from the London Region up to the north, they were competing there with traditional local jobs, even eliminating some of these traditional jobs.

At present it seems that there is impressive growth of tradable information, situated mostly in these core regions. And this growth triggers even more investment into the communications infrastructure in those metropolitan regions, because the demand is there. This also makes economic sense: obviously you want to invest where you get a good return on your investment; and because of the demand for advanced telecommunications services there, that is in the core regions.

At the Athens seminar it was remarked that we have six types of innovation. ITC-based information product innovation, distribution innovations in the retail business and also in the supermarket business, innovations in the manufacturing process (CAD/CAM, robotics, etc.), and also Electronic Data Interchange (EDI) increasingly plays a role in the structural change. And here we have very interesting sectoral differences. In the United States, for example, recently a comparison

was made between the textile industry and the car manufacturing industry concerning the use of EDI. In the US textile industry, they already have uniform EDI standards throughout the industry; whereas in the case of the car industry, there is a General Motors EDI standard, a Ford standard and a Chrysler standard. Each company would probably like their competitors to come on board and use their standard, but if you have large competing companies it is more difficult to have a common standard than is the case in a more fragmented industrail sector, such as textiles, which is under heavy external competitive pressure, where it seems easier to arrive at a common EDI standard.

Finally, there are managerial innovations. And this is probably the most difficult one, because from many countries we hear that information technology innovations are not always noticed at the level of the management of the firm, for two reasons. First of all, there are no big major reorganizations of the firm to adapt the firm to this new technology, on the grounds that people say "We are human beings—why should we adapt to the technology? The technology should adapt to us." Second, there is still the problem that information and communications technology is not always taken seriously enough by top management. And it is still considered to be a mainly technical issue, and left to the technicians to deal with.

But today IT is strategically so important that I would recommend that the managerial innovation each firm should carry out is to have at least a senior vice-president in charge of this area.

Now let's again come back to the regional aspects, which is the subject of my talk today. We have to look for a moment at the nature of these telecommunication technologies. There are terrestrial systems and non-terrestrial telecommunications systems. At the seminar in Athens it was mentioned that the terrestrial telecommunication systems do follow the existing hierarchical structure of settlements, and somehow they reinforce existing population concentrations. In other words, the terrestrial systems help in bringing forth these migration trends which I showed before. Whereas the non-terrestrial telecommunications systems, whether satellite, digital radio concentrators and mobile telephones, are ideal for more sparsely populated areas and island communities.

Let us have a look at this use of telecommunications technologies, and this is closer to the behavioral aspects of the seminar. Everyone can see that the telephone systems, although they are more than one hundred years old now, have some interesting characteristics: they are convivial, easy to use, not much learning is required for dialling a telephone; not many extra skills are required. Even young kids today use the phone as a matter of routine. There is no functional change needed to use these telephone systems. Whereas if you use advanced communications, especially data communications and electronic mail, certainly new skills are needed. Everybody who has tried to use an E-mail system can attest to this, and these procedures are not easy.

The use of these advanced telecommunications often requires change in structure of organization and inter-organizational relationships, which so far is not occurring very well. Many people are saying "We could do much better if we had those changes." In other words, although these changes are felt to be required, they are not yet occurring. And therefore there are some problems using those advanced communications.

They are mostly installed in core regions; one of the reasons why this is so is first of all that the demand is large in these core regions, by banks and by headquarters of large firms,, but secondly also because it is a question of availability of skills. Those skills—especially in the computer field—are and continue to be scarce, especially for software development, and these specialists are hard to find in remote regions.

In the remote regions, by and large, they don't have these kinds of skills. And sometimes, if those experts are trained in remote regions, since pay is generally better in the core regions, these experts migrate. Specialists have an incentive to migrate to the core region.

Another way to look at this is to consider the development of networking—computer networking. Some years ago, in the seventies, these consisted of a large computer and some terminals in a star-type configuration, and that's more or less all it was. EDP was mainly done at the headquarters of a company. Afterwards multifunctional systems emerged, and today inter-organizational networks—between different organizations—are developing, and also in an organization you have multifunctional workstations. Even in the United States they are not yet really well integrated. I saw recently a survey by a big American consultant firm and they said that not more than 5% of all the American firms had really integrated EDP systems.

But the fact is—and this is the point I want to emphasize—that by this development increased levels of skills are certainly needed. In order to use inter-organizational networks in an integrated way, you not only need really qualified specialists, but the users must also be quite good at using programs.

This brings up the question of telecommunications development strategies. Should we first push the regional penetration of the old POT—the plain old telephone system—and forget about the new applications, or should we have rather a balanced development of telephones and advanced data communication services? This is perhaps not so important for a country like Sweden, which already has the highest telephone line per capita ratio in the world, but it is an important strategy question for countries like Turkey or Greece, or for that matter for all the developing countries. This was discussed at the Athens seminar referred to above, but no clear conclusion was arrived at.

3 The Importance of Telecommunications Tariffs

Now let's move for a moment to some questions of telephone tariffs, which is a difficult area.

What is clear is today is that most telecommunications tariffs are like railway fares. They are distance-dependent, and that means automatically that remote regions are penalized. This comes from the fact that in the past, if you developed a railway, the longer the distance the more tracks were needed. So the cost increased as a function of distance. And in the old days of the telephone this was the same: the distance was a function of so many telephone poles and so many lines which could be used, and the longer it was the more expensive telephone calls were.

On the other hand, one could argue that it did not really need to be like this, because there are some alternative models which have a so-called flat rate, where the service is distance-independent, such as the postal system. Although it certainly costs more to deliver a letter up to the north of Sweden than to distribute it inside Stockholm, the stamp is the same. In France, for instance, the postal system was unified over the whole French territory in 1848 with the same postal tariffs; before there was some differentiation in tariffs. This was basically a political decision.

The same is true for the electricity system, where in most countries there is the same price whether you are in the north or in the south. Of course, there are discounts for large users, and so it is not the same tariff for everybody, it depends to a certain extent on the usage intensity. There are household tariffs, where the KWh tariff is relatively high, with a low subscription fee per month. But if you are a larger user, with 7 kilowatts for instance of installed power, you pay less for the KWh but you have to pay a higher fixed subscription fee.

Even in telecommunications, in the meantime there are some exceptions to the distance-dependent tariff, especially in data communications. If you use a packet-switched system, normally the distance does not play a role in the tariff. The same is true for videotex systems. With, for instance, the French Minitel, you always pay a local call, or multiples of local calls, depending on the length of usage duration, but not for distance.

Concerning these telecommunications tariffs, we have at present a big claim of large users, especially the multinational users, for more cost-based tariffs. The question is, what are cost-based tariffs? That is a big problem, and there are different economic schools to interpret what is cost-based. What is meant is that the large users want to have cheaper long-distance telecommunications tariffs and more expensive local rates, because it is felt that there is a great subsidization of the local loop by the long-distance tariffs.

Since long-distance calls are always distributed anyway by local loops, a certain part of the cost of the local loop must be attributed also for the distribution of long-distance calls. And therefore the calculation is not

as simple. It is true that in the United States and some other countries, at least until recently, local calls were very cheap because they were often included in the monthly subscription rate. You could make 500 local calls a month if you wanted, and it was not more expensive. Now that is changing, there are more and more parts of the US where the local loop calls are metered.

In Europe the situation is quite different, because the PTTs in Europe already introduced local call metering a long time ago.

In England for instance a local call tariff is for one minute only.

In Sweden the tariff the duration of local call tariff units are three minutes during peak time and six minutes during off-peak.

In Germany they have eight minutes and twelve minutes respectively for a local call tariff unit, while in Greece they have unlimited duration local calls, so that the inhabitants of Athens are very privileged compared to other Europeans.

Rate rebalancing, in other words more expensive local calls and cheaper long-distance calls, occurs in all OECD member countries. And I think that is a good thing.

How about Integrated Services Digital Network (ISDN)? As you know, ISDN has now been talked about for some time, and in the beginning it was what I call an engineer's dream. Many European PTTs now say this is the new future, we shall get integrated telecommunications services, which means telephone, voice, facsimile and slow-motion video.

The European Commission proposes that ISDN tariffs should be less dependent on distance.

But we should always keep in mind that if cost-based pricing is applied to ISDN, it means, at least for the foreseeable future, high access charges and low usage charges. And if you think about it, who can afford that? That is certainly not the residential user. The residential user will probably not, at least for the next few years, be a big user of ISDN. Perhaps there will be some exceptions, for instance a journalist working in his cottage somewhere, and he needs a lot of facsimile transmission, but this can also be done also with the classical telephone system and in an analog way.

So really it will be mostly business users which are interested in ISDN. The crucial question is: do they need these integrated services? So far, US users take the view that they are all in favor of digital networks, but they say they don't need integrated services. They prefer to have different overlay networks, but cheaper than ISDN.

In Europe, the PTO service suppliers are very keen to provide this strategically long-term concept which is ISDN, but they need to create the market for it. Perhaps a lesson can be learnt from the rapid introduction of the French videotex system. Through a user-friendly approach (no contracts between users and information providers, local tariffication, cheap terminals) a critical mass of users and traffic could be generated. And I think this reaching critical mass for traffic is the

important issue for ISDN introduction over the next few years.

Now let's have our final look at fibre-optics transmission, which is not necessarily only ISDN, although most of ISDN will be probably on fibre-optics on trunk lines. It is interesting that in the United States at present, fifty per cent of installed capacity is still what they call "dark", that is not yet used. There is so much competitive pressure from the various telecommunications providers to install fibre-optics, that they have invested way in advance of usage. In other words, we have in the United States, different from Europe, a situation like we had in the times of the interstate highways. When they built the interstate highways in the United States, or the Autobahnen in Germany, they were not used very much in the beginning, there were just a few cars running on them. And then gradually they were loaded more and more. So in the long term they turned out to be a good investment. But this fibre-optics trunk lines investment has very different reasons. This is not a New Deal type of Keynesian investment; it is an investment for competitive reasons, to get an edge on market shares over competitors. With fibre-optics, and the tremendous bandwidth these transmission systems offer, a new state of play in telecommunications will be reached: that of almost unlimited capacity. This has led some US analysts to argue that in the future a simple flat-rate tariff system could be introduced for the whole of the United States.

We are not there yet. The advantage of a flat-rate system in telecommunications would be of course its simplicity. It would be certainly a good long-term solution, and it would have advantages for remote regions. But at the moment the negative side of this is that the flat rate would mean higher tariffs for most users in the short and medium term. And therefore, because of this higher tariff, probably it would retard the reaching of critical mass of users of these systems.

If we ask the question "How do we go from now to this type of future situation?" we probably cannot change the present tariff system dramatically, but we would get there gradually. This would be important for regional development

As a policy goal for the next few years, if you really want to keep people in the outside regions, and at least give them a positive incentive from a telecommunications tariff point of view, a flat rate for telecommunications should be aimed at. Although in the short and medium term this would mean relatively high access charges, you would have an equity of access situation for all the users in a country.

Now we are still very far away from this situation. I think that in most countries with a future of fibre-optics transmission, a flat rate tariff situation might be envisaged in some ten or twenty years, say as a goal for the year 2000. At least that is what I hope.

Networks of Connection Among U S Businesses

Gregory Schmid
Institute for the Future

The French author Alexis Tocqueville came to the United States in the mid-19th century, and spent a couple of years, wandering around, visiting towns, and talking to people. He wrote his reflections on democracy in America, and it is probably still the outstanding work analyzing the differences between Europeans and Americans. In one of his characteristic passages he described the Americans love for change, for being different. This was one of the strongest impressions that he came away with. He would go into small towns and note that Americans love to meet someone who wore different clothes, ate different things, sang different songs, or a businessman who would come with a new product. And people loved him for it.

I am from the United States; not only from the United States, but I am from California which is the far end of the United States, which tends to love change even more. Not only that, but I work at a small place called the Institute for the Future where we spend all of our time thinking about change. So I think it is safe to say that I will be focusing my talk on change, the things that are different, the new. Let me talk a little bit about the change in information and communication uses and needs in the United States and what it means.

I will start with a few numbers. The numbers represent growth rates in communication usage over the mid- to late 1980's in the United States and these are average annual percent growth rates. Telephone access lines are growing on the order of 3% per year but if you look just at the business segment they are growing at 11%. If you count the number of telephone calls, local calls are growing each year 14%; trunk calls at 21%. Lines are growing rapidly but the intensity of use of lines are growing even more. Those numbers are startling, astounding! I have looked at many industries and very very seldom do you see growth rates like that for an extended period of time. Over the next half hour I just like to step back for a minute and ask the question why. What is going on? I would also like to ask if that is going to continue? Could we look forward into the 1990's for growth rates like that?

Let us start with a basic question. What is information? You know each one of those numbers indicate more information being passed but what is being passed? I started my career working for the Federal Reserve System, the central bank in the United States. I remember once I had the occasion to go into the archives, and I was rummaging through some old letters and I came across a letter written in the early 1920's from the vice president of the bank to the president. He had just taken a trip to Europe to negotiate a sizeable loan. The first part of the

letter described the loan negotiations, but the second and third pages were a description of his train trip, from Paris to the French border of Switzerland. His description of the countryside included commments on the grain crops, the condition of the houses and towns, the amount of reconstruction from the First World War. He talked of the train stations and the number of people coming to sell goods as an indication of local economic activity. If you think about it, that is astounding that only sixty years ago this type of information was an important economic indicator of the health of the French economy. The letter was put in the files as an important reference document.

Now I have worked for the last twenty years dealing with economic and social data on various countries around the world. You can get historical data series on virtually any indicator. You no longer have to get personal assessment. I mean if you want to find out about crops (agriculture) you can get electronic data on current production of hundreds of crops; if you want information on prices there is hourly price data. The availability of information has changed tremendously.

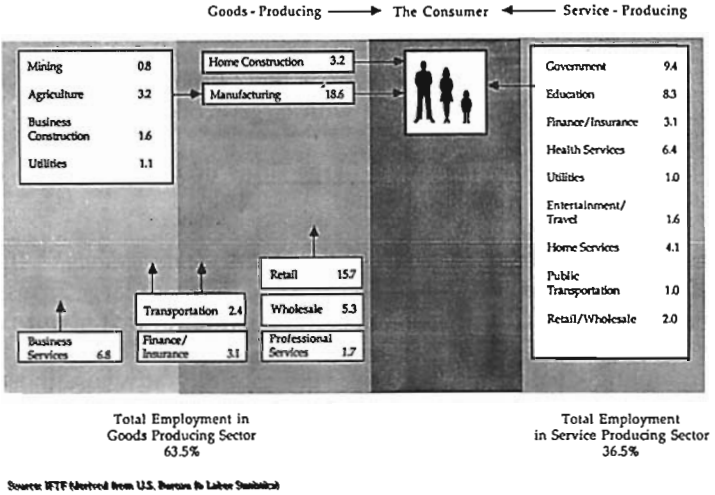
The real question, though, is, Can we assimilate that much new information? There was one important thing about that letter that does not show up in all our data books, computer files and our data tapes. And that was the individual assessment of the data as he saw it. You could tell from that letter that an individual interpretation was going on. Two years ago this country was devastated by the war but now they are recovering. They are bouncing back very well. There is an active entrepreneurial spirit active in the people regardless of the fluctuations of the economy. People are willing to invest money in their homes and to rebuild their capital goods stock. There is interpretation going on in the letter not just of the data as it appears, but how to utilize it, transform it, and basically use it for judgment. Ultimately the letter writer was going to come to his compatriots at home and make a decision on whether to approve a loan for France. And what is critical in that letter is that you could see on what basis that judgment would be made. As we look at our increased modern data flows you have to ask yourself the question: What is all that increased information going towards? Is it merely more data that is passing through? Is it like saying that instead of taking a train for 100 miles he is going to take for 110 miles and write more descriptions? Or is this data being utilized in a structured format to help people make better judgments and decisions? I think that our increased access to information must be followed by major organizational shifts to utilize the new information sources more effectively.

Let me turn to what I am going to call structural changes in the United States. This is moving away from our discussion of information for a bit but bear with me as I ask the question "Is there something going on in the structure of business in the United States which can explain those rapidly rising utilization rates of information?" Let me make four points about structural change in the United States.

1) Manufacturing is still the key to understanding the United States. You can not look at the United States and answer the question about growing utilization of information without first determining what the manufacturing sector is doing? Now this is a a somewhat surprising statement because many people say that the U S is turning into an information society, where the service sector is really critical. I think just the opposite is true, since the key to information growth is the manufacturing sector.

Let me give you a set of numbers. This figure shows the flow of all final purchases in the U S economy (Figure 1). It has the customer in the middle, the final consumer. What do they buy? Well, if you look carefully at how they spend their money, 2/3 of everything they buy is a product, a good, that you go to the store to buy, put it in your car, take home and use it. One third or slightly less than 1/3 of purchases are what we call services. The critical point, of course, is *the continued key role of the manufacturing sector.*

Figure 1: **Production of Goods and Services in the American Economy** (By Share of Total Employment)



Source: BTF (derived from U.S. Bureau fo Labor Statistics)

If you look at the manufacturing sector by itself it accounts for only 18—19% of total employment. But look at their full influence on the economy as a whole: the manufacturing sector purchases goods from the agricultural sector for use as raw materials; buys services from the business service sector such as accountancies and lawyers; hires the transport companies that take their goods around the country; provides the wholesalers with the goods to deliver to market. The manufacturing sector is the key to most major business decisions in our economy: what goods are made, where they are made, how they get to the con-

sumer, who sells them and for how much. In every way, then, the manufacturing sector remains the center piece, the nexus that determines the flow of goods to the final consumer.

That is point number one. When you think of the economy of the United States you have to think of the continuing importance of the key role of manufacturing. If you look at this number historically it has not changed over the last 20—30 years; the same percentages of workers are working on goods as happened 20 years ago. If you look at the projections of the Bureau of Labor Statistics for the next 10 years, the same percentages hold there. So in a way we are not moving towards a service economy or towards some new information economy except as it is driven by the needs of the manufacturing sector.

2) *When you think of manufacturing, you have to think of big companies.* You know another common characteristic often mentioned about the United States is the importance of small business. Small businesses creates jobs and counts for much of employment. On the contrary, though, when you think of manufacturing you have to think of big firms. Once a year Fortune Magazine describes the five hundred largest industrial firms in the United States. If you look at those five hundred firms you will see that each year they account for 75% of all employment in manufacturing. That is a fairly concentrated ratio, when compared to the European countries. Why is that? Probably because you are talking about a continental market with large economies of scales in production process.

So point number two is simple. Large firms dominate the goods producing sector in the United States.

3) *What about all the small firms in the United States, though?* If about half of all workers in the United States work for these large firms. What about the rest? I think there is strong evidence that about two out of every three new jobs that are created in the United States, are created among small firms. But look very carefully at where those small firms are, where they work and what they do? You will find that a large percentage of them are working in that goods producing sector, as suppliers to the large manufacturing firms and over 90% of the firms in wholesale and retail trade are small firms working on processing or distributing of goods (Figure 2).

4) *Let's put those three elements together and we get a picture.* Let's call it a picture of the flow of goods, through the goods producing sector in the United States. The dominating center piece is the large manufacturing firms. They produce the goods that flow directly from them to wholesale and retail outlets, and through them, to the consumer (Figure 3). The manufacturing firms hire accounting firms, large multinational banks, telecommunication firms and components suppliers. They determine the standards of the products that they use; the compo-

nents that are used; how they use it; when they purchase it. Around these large firms are constellation satellites of smaller firms, small businesses. In fact all the creation of new jobs in recent years in the

Figure 2: **Who Do the Small Firms Work For?**

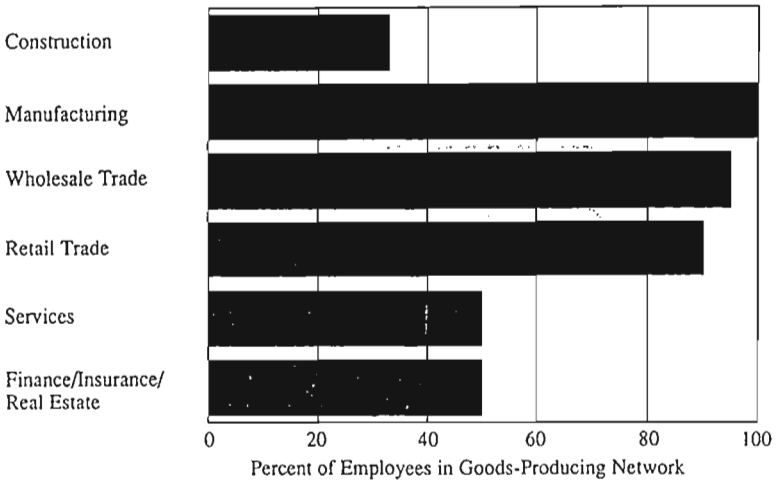
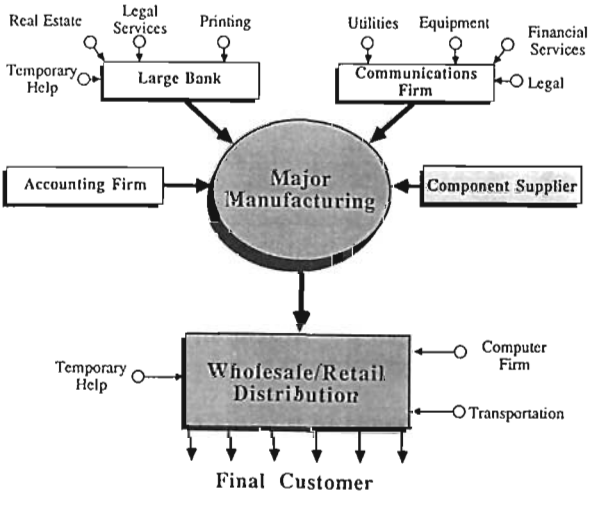


Figure 3: **The Flow of Goods: Manufacturing is the Center Piece**



United States have been in these smaller firms who are providing services to the big ones. But if you want to ask the question "Who makes the decision on what is produced, where it is produced, how it is produced, who gets employed, where they get employed, and standards of quality?" It is made in the large firms. Despite the talk about us moving to a service economy, or to smaller firms, big decisions are still made in the large firms. Despite the talk of us moving to information society it is the goods producers who are still deciding the who, when, how of our economy. Despite the talk of consumer sovereignty it is really the large firm who is interpreting what the consumer wants.

That is a picture of the United States economy as it exists today. I think it is probably very similar to that of other industrial nations' economy despite some marginal differences.

Let's go back to the original question we asked. "What has changed that might make this economy structure look different and that is causing a different attitude toward information use? We know that three out of every four workers in manufacturing work for a large firm. But look what has happened in the last eight years. The ratio has dropped by about ten percentage points (Table 1). This is a change. If we look at those numbers before 1983 they show little change. So that is a very dramatic change.

Table 1: **Predominance of Large Manufacturing Firms**
(Percent of All Manufacturing Workers in Fortune 500 Firms)

	Percent
1970	75.4
1975	78.7
1980	78.4
1985	73.0
1987	68.7

Now what is going on? When you see a change that dramatic you have got to ask why.

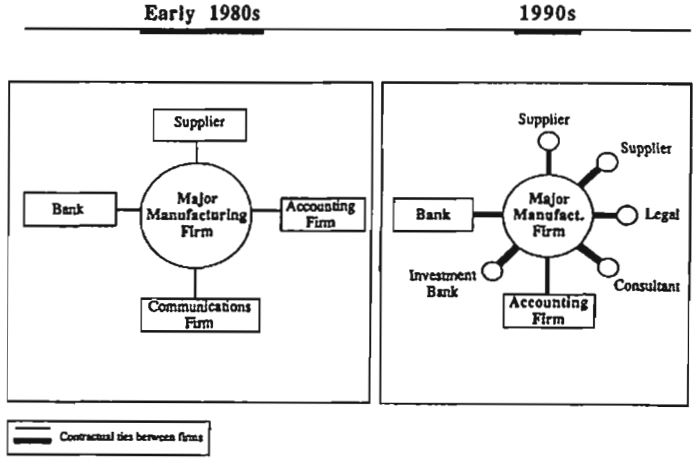
There is something important structurally going on underneath. There are two driving forces at work.

- Long term improvements in productivity mean that you need fewer workers to turn out a particular good. But that has been true all along.
- I think there is another more important reason for the reduction in large firm employment.There was a key cross over point in

> 1986, in terms of the composition of workers in these Fortune 500 large firms. Traditionally for the last eighty years the percentage of white collar workers in these enterprises have been going up. That is you need fewer and fewer blue collar workers on the assembly lines putting things together but you need more support workers. You need more people in the R&D labs, you need more marketers, you need more lawyers, and you need more managers. That is a truism, it has been true for eighty years in every industrial enterprise, especially in a country where value added is going up. By the very definition, when you add value you have got to add more brain power. In 1986, though, the ratio of white collar workers to production workers leveled off and actually started to decline. There is an important change going on, a dramatic change.

It also turns out that there are some important structural changes going on in the relationships between the big firms and smaller firms (Figure 4). On the left is a picture of the traditional relationships between big and small firms showing the major manufacturing firms in the middle. These large firms purchase goods and services from others, usually on a long term contractual basis from traditional suppliers. Sometimes they were vertically integrated, sometimes not but many operated under a long term contract in which one supplier dedicated 100% of their output to sending the manufacturing firm what he wanted. Large banks would have relationships with these firms and so on. We are moving very rapidly to a very different situation. I guess there are four key changes between the left side of the chart and the right side.

Figure 4: **Structural Change in Manufacturing Networks 1980s—1990s**



1 The major manufacturing firms are getting smaller. You do not notice it so much but that is actually 10—15% smaller. The big firms are getting smaller.
2 How are they getting smaller? They are farming out more of their work. Instead of relying on outside firms for only a few things: money, key supplies and accounting. They are now getting all kinds of things from outsiders that they did not get before. They are hiring marketing people to come in and run their marketing campaign. They are hiring service firms to go in and service their customers. They are not just going to banks to borrow money. They are now floating junk bonds and they have an investment banker and security advisors. They are getting consultants to work on their quality programs. An ever increasing number of key suppliers of services now come from the outside.
3 Their suppliers are now much more than in the past a mix of big and small firms. There used to be a couple of long term suppliers, and now there are many, many. And many of them are very small.
4 Now we come to point number 4 which is really the bottom line here. The lines connecting the firms are thin in the traditional structure and thick in the emerging relationship among firms. And what does that indicate? We are moving toward a period where the flow of information from that big center firm to the outpost is much stronger and much more intense than it used to be. Why is that? Because now we are talking about replacing your own workers with an outside worker. And yet you want them to perform at the same quality standards or maybe to even help you to improve your standards of quality. You want those outsiders to understand you and your firm as only your own employees used to do. You want your banker not just to come in and give you a loan but be able to sell your bonds to insurance companies and convince them that your management is in good shape. You want a consultant to come in and really understand your problem. This means time and effort and communications. The passage of information in a two way street. You come and understand us and then bring us back some of the information we need.

So we come to flows of information. I assert that, yes, flows of information between business firms have changed dramatically in recent years. And they are increasing. The key is the role of the manufacturing firm and their new relationships with the whole set of suppliers in these traditional areas, both big and small.

Let me end by going back to Figure 3 (p 47). This shows a flow of goods starting from components of suppliers through the manufacturers to the customer. But this could be transformed into information flow. The key parts about the information flow here, is that the arrows would go in the opposite direction at least in many

cases. One of the biggest changes we saw was the importance of the retail sector to the manufacturing sector; what you can see now is detailed information flowing from the check out counter back to the manufacturing firm. The ability to get that information translated and utilized has transformed the responsiveness of the retail store to consumer needs over the last four—five years. In other examples of more intensified information flows a consulting firm or an accounting firm can do a good job only if it understands and knows what the manufacturing firm needs. So you see the creation here not just of a single line of communication but of a whole row of arrows.

I believe that this dispersion of the modern business organization and its dependence on a whole range of service firms is one of the key characteristics that is behind our information explosion. The new technologies only enable the explosion. But the real key in the United States, the real reasons for this expansion in information use, is the structural revolution that American firms are going through. Sit down in the center point here. Remember information is good only as if it affects decisions. When you make decisions from the center you need information from others.

You now have your finance person coming in and not saying, our finance external group has met and decided this, but that our bank and our external investment advisors have given us these options. Which do we want to use? The telecommunication adviser does not come in and say, here is what our system is. He says, here are the options which we have as a firm given to us by our suppliers. So increasingly the decisions that are made at the center are made on the bases of a much wider network of information.

What does that say? That our original sets of numbers on the growth of business communication reflects a true change in American business practice: the growth that reflects new and different types of flows of information. The new information flow is just not data but reflects a new interaction around decisions that are going on in the United States.

Will it continue into the nineties? Well what we have observed is a long term change in the U S business structure toward dispersed organizations. It has been going on for a decade, it is likely to go on for another five or ten years. The growth in information use associated with it will go on for the same period. The communications usage does reflect, I think, a very important change in how business is conducted in the United States and new patterns of information flow through the U S corporate structure.

Choice of Telecommunications Services

Moshe Ben-Akiva
Massachusetts Institute of Technology

Introduction

The subject of my presentation is the analysis of telecommunications user behavior. The approach that I will describe entails the collection of survey data, the use of the data to develop models of user behavior, and finally the use of the models to predict user response to changes in the offerings of telecommunications services and products.

There are several approaches to analyze or predict user response. Most of the traditional work on demand analysis in the field of telecommunications has been based on aggregate time series and cross-sectional data, and results from demonstration projects or experiments. The use of survey research as a way of predicting user response is often considered to be unreliable. It is particularly a concern when responses to hypothetical questions about prospective behavioral intentions are used as predictors. However, the approach that I will describe in this presentation uses survey data in an indirect fashion. The data are used to estimate the unknown parameters of mathematical choice models which are then applied in a simulation procedure to predict user response. The survey data may contain responses to hypothetical choice scenarios, but whenever possible the data include information about actual behavior.

My presentation will cover the following topics:

1. Overview of Discrete Choice Analysis
2. Applications to Residential Users
   2.1 Local Telephone Service
   2.2 Optional Calling Features
3. Applications to Business Users
   3.1 Telephone System
   3.2 Inward Calling Services

I will begin with a very brief overview of the the main ideas of individual choice modeling, or discrete choice analysis; followed by a presentation of a range of applications of choice analysis to residential and business users. The applications to residential users include a study of the demand for local telephone service and an analysis of the choice of optional calling features such as call waiting. The applications to business users comprise a study of a firm's choice of a telephone system (such as Centrex versus PBX) and a study of an inward calling service. The 800 service in the US is an example of an inward calling service. Using this service a customer or a salesperson places a toll free call to a business establishment which is billed for the call. A business can

advertise the same telephone number in different areas to make it more visible to its customers.

1 Overview of Discrete Choice Analysis

Discrete Choice Analysis has been developed as a practical behavioral research tool over the last twenty years. These developments are covered in a recently published textbook (Ben-Akiva and Lerman, 1985). The approach is based on two central ideas:

i The modeling of demand at the level of the individual decision-maker; and
ii The representation of individual demand as a choice from a set of a finite number of feasible alternatives.

In any kind of user response analysis we are always interested in predictions at the aggregate level. The idea of disaggregate demand analysis (in contrast to traditional aggregate analysis of time series or cross-sectional data) is that model estimation is performed at the level of the individual decision-maker such as a person, a household, or a business establishment. A micro-level demand model is then applied using a simulation procedure to predict aggregate user response measures such as market share and penetration rate.

The second idea involves an individual choice from a set of discrete alternatives. A choice situation is characterized by

- a decision-maker;
- a choice set consisting of the alternative options; and
- a vector of attributes describing the alternatives.

The decision-maker for residential telecommunications demand would be either the household or an individual person. For a business establishment the actual decision-maker for telecommunications choices is less clear. However, a business unit can be treated as a decision-making entity without explicit consideration of internal interactions. The choice set consists of the alternatives which are available to an individual decision-maker. Every alternative in the choice set is represented by a vector of attributes such as quality, price, and other features of telecommunications services. In choice analysis it is also necessary to consider the characteristics of the decision-makers. Different individuals faced with the same choice situation may behave differently given their particular requirements and specific preferences.

A simple example of a choice problem would be a US telephone user selecting among long-distance carriers. A person placing a long-distance telephone call is choosing between competing carriers such as AT&T, MCI, and SPRINT. The attributes of the long-distance calling services offered by these carriers include price, quality of transmission, geographical coverage of carrier's network, number of digits to dial as a

prefix to access carrier's network, and probability of blockage, in addition to the carrier itself.

To analyze the choice among US long-distance telephone carriers it is possible to conduct a survey and collect data on actual behavior by observing how telephone users actually make choices, or have made choices in the past. These observations are then used to estimate the unknown parameters of a carrier choice model which is applied to predict how market shares could be affected by changes in the attributes of the competing long-distance services.

This concludes my brief overview of discrete choice analysis. In the remainder of the presentation I will describe applications of this methodology to telecommunications demand by residential and business users.

2 Applications to Residential Users

Consider the categories of choices available to residential telephone users as shown in Figure 1. The first choice is the access to the telephone network. This category is losing its importance in some areas in North America, and maybe in several other countries, where penetration rates of telephone service are very close to one hundred percent. Given access to the telephone network, the next category of choices determines usage patterns, meaning number and duration of calls placed by time-of-day and distance band. In addition, a US residential telephone user often has a choice among alternative classes of service and a variety of enhanced services. The first application for residential users is concerned with different classes of service for local telephone calling. The second application describes how a residential user may augment the basic telephone service with a variety of enhanced services, or optional calling features.

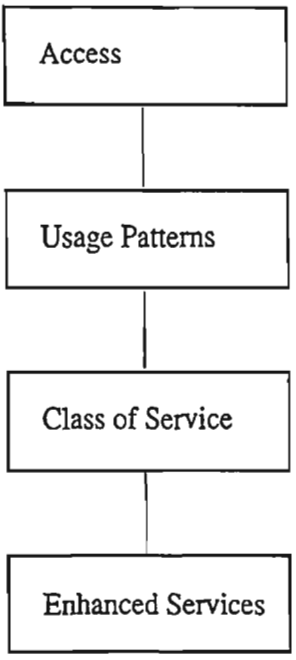
2.1 Local Telephone Service

For basic local telephone service, the choice that most US residential telephone users have to make is between flat-rated and measured service. Flat-rated service has a fixed charge per month for unlimited calling to a local calling area. A subscriber pays, for example, ten dollars per month and is permitted unlimited free calling within the community in which he or she resides. A measured telephone service has a two-part tariff: fixed and per unit of usage. The fixed monthly charge, for example, four dollars per month, is smaller than the cost of flat-rated service. The usage charge, say ten cents per telephone call, may also be dependent on the distance and duration of the call. There are many variations on this subject and these types of service options vary significantly among local telephone companies.

The choice between flat and measured service is very important because it is closely related to usage as shown in Figure 2. The horizontal axis represents usage and the vertical axis total monthly cost of local telephone calling. A flat-rated service has a fixed monthly cost

independent of usage. The cost is the same no matter how much the telephone is used. On the other hand, for the measured service the fixed cost is lower, but the total cost increases with usage. There is a break-even level of usage: for higher usage flat-rated service is optimal and for lower usage a telephone user would be better off selecting measured service.

Figure 1: Hierarchy of Telecommunications Decisions: Residential Users

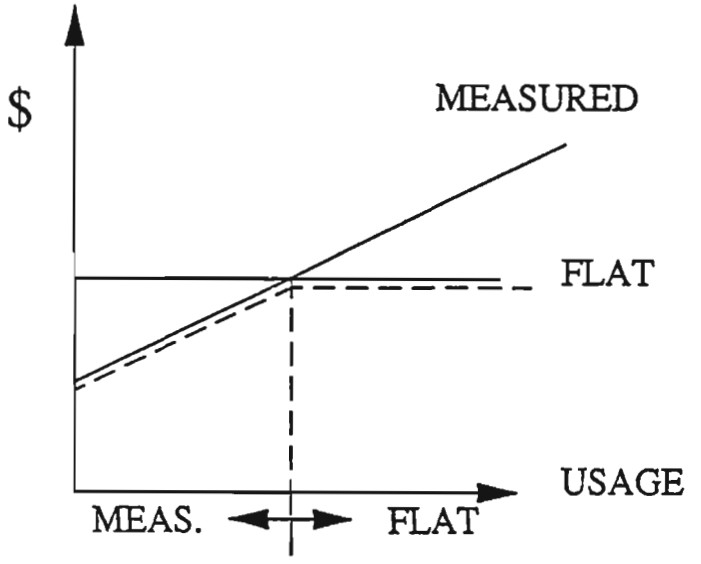


The difficulty in this situation stems from the requirement that the tariff must be selected before the usage is realized. Thus, it is not possible at the end of the month to select the tariff that minimizes the total monthly cost. A user must select it ahead of time and in order to switch from one tariff to another a user must call the telephone company and pay a fee. Observations of usage patterns by residential users over a period of time have revealed that there are many low-usage users for whom a measured service is optimal, who still opt for flat-rated service. One explanation for these sub-optimal choices is that people are buying insurance. By subscribing to the flat-rated service a user is guaranteed not to receive an excessive bill at the end of the

month for telephone usage. Thus, the premium paid for a flat-rated service provides an insurance against excessively large telephone bills.

There is a two-way causality between usage and service choice. The low-usage telephone users opt for measured service. So the selection of service type is affected by usage. But there is also a suppression effect. The marginal price of a telephone call faced by a subscriber to a flat-rated telephone service is zero. A switch to a measured service implies a positive marginal price per call that will cause usage to decrease. Thus, relative to a flat-rated service that permits unlimited free calling, a measured service will suppress demand for telephone usage.

Figure 2: Service Choice and Markets



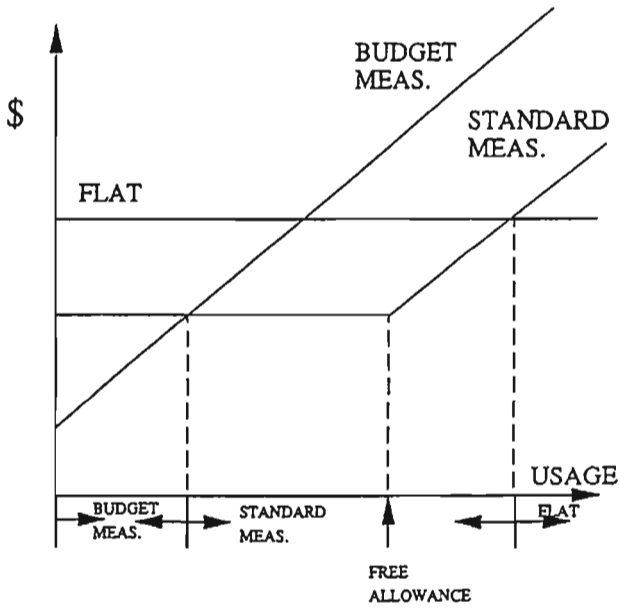
The number of service options available to US telephone users for local telephone service is often greater than two. The following five service options are offered by one Bell Operating Company:

- Measured
  - —Budget
  - —Standard
- Flat
  - —Local
  - —Extended local
  - —Metro

The budget measured service has a very small fixed price but the user pays for every telephone call. The standard measured service has a slightly greater monthly fixed charge for an allowance of free telephone calls. The subscriber has about fifty free telephone calls every month, and pays a usage charge for all the additional calls. There are also a variety of flat-rated services. The basic distinction here is in the area in which unlimited free calling is available. The local flat rate permits free calling only in the local community in which the subscriber resides. Extended local flat rate covers a wider area and the metro flat option provides for unlimited free calling in the entire metropolitan area.

This list of five options implies a more complex interaction between usage and service choice than the relationship depicted in Figure 2. The relationship between a flat-rated service and the two measured services is shown in Figure 3. In addition the usage that affects the choice between different flat-rated services is not total usage but rather the usage to different destinations of calls. So the pattern of usage becomes important.

Figure 3: Measured Service with an Allowance of Free Telephone Calls

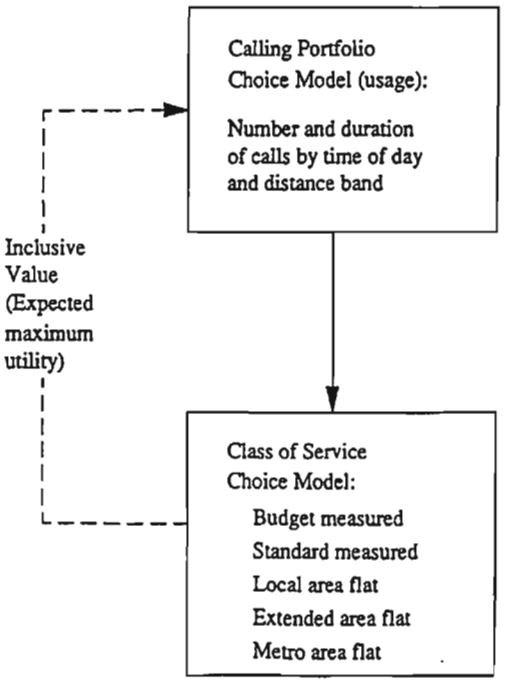


Things become even more complicated when the usage charge is dependent on the time-of-day at which the call is made and the

distance of the call. If usage is represented by total minutes of use, the slopes of the cost functions in Figures 2 and 3 depend on the time and distance of the calls. So the choice of the optimal tariff is not so simple. It depends on the distribution of the usage by distance, duration and the time-of-day. The simple diagrams in these figures really do not apply. They are just conceptual.

In order to analyze how residential users select between these different service options and how the usage is determined, we have developed a model. This model is described in a paper by Train et al (1987) and its application and testing in Atherton et al (1988) and Train et al (1989). The purpose of this model is to predict how residential users will respond to changes in service offerings; or how changes in the different tariffs offered for local telephone calling will affect the choice of service option and usage. The structure of the model is portrayed in Figure 4.

Figure 4: Model of Residential Class of Service Choice and Usage

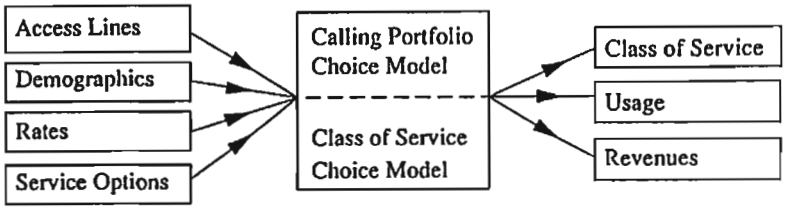


The service options include the five that I have just described—two classes of measured service and three flat-rated services. Usage is fairly complicated. It is represented by the numbers and durations of calls by time-of-day and distance band. The local calling service area is divided into distance bands and the variable charge for a telephone call depends on distance band and time-of-day. The unlimited free calling areas of the flat-rated services are also dependent on the distance band. The solid arrow indicates that the choice of service option is made conditional on the desired usage pattern. The dashed feedback arrow represents the effect of the class of service choice on usage. It is captured in the model by a composite variable that represents the expected utility of the chosen service option for different calling portfolios. Thus, this model explicitly represents the two-way causality between service class and usage.

The model was estimated using a survey of residential telephone users. From the billing records available to the telephone company, information was obtained on the class of service subscribed to along with detailed information on usage patterns. Additionally, a questionnaire survey was conducted to obtain information about the household characteristics of the users.

The overall framework in which this model is applied is shown in Figure 5. For a given local telephone service area, for example, a metropolitan area or the entire service area of a local telephone company, the inputs to the application of the model include the characteristics of the access lines, the demographics of the users, and the tariffs for the alternative service options. The purpose of the application is to predict the shares of subscription to different classes of service, usage patterns and revenues. This concludes the summary of the first application to residential users.

Figure 5: **Framework for the Applications of the Residential Class of Service and Usage Model**



2.2 Optional Calling Features

The second application investigates residential users' choices of optional calling features. A user with basic telephone service can subscribe to enhanced calling services. Some of these services, called custom calling features, have been available for a number of years while others, called CLASS (Custom Local Area Signaling System) features, are now being introduced.

The custom calling features include

- call waiting;
- call forwarding;
- three-way calling; and
- speed dialing.

Call waiting functions as if there were two lines connected to the same telephone. A beep sound indicates that another call is on the line. The first call can be placed on hold while the second call is being answered. Call forwarding allows for the redirection of an incoming call to another telephone number. Three-way calling joins a third telephone to the conversation. Speed dialing allots memory space to a particular telephone customer for storage of either eight or thirty telephone numbers. These numbers are stored in the central office switch and are dialed by just pressing a single digit or a two digit code on the user's telephone. These types of features have been available in many US central offices for a number of years. The most highly subscribed to feature among them has been call waiting. This feature is especially beneficial when an important call is expected but the line is in use. Call waiting is a useful feature for residential and small business users with a single telephone line.

The new features, which are called CLASS services, are derived from a new technology in which the central office switch that receives the incoming call has information concerning the number of the telephone set originating that call. The receiver of a call who has a – display on his telephone set can see the number of the calling party before picking up the telephone. This means that the receiver of a call may be able to identify the caller before answering the call. In the future this technology may lead to an enhanced service in which an information provider with an appropriate data base picks up the number of the caller and displays a name and an address. With this service the receiver is able to tell before picking up the telephone who is calling. This is a significant departure in the nature of telephone service which raises some privacy issues that need to be dealt with. The telephone service that we are used to is a medium in which there is complete privacy for the caller who may keep his or her identity and/or location unknown to the receiving party.

The local telephone companies are using the CLASS technology to develop additional optional calling features. Consider, for example, selective call rejection. The telephone set is used like a computer

terminal connected to the switch in the central office which can be programmed to reject calls from certain telephone numbers. Calls from these telephones may receive a busy signal or hear a message such as "The party which you are calling is unwilling to accept your telephone call."

This service could also be used to help eliminate nuisance calls in which the caller does not identify himself or herself. At the press of a button the telephone number of the unwanted caller would immediately be added to the list of rejected callers, so that in the future this call would be blocked, or would have to be made from another telephone number.

Automatic recall is a useful feature when one is trying to reach a number which is busy. This service will automatically redial a busy number for up to thirty minutes. And when the number is no longer busy, a special ring will sound and then the caller may complete the call. There exist telephone sets or devices that can be connected to the telephone which will keep dialing a busy number automatically. The difference is that the automatic recall feature does not engage the line and it permits the caller to continue to make and receive calls while the central office switch tries to reach the busy number.

Automatic call return is a feature that stores the number of the last call received. Connection to the last caller can be made by dialing a code or by pressing a feature button on the telephone set. This feature can be useful, for example, if one were unable to answer the phone before it stopped ringing.

The distinctive ringing feature results in a different kind of ring for designated telephone numbers. A distinctive ring will be received when a call originates from one of the telephone numbers in a stored list. This feature may be used, for example, to place selected telephone calls on priority for answering.

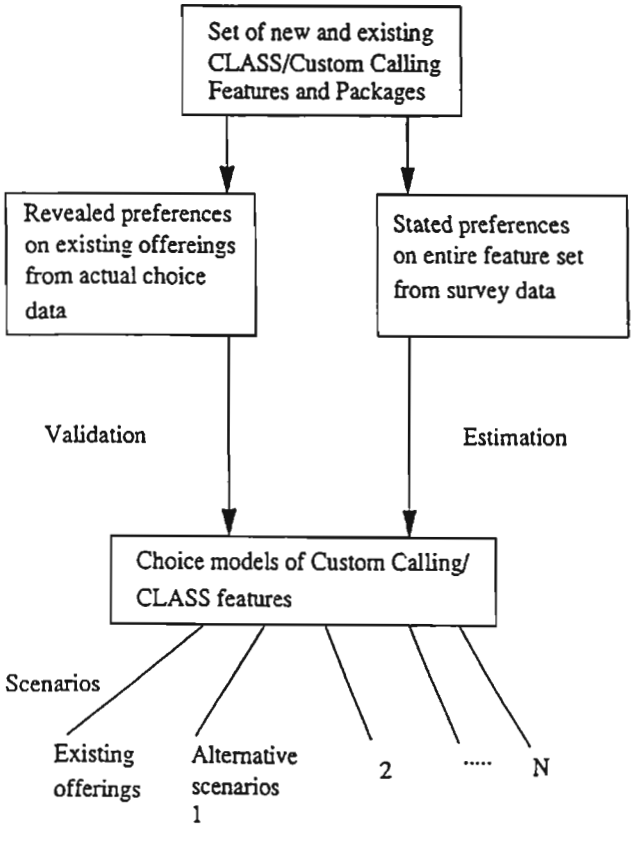
There are a variety of other selective CLASS services that have been developed such as selective call forwarding and selective call waiting. Selective call forwarding is a service which forwards selected incoming calls to another number. Similarly, selective call waiting alerts the receiver to calls from a selective set of telephone numbers.

These optional calling features are new products which are being introduced by various telephone companies. The question then becomes how to analyze the telephone users' responses to these new services. The study objectives are to:

- measure the users' willingness to pay for new and existing offerings;
- predict the demand for features;
- quantify erosion effects of new features on existing ones; and
- identify feature attributes, customer characteristics and marketing actions that affect demand for features.

The problem is that we do not have a lot of information about existing behavior. We have information about the demand for existing telephone features in areas where they were offered, but we do not have information about the new CLASS features. So in this study we collected information on both revealed preferences—information about actual decisions that people have made—and stated preferences, where respondents to a survey are presented with descriptions of new features and price lists. They are asked to assume that they are placing an order for optional calling features and are asked to report how they would react in such a hypothetical situation. The overall study framework is shown in Figure 6.

Figure 6: **CLASS/Custom Calling Features Research Approach**



Clearly, in estimating a choice model for new services one has to rely on stated preferences. We try to collect this information using a fairly realistic survey framework, so that one can estimate the model with some credibility. But of course that is not enough, and it is always useful to compare these results against some actual choices. Since certain optional calling features have been offered already, there is some information about actual choices. This information can be used to validate the choice model before predicting how telephone users will respond to the new features. For detailed descriptions of the data collection and analysis methodologies, and model estimation and analysis results see Valdivieso (1988) and Ben-Akiva and Gershenfeld (1989a). This concludes my presentation on the residential side.

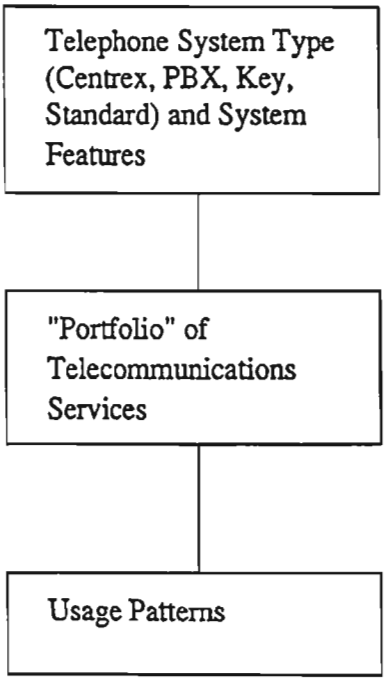
3 Applications to Business Users

I want to move on now to applications on the business side. I will cover two applications. A hierarchy of telecommunications decisions for business users is given in Figure 7.

The first decision in this hierarchy involves choice of a telephone system type. For example, a business user with a number of extensions needs a facility for internal communications in addition to telephone communication with the outside. In Centrex service this facility is provided by the telephone company switch which is located at the central office. In contrast, with an electronic key system or a PBX the equipment is purchased by the user and is installed on the business establishment premises. Thus, from the perspective of the local telephone company, a user's choice between Centrex versus PBX and electronic key systems is on one level a choice between owning and maintaining the telephone system oneself versus utilizing the system which is owned and maintained by the telephone company in the central office. Very small business establishments that have few employees are more likely to have standard telephone sets and similar service to that in a household. A firm with up to fifty extensions typically either has an electronic key telephone system or subscribes to Centrex service. Larger business establishments typically have a choice between PBX and Centrex, since a key system becomes infeasible with a large number of extensions. The choice of telephone system type is of interest to telephone companies and to equipment manufacturers and will be the subject of the first application to business users that I will describe.

Given a telephone system type, the next decision shown in Figure 7 reflects the choices of telecommunications services, such as different vendors for long-distance calls, and a variety of specialized services offered for business telecommunications that include a service for inward calling that I will describe in the second business application. Finally, the remaining decision in this hierarchy is concerned with the usage pattern.

Figure 7: Hierarchy of Telecommunications Decisions: Business Users



I will now describe the two applications that I have mentioned already: the choice of telephone system type, and a choice of an optional service for inward calling.

3.1 Telephone System

The choice of the telephone system is very involved. The relevant cost categories associated with a telephone system are: one-time investments in equipment, one-time installation charges or other charges which are non-depreciable and monthly recurring charges payable to the telephone company. There are usage dependent charges which are contingent upon the telephone system being used because different tariffs usually apply to Centrex and non-Centrex users. Usually there are also internal costs to the firm that include training of personnel in the use of the telephone system, etc.

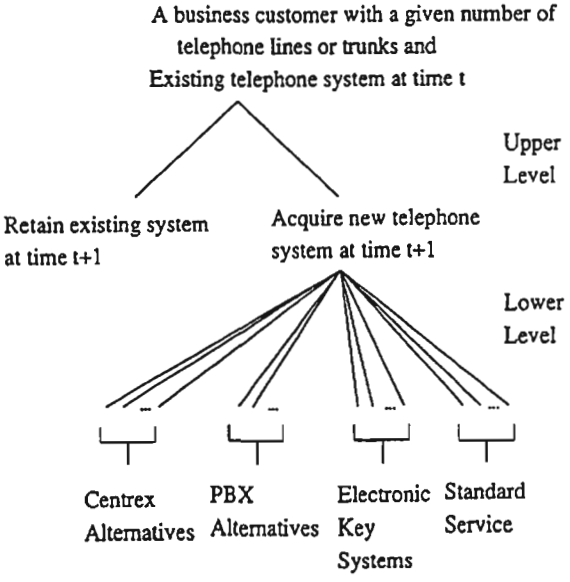
The acquisition of a new telephone system involves substantial one-time transaction costs which may include:

- installation charges;
- internal wiring costs;

- a remaining or salvage value of existing equipment;
- equipment costs for proprietary telephone sets, consoles, etc.;
- penalties for early termination of previous contracts and leases; and
- expenditures for staff training on new equipment.

Thus, firms cannot switch from one type of telephone system to another with the same ease that, for example, residential users can switch between different calling plans. Because of this we do not model a static choice of system type, but rather develop a dynamic transaction model. The structure of the model is depicted in Figure 8.

Figure 8: Telephone System Choice Model Structure



A business establishment is characterized by the number of lines or trunks it already has and its current telephone system type. The choice for an existing business establishment is to retain the existing system or to acquire a new telephone system. There are also new business establishments which do not have an existing telephone system and must acquire a new telephone system—in other words, they will choose to obtain a new telephone system with probability equal to 1.

Once a firm has decided to acquire a new telephone system, it has a choice between the different system types that I described. Of course, these systems come in a variety of forms, with different features, and they are being sold by different vendors. Standard service is sold only by one telephone company, but even standard telephone service, as you have just seen, comes with a variety of optional calling features. Some of them are available to business and individuals, and there are new ones, or other types of optional calling service that are only available to business users.

This research was sponsored by a telephone company which markets Centrex and dial tone services. With the dial tone option the company is providing telephone lines to a business which installs its own PBX or key system. We conducted a survey of a sample of business establishments, with an emphasis on business establishments that had actually undergone a change in their telephone system types during the past 18 months.

The key findings from this research are as follows. In general, Centrex and dial-tone demand are both inelastic overall with respect to recurring charges. However, Centrex demand is extremely elastic with respect to nonrecurring installation charges. So, if a telephone company would like to encourage a business to subscribe to Centrex service it would tend to waive the installation fee and maintain a high monthly recurring fee. As expected, there is a high degree of substitutability between Centrex and competing CPE (Customer Premise Equipment). Business establishments which have a small number of lines are more sensitive to price changes than large line-size categories. That concludes my discussion of choice of telephone system type. For more detail see Ben-Akiva and Gershenfeld (1989b).

3.2 Inward Calling Services

The final application I will discuss relates to an expanded remote call forwarding (XRCF) service for inward calling. The 800-service is oriented to long-distance inward calling while XRCF is oriented more to local telephone calls. The concept of XRCF is illustrated in Figure 9. A business, for example a bank in a major city like Philadelphia, may want to have a single telephone number that it can use to advertise not only in Philadelphia but also in communities around Philadelphia or in the state of Pennsylvania. This number would have the appearance of a local 7-digit telephone number rather than an 800 number. An 800 number suggests to the customer that the business establishment is in a remote location, maybe in another state, or even another time-zone. In contrast, the firm using this XRCF service would have the appearance of a locally situated business. For example, a caller in Allentown dials this number and the call goes to the local central office which has a 991 XRCF exchange that translates this number to the number of the business user who will receive the call.

XRCF also permits free calling. The calls are billed to the receiver, i.e., to the business. Of course, the business does not pay a per call

charge, but rather per hour of telephone use. Also, as usage increases, the additional marginal price for additional units of use decreases.

Figure 9: **Expanded Remote Call Forwarding**

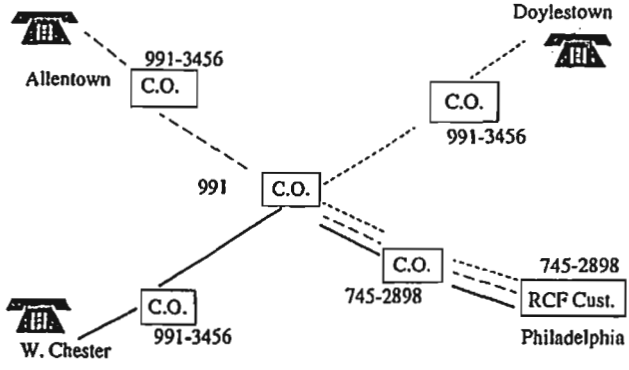


Figure 9 depicts two features of the XRCF service—a single local telephone number for the entire service area of a telephone operating company and free calling for customers to the business. Another feature, which is not shown in the figure, is the custom routing option. For example, a business establishment with many branch offices located at different places around the state, may still want to advertise a single telephone number, but have calls be directed to different branch offices during the day-time, and to a central location in the evening hours. A specific routing pattern is accomplished by allocating telephone company central offices to the local branches of a business customer. The routing pattern can be adjusted according to the time-of-day.

In addition to what I just described the attributes of such a service are a non-recurring fixed installation charge for the XRCF telephone number, a recurring fixed monthly charge for the service, a usage charge per hour (where the rate for additional minutes of use decreases as the usage increases). With the custom routing option the additional charges are: a non-recurring installation charge per central office (because each central office in the area covered by this service is assigned separately to a branch office) and a recurring monthly service charge per branch location.

The purpose of the study was to collect information on business users' preferences for such a service, and then predict the demand under alternative tariffs for this service. The major findings of this study showed an extremely high sensitivity to non-recurring

installation charges with much less sensitivity to recurring monthly service charges and even less to usage charges. The model was applied to predict the demand for the XRCF service and its net financial contribution to the operating company. Since the completion of this study the XRCF service has been introduced. It is too early to tell whether or not it will successfully compete with the 800 service. Time will tell how well the predictions worked. This concludes the review of the fourth application.

Conclusion

The purpose of the presentation was to give you a flavor of the kind of telecommunications choices that can be analyzed using discrete choice modelling. I did not go in detail into the specific methodology itself due to lack of time, but I think that the presented applications show the usefulness of choice modelling in the telecommunications field. I selected the four applications from my own experience in this field which includes projects at Cambridge Systematics and work with graduate students at MIT. There are of course many other applications of choice modelling to telecommunications that I did not mention. These include applications to telecommunications services such as mobile telephone and network management systems and other multi-featured telecommunications products, some of which were described here by the previous speakers.

Thank you very much.

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Discussion

Chair: —Thank you Doctor Ben-Akiva, for giving us this very interesting overview. We see now why there is such a use of choice analysis in your country because there are so many things you can do. Questions from Doctor Warneryd and then Doctor Carey, please.

Audience: —This is a question relating to Figure 6 with the revealed preferences and stated preferences. My first question is do you make a comparison to test the agreement between the stated preferences and the revealed preferences? My second question relates to the bottom part of Figure 6, where you say you developed choice models and then you have a number of lines indicating scenarios. Do you use the scenarios to go back to the same people and to try out the scenarios on the people you made the measurements on in the first place? Is that a way of validating the whole thing?

Moshe Ben-Akiva: —Your second question is easier, so I'll answer it first. The lines for the different scenarios indicate applications of the model. Once you have collected the survey data and developed the model, you first try to validate the model against actual market data and then apply it to different scenarios. The scenarios are generated by the analyst as input into a prediction system. This is a computer program in which the model is applied with a simulation routine that takes as input the scenario and its output is the predicted market response. A scenario in this case is usually represented in terms of service offerings. But a scenario could also be a projection of future population characteristics. Such a scenario will be run when the question that is analyzed is, for example, how the demand for telephone service will change in the future with anticipated demographic changes. Thus, this figure shows that one develops a model and then applies it for predictions under a range of scenarios.

The inconsistencies between stated preferences and actual or revealed preferences present a very difficult problem. Information about actual choices should be used as much as possible. If actual choice information is unavailable one must rely on stated preference data. In collecting stated preference data, there are two important issues. One is how to collect the data itself. And the second is, given that stated preferences are different from actual behavior, how then could one use it for prediction?

To address the first issue, the approach that we have taken is to try to make the context and the format of the survey as realistic as possible. One possibility is to relate the hypothetical choices to something that people know. A good description of a new product that people can understand should be able to relate the new product to existing choices that they have made. Then, people who are not familiar with a new concept may be able to understand the functionality of the product, or what this product can be used for. When presenting respondents with

hypothetical choices one should include, if possible, alternatives that exist already. In other words, we try to mimic in a survey setting as closely as possible the way in which these kinds of services will be actually marketed later on. This sometimes leads to confusion when people call after the survey and request to cancel their orders. But that is the idea, to try to make the survey as realistic as possible.

However, even with extremely realistic questionnaires, the survey responses are still only hypothetical choices. Therefore, to address the second issue the model is applied against existing alternatives for which there are some sort of revealed preference or market data. The model is then calibrated to match actual behavior data so that it produces a realistic forecast under existing or known conditions.

While investigating how people respond to these kind of stated preference questionnaires I have found that people tend to use a different decision protocol to respond to these surveys than they actually use in practice. They tend to apply heuristics that allow them to respond more easily to these kinds of questions. Therefore, one may exclude observations which are obviously quick responses to the request for information and show a lack of mental effort that one would exercise when placed in an actual decision situation. I am currently working with a graduate student on model estimation methods for stated preference data that would isolate the potential biases in this type of data. Nevertheless, we need stated preferences which are a true reflection of actual behavior. It is a very difficult thing to devise, but it may be the best approximation available.

Audience: —It's a matter of following up the same question. In the models you have got, what are the principal variables?

Moshe Ben-Akiva: —The principal variables are the attributes of the alternatives and the characteristics of the decision-maker. The attributes of telecommunications products are primarily the elements of their tariffs and the functionalities provided by different services or hardware options. For the residential applications the decision-maker characteristics include variables such as household income, household composition, age, and occupation. For the business models the decision-maker is represented by the characteristic of the firm such as line of business, number of employees, and number of branch locations.

Consumer Adoption of New Telecommunications Services: Economic and Behavioral Components

John Carey
Greystone Communications

Let me note first that I am going to be concentrating on mass adoption of technologies. Also, I am going to move freely—perhaps too freely—back and forth between telecommunication services such as the telephone and mass media such as broadcast or cable television. While I'll make a number of points about adoption, I don't think they will come together and form a clear model. There is a lot of interest in the U.S. in models that might predict the adoption of new telecommunication services, growth rates, etc. What I'm going to discuss won't be predictive in this sense but I do think it will provide some useful lessons. If anything, my work in the past year or so suggests that there is a lot of serendipity in the growth of services. There are many unanticipated events that are vital to the growth, to the success or to the failure of new services. This is why it's so difficult to predict the future—you cannot predict the unanticipated events.

Having said this, let me quickly show you a baseline of current adoption of communication technologies and services in the U.S.[1]

Table 1: **Penetration of Selected Media in U.S. Households** (January, 1989)

Technology/Service	Penetration Level in U.S. Households
All Television	98%
Color TV	95
Stereo TV	15
Telephone Service	93
VCR	61
Camcorder	7
Projection TV	4
Basic Cable	53
Pay Cable	29
Remote Control For TV or VCR	68
Backyard Satellite Dish	2
Compact Disc Player	13
Answering Machine	24
Home Computer	21

Sources: Electronic Industries Association; National Association of Broadcasters; U.S. Dept. of Commerce.

[1] The data mentioned in this presentation were updated in 1989.

As you see in Table 1, television sets are ubiquitous; cable television has passed 50 percent penetration; VCRs have achieved very significant penetration in a very short time; home computer penetration is pretty strong; and telephone service is in 93 percent of households. By the way, the average consumer telephone line is used for 23 minutes per day.

Multiple units of these technologies are common. For example, the average U.S. household has two TV sets, six or seven radios and multiple telephones, as we see in Table 2.

Table 2: **Telephones in U.S. Households**

Number of Telephones in Household	Percentage of Households
1	28%
2	34
3	21
4	10
5 or more	7

Source: Electronics Industries Association survey, reported in *USA Today*, August 8, 1988, p. D1.

The first point I want to make is that price has been a very important factor in mass adoption of a technology or service. Price has to really come down for mass adoption. The average household does not pay a lot for information services or communication services. The money is distributed broadly—a little bit for this and a little bit for that. Maxwell McCombs has developed a principle which he calls the Principle of Relative Constancy. He argues, based upon an analysis of several decades of spending data, that the amount an average household spends on information and media is a relatively constant proportion of income. It just hasn't changed that much over the decades. Well, if it doesn't change that much and we have been introducing many, many devices in recent years—how do technologies get adopted? One significant factor is that price has to come down sharply. Let me show you a couple of quick historical examples.

Table 3 shows us the cost of a three-minute telephone call from New York to Chicago at the beginning of this century and then at selected points over time. The prices listed are in the current dollars of the day. As you see, the price dropped sharply. Table 3 also traces the pricing for telegraph service.

Now, in the U.S., 1946 was a very significant year. It is the year when telephone service achieved a 50 percent penetration of U.S. households. It took 70 years for telephone service to achieve this penetration level. It is also a significant year for telegraph service. After some up

and down swings in telegraph volume during the 1920s and 1930s, use of telegraph service goes downhill after 1946. In the early part of the century, basic telephone service in New York City cost $20 per month (in the current dollars of the day)—it was very expensive. Today, basic telehone service in New York City costs a bit less than $20 per month. Not surprisingly, early telephone users were businesses predominantly and some wealthy people.

The point I am trying to make is that price had to drop in order for a mass market to adopt the technology. In order to get started however, a new technology has to find some early users who are willing to pay a higher price for the service. In the case of the telephone, businesses and some wealthy individuals were willing to pay the price.

Table 3: **Pricing of Telephone and Telegraph Service**

	New York to Chicago (Current Dollars)	
Year	Telephone Three Minute Call	Telegraph Minimum Charge
1902	$ 5.45	
1908		$ .50
1927	3.25	
1946	1.55	.72
1968	1.30	2.25

Source: *Historical Statistics of the United States*, 1975.

Now let me show you what happened when other important electronic technologies were introduced. Table 4 shows the average price for radio sets, black and white television, color television sets and VCRs when they were first introduced and over the next several years. As you see, the price dropped significantly in each case.

O.K., let's translate these raw prices into practical terms for an average household. Table 5 shows how those prices translate into weekly wages. That is, how many weeks gross wages (for the average income household) did it take to buy those items. They each started out quite high but then dropped.

The asterisk is interesting. It marks the approximate point when the technology entered 50 percent of U.S. households. For radio sets, black and white TVs and color TVs, the technology cost 1.8 or 1.9 weeks of gross wages just when it was entering half of all homes.

However, for VCR the wage barometer has dropped to just a bit more than 1 week's wages. This makes it quite tough for those introducing new products. In today's U.S. context, a major electronic product—even if highly desirable—would probably have to drop to $500 or lower in order to achieve a 50 percent penetration. Mobile

telephones just dropped below $500 in 1989, so it will be interesting to see if this boosts adoption significantly.

Table 4: **Average Price of Selected Electronic Products** (Current Dollars)

Year	Radio Set	B&W TV	Color TV	VCR
1925	$ 83			
1930	78			
1935	55			
1940	38			
1945	40			
1947		$ 279		
1950	26	190		
1955	20	138	$ 500	
1960		132	392	
1965			356	
1970			317	
1975			341	$ 1,400
1980				1,122
1985				494
1987				414

Sources: Electronic Industries Association; Sterling and Haight, 1978; *Historical Statistics of the United States*, 1975.

Table 5: **Price of Selected Electronic Products in Terms of Weekly Household Income** (Number of Weeks Income to Pay for Product)

Year	Radio Set	B&W TV	Color TV	VCR
1929	* 1.8			
1947		5.3		
1950		3.3		
1955		* 1.8	6.6	
1960			4.1	
1965			3.1	
1970			* 1.9	
1975				6.2
1980				3.3
1985				* 1.1

Sources: *Historical Statistics of the United States*, 1975; Statistical Abstract of the United States, 1982, 1985, 1988.

* Product entered half of U.S. households within two years. (Radio achieved 50 percent penetration in 1931, B&W TV in 1955, color TV in 1972 and VCR at the end of 1987.)

I would like to add one more component to the baseline of data on adoption. What does the average household pay each month for communication and information services? Table 6 shows data from

1987 about average monthly expenditures. It takes into account whether the household has the service or not—that is, the cable bill is the average for those who have cable service. For comparison sake, I've included some other important household expenses such as food and electricity. This reinforces the point I made earlier that the average household spends relatively small amounts on information and communication services.

Table 6: **Selected Monthly Expenditures for an Average U.S. Household**
(Based Upon 1987 Data)

Category	Expenditure Per Household
Household Food	$ 326
Gasoline *	79
Electricity	59
Telephone Service *	44
Radios/TVs/Records/Musical Instruments	38
Cable TV Service *	23
Magazines/Newspapers/ Sheet Music	15
Bank Service Charges	14
Books and Maps	9
Videocassette Rentals *	5
Admission to Movie Theatres	4

Source: U.S. Department of Commerce, 1988.

* Average expenditure for those households utilizing the product or service, e.g., households subscribing to a cable TV service or households with a car that uses gasoline. For non-asterisk products and services, the average is based upon total consumer expenditures divided by all U.S. households.

I also want to note a phenomenon that has occurred with many new telecommunication services such as videotex. The marketing people look at these data and say "we're just as valuable as telephone service, so let's price the service at $40" or "we're going to save money for people—they won't need to use their cars as much as before, so let's assume that they will take $10 from gasoline payments and give it to information services." People in a particular industry don't like to look at the meager spending in their own category; they like to look up the ladder of spending. But it does not appear that there is a lot of transfer of spending from one category to another.

What follows from this is that it is very important to accurately gauge the price comparisons that consumers will make when they

assess a new product or service. Many groups who started with business services and then tried to enter the consumer arena used the business pricing as the point of comparison. So, for example, a database service that was charging business customers $100 per hour for their service might then offer it to consumers for $30 per hour and assume that this price was a bargain. However, the price comparison had no meaning for consumers. Instead, consumers compared the new service to a magazine or newspaper subscription and, by that comparison, found the new service to be quite expensive.

Pricing issues are one part of the adoption puzzle. Another part of the puzzle is the issue of change. How do sharp changes occur from the use of one service to another, in the growth of a service or in the patterns of use within a service? Let me talk about three interesting examples. First, there has been a dramatic shift in audience share for AM and FM radio in the U.S. As Table 7 shows, the audience share for FM radio went from approximately 30 percent to 70 percent over a twelve year period. Why did this sharp change occur? And, why did it occur in the 1970s nearly 40 years after FM radio was offered to the public? To answer this, it is necessary to look at several factors.

Table 7: AM—FM Share of Radio Audience

Year	AM	FM
1973	72	28
1976	58	42
1979	48	52
1982	37	63
1985	28	72

Source: Statistical Research, Inc.

In the 1930s and 1940s, FM receivers were quite expensive. Further, FM was hurt by some FCC rulings: one ruling shifted the spectrum for FM and made some receivers obsolete; another ruling allowed radio broadcasters who owned both an AM and FM station in one market to transmit the same content on both stations. However, by the late 1950s things began to change. AM stations saturated the major markets, so a new group that wanted to get into those markets had to apply for an FM station. The price of receivers also declined in the 1950s. Then, in the 1960s, stereo FM came along, many car manufacturers began to offer combined AM-FM receivers in autos, and the FCC ruled that an FM station could not simply transmit duplicate content as a partner AM station (this led to much experimentation in new content formats). So, by the early 1970s, an accumulation of factors gave FM the strength to seriously challenge AM's control of audience share.

My second example of change is cable television. From 1950 to 1972

cable grew from zero penetration of U.S. households to 10 percent penetration. From 1972 to 1989, cable grew from 10 percent penetration to approximately 55 percent penetration. Why did penetration jump so rapidly in the 1970s? Once again, it was not a single factor. In the 1950s and 1960s cable TV represented a way to get better reception for over-the-air signals in communities that had poor reception—and little else. In the 1970s, several new elements acted as a "starter motor" for a large growth engine to "kick-in." For the first time it appeared that cable could be profitable in large cities; satellite transmission made national cable program distribution easier and less costly; and, an interest in interactive cable services encouraged much experimentation with program formats as well as investment in cable as "the technology of the future."

In drawing a lesson for new technologies from the experiences with AM-FM radio and cable television, I would argue that it is useful to ask "what factors need to come together for an engine of growth to kick-in?" The factors will differ from one technology to another (e.g., regulatory issues may be crucial in one case and not so important in another) and the process will not be as clean or predictable as some adoption models have suggested.

Another general point about the adoption process is quite simple: the early uses and the early users for a technology may differ from later uses and later users. The analogy I like is a staircase. In order for a technology to be adopted, we have to climb several steps. The first step may have one collection of users and uses but the collection or mix at the second and third steps may change. In this analogy, there must be a first step if we are to reach the second step. At the same time, we must be prepared to shift strategies as we try to climb each new step. Let me use VCRs (my third example of change) to illustrate this process.

When VCRs were first introduced in the U.S., they were quite expensive. Early users were upscale generally and many were "high technology aficionados." Usage included time shift viewing of television programs and a considerable amount of pornography. Now, the people who were willing to pay a high price for time shift viewing of programs along with those who wanted to see pornography made up the first step of use and users. They made it possible for a second step of adoption to occur—at a lower price and with a different mix of uses.

There are some services which "might" have had a second step of users and uses but we never had a chance to find out because the first step just wasn't there. In the case of VCRs, there were also some important unanticipated events. The emergence of "Mom and Pop" video rental shops was unanticipated and unplanned. Yet, these shops were critical for the second and third steps of VCR adoption to occur. In fact, some of the major video distributors tried initially to stop the small, local rental shops from doing business. They sued to stop them but were defeated in court—a defeat that led ironically to billions of dollars in revenues for those major distributors. But this suggests that

the growth of a technology is often a fragile, changing process. Early use can be different from later use and the elements that are critical to success at various steps along the way can sometimes come from unplanned and unanticipated sources.

O.K., let me add just a few more points about the process of adoption, looking towards the future and the many new telecommunication services that will enter the marketplace. A lot of people in the telecommunication industries view the services they provide as "serious." You know, the telephone is a serious tool for communication, fax machines support business, household telephones keep families in touch with each other, and all that. The image is one of stable usage that grows over time and is a vital part of the community.

Well, as telecommunications and consumer electronics start to merge in a fiber optic environment, some of the new services may not be so serious or so stable. They may be fads and novelties; services which come and go. One example in the U.S. is audiotex information services. Some of these are highly used and have stable patterns of adoption and use, e.g., weather information. Others involve pornographic messages, calling your favorite wrestler or participating in a promotional contest for a rock and roll band. Really, there are a number of wild services and if you look at a directory of these services one year and then the following year, half or more of the services will be gone. What this suggests is that telecommunications, along with providing traditional, stable services is now moving into areas that are highly volatile. We will be in the entertainment business and the toy business. And these require a different way of thinking and planning.

There are also many questions about this new arena that we are entering. One question is: how important is interactivity? That is, how important is it that these new services allow the consumer to interact with information or entertainment content? After all, one of the vital attributes of a fiber-based broadband ISDN is that it can provide interactive services. But, is there a demand for interactivity? It is curious that telephone companies believe that interactivity is very important. I assume that this relates to their own history: they have been providing interactive voice and data services for more than a century. Broadcast and cable television companies are skeptical or ambivalent about interactivity. Not surprisingly, their experience has been in providing one-way services predominantly. I believe that interactivity is important but I'm not sure that I can build a rock solid argument for interactivity based upon the evidence to date. So, I pose it as a question that fascinates me.

A second question that fascinates me concerns the current generation of young people. If you think about broadband fiber-based services to the home, we may have some services by the end of the 1990s. However, mass penetration of such services will likely be in the next century. Well, this means that a vital part of the market will be the current generation of young people. What are their appetites and

attitudes? What demands will emerge as a result of their current exposure to computers, videogames, videocassettes, multi-channel cable systems and remote control devices?

A third question relates to the uncertain regulatory environment in the U.S. We really don't know which groups or which combination of groups will be providing broadband fiber services to the home. It is not difficult to imagine that the Walt Disney Company might provide a different mix of services than AT&T. How will the regulatory battles work themselves out and what will this mean for services to the consumer?

Fourth, how do you plan services for the consumer market? Do you create totally new services or do you adapt existing services? There is an argument associated with Marshall McLuhan that people always fill new media with content from old media. For example, early television was filled with radio shows that were minimally adapted for TV. It is implied that this is a mistake: that if you really understood the characteristics of a new medium, you could create appropriate new content for it and people would like it much more. I am not sure that it is a mistake. My suspicion is that it is a natural process, that both producers of content and consumers approach a new medium with old habits and old expectations. This is the starting point. As you move along, you discover new services.

I'll end with a story. As you may know, AT&T was involved in radio during the 1920s. Indeed, they were a significant force in radio. At that time, everyone was trying to figure out what you do with all this spectrum. AT&T came at the question with their old habits. They believed that a good use for radio was to allow consumers to give public speeches. If you think about it, there was a logic to it. Since people used the telephone—a two-way, point-to-point medium—to talk to other people, why not use radio—a one-way, point-to-multipoint medium—to give speeches to the public? As we all know, it didn't work out. But you have to start somewhere and we may start off with a number of ideas which in hindsight will appear ridiculous. The lesson for me is to be flexible, try new services and be ready to correct errors quickly. Also, we have to be open to discovery and to learning as we go along.

Audience: —I think this is a fascinating approach you have demonstrated. But what about the case of facsimile? As you know, facsimile has been around for a long time, longer than telephones. It took 100 years for fax to take off. How would you add this to your picture of adoption?

John Carey: —I am aware that it is an old technology and I guess I would look first at price as a factor in adoption. Also, in my classification scheme there is a category of false starts. Facsimile appears to be one. Television in a curious way is another example.

Television was introduced in the U.S. in 1939, but TV sets cost $600, an unbelievable price for the average consumer then. Also, World War II intervened in manufacturing and so television got off to a false start. VCRs also got off to a false start. There were two systems introduced in the early 1970s that were quite expensive. They went nowhere but the technology was reintroduced in the mid 1970s and it took hold. Price is very important. So is competition at the time when a technology is introduced. Also, with some technologies there may be a window of opportunity. Some technologies may be introduced at the wrong time. Some will come back but some may not come back at all.

If you look at teletext in the U.S., it was hurt badly when the FCC failed to adopt a single standard. Teletext had a window of opportunity but now that the window has passed, I don't know if it can come back. In the case of facsimile, my guess is that price was very important. But this raises the question of business and consumer adoption. In the staircase analogy I presented earlier, the first step of adoption is often business. They can pay more for a technology which helps to bring the price down for consumer adoption at a second or third step. So, I wonder if facsimile was very expensive even for businesses when it was introduced? However, this doesn't really answer your question. I'm really talking around it.

Audience: —Considering your last answer about business, we have studied videotex in some detail. I think that British Telecom or the British Post Office when they introduced Viewdata made a big error in assuming that the home market would be more important than the business market. In doing that, they went against any historical evidence because it is clear that in most of these communication services, the business applications came first.

Second, we have done some studies about information goods and services for households. You mentioned that spending is constant. That is not what we found. We found that there was a slight increase but we were astonished to find that it was so slow with all this talk about the information economy. We also found a lot of substitution effects within information sectors. Today, you spend less on books and more on TV and so forth. So there is a lot of movement within these specific categories even though overall spending is moving up slowly.

John Carey: —Those are interesting comments. One point struck me as you were speaking. I've read some recent studies that say VCR usage is dropping just as VCR penetration is growing. In particular, people are not recording as many programs. So, you shouldn't expect the usage curve to continue going up. It is a dynamic and changing consumer marketplace. In the same way, there is a lot of change in the use of cable services, people dropping some services and adding others. So, a pattern that may look simple at a macroscopic level of analysis, may be quite complex underneath.

Audience: —You were talking about monetary budgets but there is also the amount of time that a household has to use communication services. Is that also constant, has it been growing or is it expected to grow?

John Carey: —John Robinson at the University of Maryland has been doing periodic, decade by decade studies of how consumers use time. The amount of time available for using information services varies by groups. For young people and older people and those with low incomes, spare time has increased slightly in the past decade or so. However, for a very important group, middle aged professionals with high incomes, spare time has been decreasing. In particular, there is an important target group for new information services—households in which both spouses work. Seventy five percent of all households with an income over $50,000 per year consists of a married couple in which both work. Also, there are usually children in these households. Now, this group which buys the new technologies seems to have less time to use them. Yet, usage in those households is strong. You get the image of a couple that races home from work, pick the kids up from a day care center, stops to rent 3 or 4 videocassettes, takes a quick exercise class, comes home, eats a microwave dinner, does some quick work on the household computer, then speeds through the videocassettes. It is a new harried class.

Audience: —A question of clarification. You said that kids will be a big user group for new services. Do you mean that kids in the future will be the big user group or that the current group of kids will, when they grow up, be the important market?

John Carey: —I meant the current generation of kids who will be adults when broadband ISDN services are widespread in households.

Audience: —But are there signs that this generation of kids when they grow up will be serious information users? That is, will there be more information seeking by the next generation of adults than there has been in the past?

John Carey: —I think that is a good question, but I don't have a good answer. First, I believe that there will be a larger group that can use and will want computer-based technology for entertainment. There will also be a very large group that has gained experience with information technologies as kids in their homes or at school. These will be the serious information seekers you mentioned. There will be a larger group of them, I believe, than fifty years ago, and they will have considerable income. But I don't think serious information seekers will constitute anything like a universal base for the new information services.

Audience: —Do you have any idea why one and one half week's salary is the critical amount of money?

John Carey: —I believe it is part of a pattern of major purchases by a household. That is, at Christmas time or a birthday the household may consider buying a major electronics appliance such as a new TV. In the past, there were fewer products available and this was a major decision. Two weeks salary was an attainable price for an average household for some new product that they wanted very much. However, as more products have become available and people want them, the price that an average household pays has dropped. It is closer to one week's salary. So, instead of saving and buying one major item per year, they may buy two or three items but pay less for each.

Audience: —Let me make an observation that comes from France. In France now we have several more channels than before. The price you pay for this of course is that we are getting more and more advertising. A lot of people don't like this, getting ads in the middle of films. With all the increasing content available, people may be getting tired of watching so much TV. Do you feel there is a similar type of tiredness in the U.S. or not?

John Carey: —So far, no. But let me add some qualifications. It is curious that with many large channel cable systems, 50 to 100 channels, people still watch only 7 or 8 channels on a regular basis. They watch the broadcast networks and a few additional channels. This may suggest that changes in media behavior occur slowly. Just because you offer 100 channels, it doesn't mean that viewing will spread out quickly. It has been changing but slowly so far.

Audience: —But have there not been changes in the U.S. with the advent of remote controls? Haven't people been going around the dial more now that it is easy to change channels?

John Carey: —Yes, absolutely. There have been several studies which have supported your conclusion. Approximately 80 percent of U.S. households have a remote control. It appears that many are changing channels during commercials and many are grazing up and down on the dial. One implication is that it is beneficial to be just above or just below popular channels, a sort of geographic halo effect.

This also brings up an unrelated point I wanted to make earlier. In some studies of the replacement cycle for color television sets, there is evidence that replacement time is a good time to sell new services and features. Remote control has moved into households as the replacement cycle moves forward. In the U.S., the sale of telephones to consumers is relatively recent. The replacement cycle for older telephones or extra telephones may be a good opportunity to introduce some new services.

Research and Design for New Banking Terminals

Eileen Connell
Citibank

I would like to present to you the approach taken to designing new services and using emerging telecommunications by the Development Division at Citibank. I have been asked to describe this group and how it works because it has had a remarkable record of success in its applications and uses of some of the technologies we have been discussing here.

The Development Division at Citibank is well regarded at the bank. It is staffed with people who designed Citibank's extremely successful customer activated terminals (Citibank's term for ATMs). These terminals have been credited with significant increases in the customer base of the consumer banks. Senior management is convinced that in order for Citibank to become the global bank it envisions, it must have exceptional electronic delivery systems that are fast, secure, appealing and easy to use. The Humanware Agency was set up within the Development Division to design user interfaces to meet the last two criteria: easy to use and appealing.

For any project we do, we have various clients whose needs and wishes we must take into account when we begin the design process. The case study I wish to use to illustrate the design process we go through was an initiative to design a sales and service terminal. In this instance, we had two sets of clients: (1) the people who brought the project to us and (2) the eventual users of the terminal, that is, customer service representatives, sitting in bank branches, servicing customers.

Currently, the customer service representatives have a desk full of forms and brochures and stacks of paperwork to be completed on top of their desks. They are drowning in paperwork. And secondly, they are asked to handle distinct product lines outside of traditional banking services. Many do not understand nor do they have time to learn anything in-depth about most of these products. They do know traditional banking products, that is, checking and savings accounts. But they are expected to deal with mortgages, with insurance, with certificates of deposit, with equity source accounts, and personal loans, to name a few. And so their product knowledge of many of these products is minimal. Yet they are held responsible by the customer for a range of different products that are all distinct.

Now the Development Division has very strong design principles, like "mantras" and anybody who comes to work there must learn these "mantras". The Division is headed up by a very interesting fellow, Larry Weiss, who came to us from General Foods. One of his best

known marketing campaigns is for Cocoa Puffs Cereal, which uses Fred Flintstone from the TV show "The Flintstones" as the spokesman for the product. It is one of his principles that you use an old metaphor to sell new products—go to something familiar in the past in order to make the new product acceptable in the present.

For the customer activated terminal the metaphor that was used to inform the tone and style of the screen set was Tilly the Teller. This fellow went back to the notion of a bank in the 1930's. You had a teller who was a middle aged woman, very confident, who knew you, knew how to add and subtract accurately and knew you and your accounts. So Tilly the Teller became the metaphor for the Citibank customer terminal. More importantly, a conversation with Tilly the Teller, while never stated, is always implicit and everything you do on the machines has that same tone and style. It works very well. It was accepted instantly by a large segment of the customer base.

So for the product that I am working on we have chosen conservative colors and muted tones to create a classic color scheme. We have taken very classic symbols and icons and incorporated them into the design. The platform is cutting edge, the design, made possible by advanced computer technology is traditional, classic, balanced.

We are now at the stage of the development process of clearly identifying the metaphor for the system. One of the choices is to adopt the tone and style of a top-notch administrative assistant. In essence the customer service representative is treated like a professional and their personal computer functions as an administrative assistant who supplies their boss with the information they might need for the meeting with the client. The system tells the rep everything they need to know about the client to treat them appropriately.

Another metaphor we are considering is that of a coach—the kind of coach that encourages you from the sideline and reminds you of what you have to do to optimize your advantage.

Before talking about the role research plays in the development process at Citibank, I need to mention some other characteristics about the group that informs the quality of the design. Half the designers are women. As you know, the statistics on female use of computer systems for other than data entry functions are extremely low. I think the high involvement of women in the design process at Citibank has helped bridge this gap. Customers using the Citibank ATM are equally divided between men and women.

The people I work with are not computer programmers. They are designers, writers, producers who use computers and may also know how to program. They aren't bankers. Before coming to Citibank they designed games, interactive discs, kiosks, teletext and videotex system. Virtually everybody is a writer in the sense of understanding the use of written language to communicate clearly. There is a real appreciation of what words do on screen and the need to communicate clearly.

And the other thing that I think contributes to the excellence of the

group's designs is that almost everyone has been involved with projects that have failed on a grand scale. As I mentioned earlier, they were involved in teletext trials, they poured their hearts and souls and life savings into games that never made it. At this point in their careers they do not take themselves terribly seriously nor do they have false hopes that the projects they work on will take the world by storm. Rather, their expectations are seasoned by their experiences.What we do not have in this environment is people who are vested in a particular design approach. Experience has given these people a very flexible approach to design issues.

This becomes important when formulating research questions. We ask very simple questions to the user groups we bring into the lab to test the designs. Do you get it (does it make sense to you)? Was it easy to use? Because the design staff does not have a vested interested in one approach, designs are changed to incorporate the responses to these questions.

The last, key ingredient to being able to produce well designed products at Citibank is the role these products play in the banks business strategy. Technology and technological innovation is not an ancillary activity at Citibank. Rather, it is viewed as a core activity, central to the bank's economic well being and future role as a global bank.

Hence, technology based development activities continue during lean times. The investment is a long term one, the commitment is at the core of the banks planning and budgetary process. This enables longevity of staff, a certain amount of coherence in the initiatives pursued, and, most importantly, regard for technical innovation at the very highest levels of the bank.

Adoption and Use of Fax in Sweden

P G Holmlöv, Christina Lindberg & Karl-Erik Wärneryd
Stockholm School of Economics

Introduction

A Timely Object of Study

The rapid diffusion of telefacsimile at the end of the eighties, together with the great interest Swedish Telecom had shown for research on telecommunications use and users, induced us to conduct a constructive replication of a ten-year old study we helped conduct on the adoption and use of fax in Sweden.[1] Here we will offer some of the findings from this recent piece of research, more of which are reported elsewhere.[2]

Today, having and using a fax machine is natural to most firms, however small or geographically remote. In Sweden, fax machines were advertised as an ideal Christmas gift in December 1989. Many corporations have several faxes and even the tiniest firm has at least one.

A small home-shopping company in San Francisco lets customers order groceries from their homes or offices by phone, videotex, or fax; and use of fax is increasing at a faster rate than the other means. One US firm markets fax stationary in ads transmitted by fax, and promises a Sony Walkman to anybody who can supply the company with 100 fax numbers. Researchers at the Institute for the Future estimate that 5—10 billion pages were transmitted by fax in 1989 in the US, which was 1—2‰ of the total number (4 trillion pages) of all pages processed.[3]

In fact, we were only able to gather and instruct all the speakers at this conference with the aid of our fax—+46-8-33 94 89. Those who had no immediate access to a fax, or whose fax number we weren't able to locate, were asked to participate in the conference one or several weeks after the first speakers had received their invitations, and then it usually proved to be too late.

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1 Jundin, Silja & Lindqvist, A (1978; ed): *Telefonen som brevlåda* [The telephone as mailbox], Economic Research Institute at the Stockholm School of Economics.

2 Lindberg, Christina, Holmlöv, P G & Wärneryd, K-E (1989): *Telefaxen och användarna* [Fax and Fax Users], Economic Research Institute at the Stockholm School of Economics.
Wärneryd, K-E & Holmlöv, P G (1990): Adoption and Use of Fax in Sweden. In *Modelling the Innovation: Communications, Automation and Information Systems.* Preprints of the TC-7 IFIP International Conference, Roma, Italy, March 21—23, 1990, p 377—384.
Holmlöv, P G & Wärneryd, K-E (1990): *The Fax Machine—A Revolution in Communication.* Research Paper 6412, the Economic Research Institute at the Stockholm School of Economics.

3 Khilnani, A and Schmid, G, personal communication (Institute for the Future).

Why Study the Adoption of Faxes?

An innovation such as telefacsimile typically doesn't alter work routines or settings. Fax doesn't require that users learn new skills or change their perceptions. But used at an even larger scale than today, fax may significantly change the ways in which firms and—in the longer run—households communicate.

The arrival of an innovation poses several questions regarding its possibilities and potential. These questions are related to characteristics of the innovation itself, as compared to its existing substitutes, and to factors in the social milieu where it is to be adopted or rejected. Which milieu factors favor adoption, and which characteristics of the innovation are crucial? How is interplay between social factors and innovation characteristics?

As a start it is quite natural to analyze what a new innovation may replace, but in the long run it is more fruitful to try to identify new possibilities created by an innovation and the kinds of new services and concepts it may help to create. From a scientific point of view a study of the diffusion of an innovation in time and space serves to construct theories for describing and explaining adoption of other innovation as well as predicting their diffusion.

The adoption of fax has been extremely rapid during the last two or three years. Perhaps some time in the future this as a hindsight will be interpreted as a major revolution Does the adoption of fax involve heavy resistance and violent reactions? This does not seem to be the case. Fax often is perceived as convivial and natural, well suited for humans' ways of working.

Two Studies of Adoption and Use of Fax in Sweden

Ten years ago, in the late seventies, prospective users of fax were facing a totally different situation. Indeed, to borrow a phrase from Bay Area futurist and computer columnist Paul Saffo, *it took fax more than a hundred years to become an overnight success.* (The basic principles of telefacsimile were developed by a Scotch electrician, Bain, already in the 1840's.) The number of faxes in Sweden in 1978 could be counted in hundreds rather than tens of thousands Only very few people, other than those employed at the 500—600 establishements where fax machines were installed, knew of or used the technology.

Fax machines were painfully slow in the late 1970's (it took three minutes to transmit a single page), noisy, and sometimes stinking, as we found out when the two senior authors and several other researchers carried out the 1978 empirical study on one hundred Swedish fax users' adoption, usage, and perception of telefax.[4]

In the fall of 1988, replicating the original study, we took a random sample of 385 fax numbers from a directory of fax numbers published jointly by Swedish Telecom and the trade association LKD (Swedish Office and Data Processing Equipment Trade Association). The

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[4] As reported in Jundin, Silja & Lindqvist, A (ed).

directory listed some 27,000 fax numbers—supposedly the bulk of faxes in use in Sweden. We telephoned and reached 371 of these 385 sites (the remaining 14 had discontinued their subscriptions) to obtain the name of a person who would be able to answer most accurately a number of questions regarding the adoption and use of fax at the site. We sent out—by fax!—a six-page questionnaire to these respondents and received, after two reminders, 283 completed questionnaires—an acceptable response rate of 76%.

Adoption of Fax

From specific to general purposes

The 1978 study indicated, as one of its more fascinating findings, that there were essentially *one dominating motive for acquiring a fax.* The majority had acquired a fax for a very specific purpose, communicating almost exclusively, and with a high frequency, with one single partner. They were very satisfied with the innovation. These early adopters of telefax to a large extent used their machines for communication only between a small and fixed number of sites—there was hardly any notion of a need to instantly transmit text and images to new business contacts, and there was no *general* critical mass that could have nourished such a notion.—A smaller group of firms acquired a fax for general communication purposes, to communicate with other fax users. Since those were very few, adoption was hardly considered to be a success.

In 1988, faxes are purchased and used for a large—and increasing—number of applications, and to reach a general critical mass; *"everybody else"* is believed to have a fax, and this has induced a number of firms and departments to acquire their own. Adopters in 1988 increasingly refer to the emerging critical mass of other fax users; and they feel they have replaced fax at least partly for a larger number of communication means—mail, phone, telex, etc—which indicates that late adopters use fax for a larger number of purposes than early adopters.

The number of faxes per company has increased tremendously—from an average of 2 in 1978 to an average of 27 in 1988. While faxes in 1978 to a large extent were leased—an indication that this was seen as an expensive or risky investment—most faxes in 1988 are purchased. Fax is no longer pereceived to be expensive.

Mostly the initiative to acquire a fax stems from within the firm, rather than from exposure to sellers, etc. Prospective users have a say in the buying process, but the formal purchase decision is surprisingly often made by higher management. This means that initiators and decision-makers haven't changed much since the 1978 study.

Determinants of Adoption

Adoption time is expected to show some correlation with company characteristics. Organizational *innovativeness* seems to go hand in hand with early adoption of fax: firms who have adopted ten or more

other IT devices also tend to have adopted fax relatively early. Degree of organizational *decentralization* is however unrelated to whem fax first was acquired, and a high degree of organizational *complexity* does not indicate early adoption.

By far, the most common advantage of telefacsimile for the 1978 sample is transmission *speed;* 87% offer speed as an answer to an open-ended question. On the other hand, transmission speed is the fourth most commonly felt disadvantage of telefacsimile; and transmission speed is also identified as the most important attribute for increasing fax use.

In 1988, by far the most commonly—by 74%—identified advantage of telefacsimile in 1988 is its *service* aspects; fax is *speedy, safe, and smooth.* Researchers at the Institute for the Future[5] say users prefer fax not for its immediacy or speed, but rather for its free format, *"fuzzy factor"* appearance: it is perfectly possible to scribble a few notes on a piece of paper, perhaps on a previous fax message, and to then transmit this by fax to a large number of addressees. Two in five of 1988 respondents claim they send as much penned as typed material; and one in five claim most of what they send by fax is handwriting.

In the 1978 sample, only one variable was found to correlate (.24) with length of use of telefacsimile—whether fax was seen as a means for distributing technical reports.

In 1988, five variables were found to contribute significantly to the variance in adoption time. These five variables are:

1 The number of pages sent per day—the more pages, the earlier the adoption;
2 The percentage of external communication by fax (to receivers outside the firm)—the larger the share of external fax transmission, the earlier the adoption;
3 The number of means of communication that were replaced at least partly by fax—the more means replaced, the earlier the adoption;
4 Whether contacts are primarily with one or few receivers rather than in an "open system"—the more routine contacts with few partners, the earlier the adoption;
5 The number of employees in the organization—the larger the firm, the earlier the adoption.

The explanatory value of the five significant variables is not overly high (R^2 is 0.196), but there are some interesting implications. Early acquisition is more likely when there are specific needs for communicating with a certain party, when the organization is large, and the communication is external. The number of pages sent per day may be an indication of need prior to the acquisition; but it may also be attributed to rapidly increased use of fax.

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5 Khilnani, A and Schmid, G.

Use of Fax in Sweden

Increased Use—But How Much? And for How Much Longer?

Respondents in 1988 were asked to estimate the number of pages sent per day from their site. While this figure is imprecise and may be incorrect, a similar measurement was made in 1978 and offers a baseline for comparisons.

About half the 1988 respondents, 48%, claim they *send more than ten pages* per day; in 1978, only one in four reported such a use. The reported mean number of pages sent per day has doubled and almost tripled from 1978 to 1988—from 7.5 to 18 pages sent per day.

An average transmission of less than 20 pages per day intuitively seems quite small. Researchers at the Institute for the Future[6] claim that US firms queried by them on the average send 40 pages per day and fax.

Swedish Telecom has collected the phone bills for the faxes in our sample and find that these on the average incurred annual calling charges of SEK 4 800 (approximately USD 750). Put differently, an average fax was used for 20 700 tariff units per year, where one tariff unit represents a (short) local call or a fraction of a long-distance call. With the information at hand about the distribution of normal phone calls from companies, we estimate that these calling charges correspond to an average transmission of 50 or 60 pages per day.

Swedish Telecom has found that the average transmission volume (measured in tariff units) per fax machine has decreased with a fifth from 1987 to 1988. On the other hand, our 1988 respondents seem confident that their use of fax will increase. And there is a clear difference here between the 1988 and 1978 samples: 80% of 1988 respondents and only 28% of 1978 respondents believe their use of fax will increase.

We believe that a decrease in the use of the average fax does in fact correspond with the respondents' confidence that their own fax use will only increase. Late adopters are likely to send and receive fewer faxes than today's users. 3% of the 1988 respondents report they have one or several fax machines that are used only to send messages, not for reception; and it is probable that a number of newly acquired faxes will be used for sending-only or reception-only to facilitate urgent transmissions. Also, when the price of a device such as fax drops—both hardware costs and transmission charges, as transmission time has been cut drastically since 1978—each new fax will be used by fewer people (increasingly by a single person) and new adopters will feel they can *afford* to use their machines less.

So, for the nineties, we—as well as our 1988 respondents—foresee an *increase* in overall use of faxes but a *decrease* in the traffic to and from each fax.

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6 Khilnani, A and Schmid, G.

Other Facets of Fax Usage

The number of applications fax is used for seems to be steadily increasing. In 1978, the large majority of users perceived they were still using fax for the same applications it was acquired to serve; whereas in 1988, half the sample claim the applications fax are used for are increasing. Also, fax is decreasingly being used for routine purposes: a majority now report general-purpose use.

Larger corporations and those who used fax for more than five years more frequently than others use fax for routine transmissions, while more recent adopters tend to utilize fax at emergencies.

More than half of the organizations queried use fax to reach, and to be reached by, anyone—they have open networks of communication. This is a marked increase since 1978. However, only a limited number of new contacts are first made through fax. Fax is used most for external communication, i e for contacts outside of the own company group. A combination of external and internal communication is becoming much more common than it was in 1978.

Heavy users of fax have more positive attitudes towards the medium as well as to other electronic gadgetry in the office.

Only half of the organizations queried have any idea of how communication costs are affected by the use of fax. No more than one in ten are budgetting costs for the use of fax.

What effects are caused by fax? A large majoority perceive that work has been made more efficiently. However, only few work routines have been changed due to the increased use of fax.

The majority of our respondents claim they have used company faxes for private purposes only sometimes, one in five never. We cannot judge the reliability of these responses. A respondent who does her marketing on fax told us that about her private uses of her home fax, which she feels is super. She uses it all the time, not only for working purposes but also to for example check on her son when he is alone at home whether or not he has done his homework.

In the questionnaire, respondents were asked whether fax had given rise to ideas of new successful products or services. One third responded in the affirmative, but alas we have no data on what kinds of service or product offerings are in their minds. It will conceivably take some time to develop these products and services.

Respondents' general opinion is that fax is great, fax is super, not only because you can do so many fascinating things with fax but also because it is so easy to learn. Even so, everybody who use fax goes through a numbver of steps of learning. Most people buy fax with some specific motives at hand, but after a while they discover that they can use fax for much more than first thought of. For example, a user first knows he can mail his letters via fax. In the beginning he types the letters very formally, but after some time he finds he can send them in handwritten form.

Another example: we chatted with a financial research group in a bank who first acquired a fax to receive information on the Swedish

stock exchange. After a while they perceived they could use the fax to distribute their own information to their customers. After some more time they developed new information products with the help of fax transmission.

Future for Fax

We asked respondents whether they believe that fax will be replaced by another technique within a couple of years; and it seems as if most people have great faith in fax. Also, fax is perceived as being cheaper than mail, it is characterized by faster transmission, and obviously fax is pretty natural.

We asked fax users whether they would consider purchasing a fax for residential, private use if and when the price falls more? Not very many would consider acquiring a fax for the home. This may be an effect of the non-existence of a critical mass of home fax users; if no other household has a fax, there is noone else with whom you can communicate.

Four in five of those queried believe that their use of fax will only increase. We are inclined to share this belief and would like to point out a number of factors likely to favor thew adoption and use of telefax.

When the number of users rises, the pressure to be reachable thrugh fax is increased on those who have not yet adopted. New ways in which the fax is put to use further increases the number of late adopters who feel they simply have to acquire fax, for example to be able to handle fax orders as well as phone orders. Early adopters find that due to increased transmission volumes they need to have multiple fax units.

Fax machines will come to be equipped with programming of extended functions, for example group transmission at predefined points in time. This makes fax conceivably more cost effective.

The design of our study made it impossible to mirror other ways of materializing what may be called *"fax as a function"*. A growing number of PCs are being equipped with cards and software for sending and receiving fax messages more or less seamlessly—"in the background"—and users of electronic mail systems and computer conferencing networks may now use these for automatically faxing text files to a number of recipients. We believe these developments merit scientific study. We have cause to believe att *fax as a function will continue to grow.*, perhaps at a faster rate than the stock of existing and newer generations of dedicated fax machines.

Respondents feel they are using fax to replace and complement a number of existing communications means, and report that the applications for which they use fax are steadily increasing. We have been able to gather very little data on *novel and unforeseen uses* of fax. In fact, we interpret our findings so that fax is primarily adopted as a *replacement* for something that can be done in other ways—primarily for mail, telephony, or telex. The really novel uses may appear at a later

stage; and they may mean a revolution in the light of hindsight. It will be a challenge for research to identify and analyze these new kinds of uses for the fax, uses that in retrospect will help us pass the judgment on whether or not widespread adoption of telefacsimile is to be seen as epitomizing a much heralded entry into the information age.

Variations of Business Use of Telecom Services in Norway

Svein Bergum
Gjövik Telecom Area

I am living in a small town in Norway called Lillehammer. It will be famous in 1994 when we will host the Winter Olympics, instead of Östersund in Sweden.

As P G Holmlöv said I have been working at the Norwegian School of Economics & Business Administration. I joined the Research Institute of Norwegian Telecom for five years, working with new services from an user point of view. After two years at the Interactive Telecom Program at New York University, I am now running field trials and managing the marketing department of Gjovik Telecom Area.

Most telecom user research has been future oriented forecasts on services in the years 1995—2000. The study I will present here makes research on real usage today of existing telecom services. This is useful in my opinion.

The title of my speech is called: "Variations in business use of telecom services in Norway". The findings are based on Norwegian research data and served as my thesis at the Interactive Telecom Program in New York. In fact I think I was the first Scandinavian to attend this program. Even before any Swede.

Comparing the size of Norway and Sweden, Norway is much smaller—with only 4 million inhabitants. Norway therefore mostly imitates the Swedes. You should relate/compare the results of my findings to the size of Norway. Because of this small size, my talk will be shorter than those of the previous speakers.

The purpose of my report was to find out variations in usage of business telecommunication services in Norway across:

- industry categories
- occupation groups
- business size
- and geographical locations of firms and workers.

A main question was to explore the relative importance of these variables to variations in telecom usage. We therefore deal with how to establish criteria or bases for selecting market segments, i.e. market segmentation analysis.

An inductive approach was applied. Theoretically we were just modifying an existing market segmentation model or approach. The empirical bases were two Norwegian studies, conducted in 1986—87, by Norwegian Telecom Research Dept., Central Bureau of Statistics and Norwegian Institute of Urban & Regional Planning/Research.

A nested approach to market segmentation was used, from Bonoma & Shapiro (1984)[1]. The marketer moves from outer nest variables like demographics, through operating variables, purchasing approaches and situational factors.

Earlier research in e.g. the US and Norway illustrates that:

- the usage pattern of telecom services is rather stable from one telecom service to another
- large firms have the highest spendings on telecom services
- industry and occupation categories could both be used as segmentation bases. Occupation groups have the most dispersed usage pattern

These aspects were further explored in our empirical studies.

But before that we should give some demographic information about the Norwegian business market. This market is characterized by:

- 90% of the 171 000 firms consist of less than 10 employees
- most of the companies are within manufacturing and retailing/ hotels
- one third of the companies are located in the four largest cities: Oslo, Trondheim (Tröndelag county), Bergen (Hordaland county), and Stavanger (Rogaland county)

The ambitions of the first Norwegian study was to analyse the knowledge and usage of information technology at work among Norwegian occupants. Data from a representative sample of 8 500 individual respondents was collected as part of the quartely held labour market survey.

Some of the main results from this study are:

- half of the respondents use telephone every day around 10% of the respondents have been using mobile telephones, telex/facsimile, paging devices, and added telephone equipment. 5% have been using audioconferencing, and only 3% data communication services
- the highest user frequencies in an industry were generally found in transportation and bank/finance. The lowest frequency is in the primary sector. User frequencies are multiplied by the mumber of employees within the industries, to find market shares. The largest market shares are in manufacturing, retailing etc, education, health and social services.

Administration & management has the highest user-frequencies among *occupation categories*. Technical & scientific work has the

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[1] Bonoma, T V & Shapiro, B I (1984): Segmenting the industrial market. Lexington Books, Toronto.

highest market shares. These two groups together with clerical work have almost half the market shares.

Occupation groups show variations in user frequencies across industries (e.g. a manager in public administration versus a manager in banking). This indicates that professions are transformed to industry standards. Industry should therefore be preferred to occupation as segmentation criterion.

Regional studies showed a concentration of telecom usage towards urban environments. This is due to bias in industry and occupational structure.

Another finding from this study is the relatively stable usage pattern across services; high users of telephony also are high users of data communications, etc.

Another Norwegian study looked at telecom usage measured by the number of company subscriptions in Norway. 7 000 companies responded to a questionnaire. This study involved 16 telecom services, but only four have been analysed in detail: facsimile, telex, mobile telephones, and leased lines for data communication.

Some of the main findings are:

- there is a significant correlation between company size and subscription rates for all services. Variations in usage within business size groups are generally smaller than within industry categories. This indicates that business size should be preferred to industry as segmentation criterion. This is especially true for small firms (less than 20 employees), and large firms (more than 500 employees).
- the highest user frequencies are found in industries: mining/oil, manufacturing, and bank/insurance. Multiplying user frequencies and number of firms within an industry gives market shares. Analyses of market shares of services gave the following results:
  - the low telecom consuming industries with 0.1% to 1.5% of the market, consist of primary industries, mining/oil industries, electricity, and public services
  - the medium telecom consuming industries with 4% to 13% of the market, concist of constructions, transportation, and banking/insurance.
  - the large telecom consumers are firstly manufacturing industries, and secondly: retailing. These have together around 60% of the subscriptions. Manufacturing is the definitive market leader, because of the large number of companies and the size-distribution of the companies biased towards large ones.

We were also testing the homogenity of *telex* usage within manufacturing, retailing and bank/insurance. The results indicated the following:

> all groups are rather heterogenous, where user frequencies of the lowest ones are only halves of the highest ones.

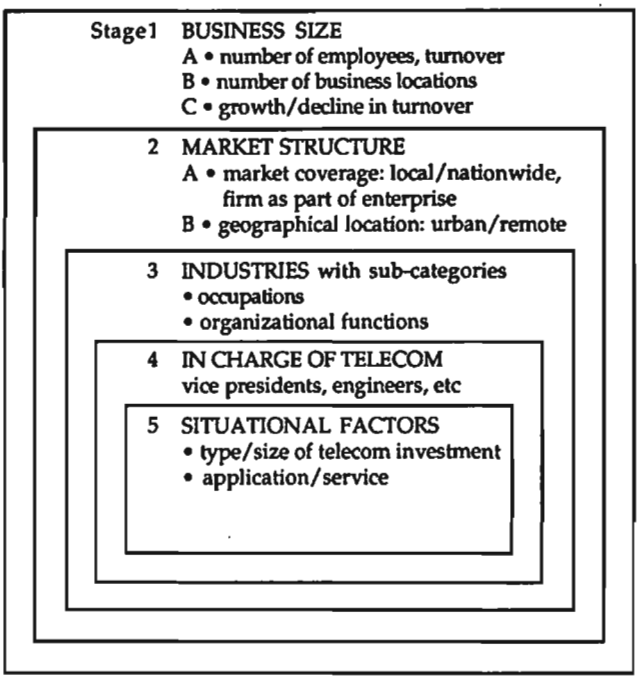
There are thus considerable intra-industry variations. At the end of the *report* we were shortly turning our attention from market segmentation *analyses* to market segmentation *strategies*, based mostly on secondary data. The changing role of communication resources in organizations is noticed. Organizations are moving from the cable room mentality, through telecom as a corporate utility and business resource, to telecom as a marketing tool. This affects the telecom organizations and decision making of telecom investments within firms, as well as marketing strategies of service providers. During the last few years the number of people working with telecom in business organizations in Norway has been increasing rapidly. But the number is lagging far behind countries with more deregulated telecom markets. Results from Norway show that telecom decisions are taken at relatively high levels in organizations, even for small investments like e.g. facsimile.

At last we are trying to modify the "nested approach" into business telecom market segmentation. The following general statements are made, based on empirical primary data and secondary sources.

- Size of firms is the most explanatory segmentation variable.
- Market structure (incl. export/import) affects telecom consumption considerably, but was not analysed in our empirical studies.
- Controlling for size, industries give a *rather* satisfactory homogenity in telecom usage.
- Telecom usage in a job/occupation might be a segmentation base, but the analysis showed that occupation is affected by the industry in which it operates and the geographical location of firms and workers.
- Spatial variables like number of locations, are highly correlated to size. Other spatial variables like occupants living place affect telecom usage. Urban places consume most.
- But this only/mostly, reflects industry variations. Organizational *functions* (sales. productions etc.) have different needs, but are more basically reflected through industry categories.
- We have limited knowledge of purchasing approaches and situational factors. Some relevant aspects are:
  - purchasing approaches: e.g. who is in charge of telecom investments
  - situational factors: e.g. type and size of purchase. Investments in *new* services are decided at higher organizational levels than more routine decisions.

This has given us a proposal for a nested approach to segmentation of business telecom markets, shown in the figure.

This reflects an approach of discriminating the more basic variables like business size, through market structure, industries/occupations, to purchasing strategies and situational factors.



The analysis has made a clear distinction between user frequencies and market shares. If we are using user frequencies as the criterion for segmentation, banking/finance and transportation should be given high priority.

Market shares take into account the relative size of the industries. According to this criterion we should concentrate on manufacturing industries and retailing/hotels.

There are *no* universal segmentation criteria, and the target segments depend on the decisions to be made.

This analysis only deals with the analysis of *existing* pattern of usage. Potentials, economic effects and time series are therefore ignored, being among the questions that need to be further explored.

A last question is of course: what more could we do with these data?

1 use the results as a basis for dimensioning or budgeting your marketing activities
2 find the "best users" in each segment and convince the rest of the segment about the service in question
3 use this analysis as means for trailoring telecom services and marketing program to specific segments, e.g. videotex for the transportation industry
4 basis for political efforts to stimulate telecom applications and usage in rural areas.

Thank you.

Chair: —Thank you Svein, thank you for coming from such a short country. Let nobody think it should be shorter because it is quite an interesting country.

I think that in view of it's getting darker we should have a few minutes of break, to stretch our legs, smoke, and make phone calls. Yes, we certainly encourage that, make several phone calls!

Information Technology and Product Delivery: One Swedish Example of EDI

Odd Fredriksson
Stockholm School of Economics

As the chairperson said, I am going to tell you, briefly, about one Swedish example of an industry-wide EDI system. The EDI system in question is an interorganizational computerized buying-and-selling system in the Swedish hardware industry and it's run by a third party company called BASCET Infolink. Here I will share some preliminary results from a survey I have conducted on the users of two inter-organizational buying-and-selling systems, called BASCET and Infolink, respectively, run by the Swedish BASCET Infolink company.

New IT is Transforming Distribution

The Research Project

The research project I am conducting I call "Distribution Systems in Transformation". That I have chosen the term transformation is very much due to the rapid development in the telecommunications area in the last few years and especially to the increased possibilities for external computer-to-computer communication, what is often called EDI. I will comment a little on two concepts: EDI and the concept of information brokers.

What is EDI?

EDI, which stands for Electronic Data Interchange, is one type of computer-to-computer communication between different companies. For the communication to be EDI, it should entail an exchange of standardized electronic messages, which means that electronic mail does not fall within the concept of EDI.

The reason for standardization is that the computers should be able to "speak" to each other in the same way people need to speak the same language in order to understand each other.

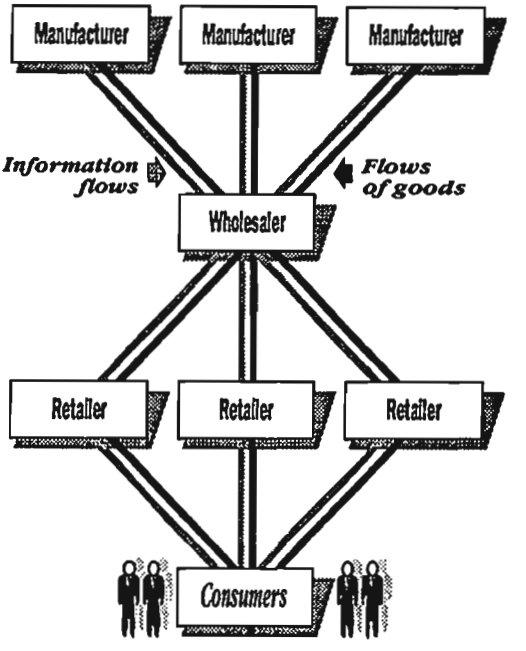
Why EDI?

EDI communication means that you can exchange documents much faster than in paper form. With EDI you also reduce the number of errors due to multiple keying-in of data. Moreover it can be strategically important to create electronic connections, or ties, between companies. One famous example of this is American Hospital Supply Systems, which I suppose you have heard about.

The Information Broker

Figure 1 outlines the way we traditionally draw a distribution system with manufacturers, wholesalers, retailers and the customers.

Figure 1: Traditional Distribution System



In every distribution system you have information flows, including payment flows, and you have flows of goods. But with the new communication technology and EDI it is possible to separate the information and physical flows from each other (as in Figure 2). An information broker can handle all the information flows within a distribution system, and a forwarding company can handle the physical flows.

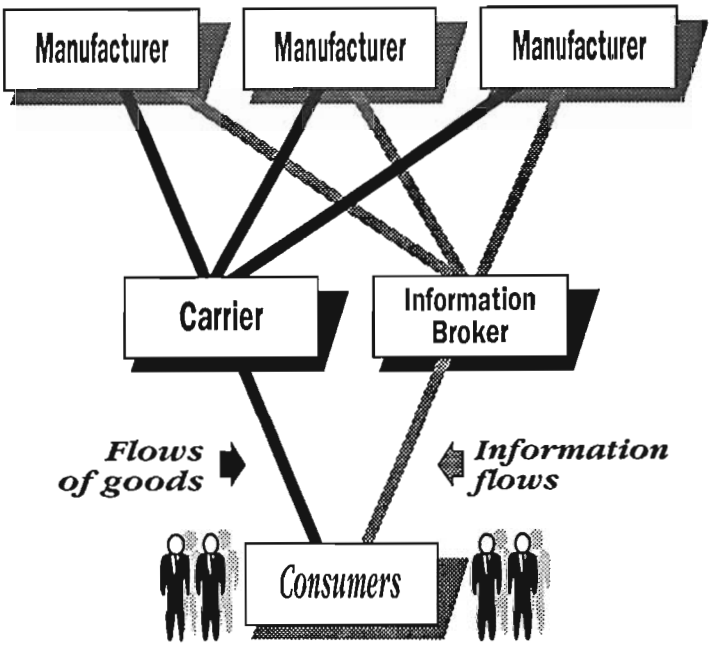
A distribution system like this means fewer middlemen than in the traditional distribution system, which ought to mean lower levels of inventories in the distribution system as a whole. This in turn means lower capital costs and lower administrative costs.

This scenario of a possible future distribution system does not mean that today's wholesalers or retailers should vanish, only that their roles will be modified and altered. Of course, the wholesaler could take care of the functions of an information broker and a forwarding agent.

The BASCET Infolink Systems in the Swedish Hardware Industry

The BASCET Infolink company in Sweden is one example of an information broker—a "third party"—managing EDI communication.

Figure 2: The Distribution System of the Future...?



The Swedish Hardware Industry

The Swedish hardware industry is characterized by the existence of a few, large and very export-oriented manufacturers. These are large corporations like SKF and Atlas Copco. The wholesalers are also few and large, so it's a high degree of concentration in the industry.

The number of dealers is about 550 companies with a total turnover of USD 1.3 billion, where 75% of the turnover is sold to industrial buyers and the rest to consumers. The dealers have to store and market a wide range of products—25,000 items is not uncommon for a dealer.

The dealers are very heterogenous. The customer orientation can differ a lot as well as they can be rather different in size. The major problems faced by dealers are high capital costs due to high inventories and high costs for personnel.

The degree of computerization among Swedish hardware dealers is pictured in Table 1.

The BASCET system

I mentioned there are two systems run by BASCET Infolink. These BASCET Infolink systems mediates only information, although information about the physical transports of the goods are not included. The seller and the purchaser have to agree separately on prices, schedules, and other conditions regarding the deliveries.

Table 1: Degree of Computerization Among Swedish Hardware Dealers

Function	Computers areUsed by ... (Percentage in Sample):
Invoicing	65%
Requesting Payments	60%
Accounting	48%
Payment Functions	42%
Ordering	42%
Pricing	15%
Other	25%

I now turn to the BASCET system, the *online* system of the two.

When an user connects to BASCET, the first image that appears on his CRT screen is a main menu where sellers are shown by numbers—1 = Atlas Copco, 2 = Bahco Verktyg, 3 = Sandvik Coromant, and so on. All these companies are either hardware manufacturers or wholesalers.

If the user then pushes a button for a specific number shown on the screen, say number nine, a picture with the different functions available from Järnia appears. Number nine denotes Järnia, the largest hardware wholesaler in Sweden. You can choose between all the services currently available in the BASCET system—ordering of goods, inventory-level queries, queries about order status, and so on.

The design of the Järnia opening screen and all other screen images are standardized for all sellers in the BASCET system. Standardized screen texts and uniform procedures for all sellers connected to the BASCET system gives the user the feeling that he has access to a very wide range of providers and products.

Services not yet included today—but likely to be implemented—are: electronic payments, acknowledgements of orders, computer-stored price lists and catalogues.

User Adoption of the BASCET system

In Table 2 you can see the number of online-connected users to respective seller in the BASCET Infolink online BASCET system in August 1988.

The number of BASCET-connected customers per seller is rather different. The reasons for this are that: some sellers have a selective distribution policy, users are charged a fixed sum for each seller they want to be connected to, and the value of having instant access to a seller varies with the range of goods he is offering.

As you can see, Järnia and Luna, the two dominating wholesalers in the industry, have by far the most users connected to them.

BASCET users are mainly dealers, but in some cases they are large corporations, i.e. end-users.

To sum up about the BASCET system: the main advantage is that the BASCET customers can get quick access to information from about 15 suppliers and wholesalers in the hardware industry.

Table 2: User Adoption of the BASCET system

Seller	Number of Users
Bahco	31
Atlas Copco	29
SKF Tools	24
Sandvik Coromant	15
ESAB	28
Tibnor	3
Slip Naxos	10
Göteborgs Bult	29
Järnia	125
Luna	199

The Survey

One of the purposes with this research project is to collect data on user experiences with the BASCET Infolink systems. I made a questionnaire which was sent to 150 randomly drawn dealers in Sweden, out of a total number of 550 establishments. I have received 95 replies and will present some data taken from the questionnaires from the 71 first respondents.

User Segments

Users can be divided in four subgroups with regard to the nature of their use of interorganizational ordering systems.

The *first* group are the ones using only one or both BASCET Infolink systems; the *second* are the ones using either (or both) of the BASCET Infolink systems *and* some other system; the *third* group are the ones only using *other* systems; and the *fourth* group are the ones currently using no interorganizational ordering system at all. The number of respondents—users—in each group is 38, 10, 11, and 12, respectively.

As you can see, the users of the BASCET Infolink systems have an average annual turnover of about USD 5 million—on the average, they are the largest dealers in the sample.

Perceived Annual Average Net Effects due to the Interorganizational Ordering Systems

When you make investments, it is always important to ask yourself what the economic net effects of the investment will be. As shown in Figure 4, BASCET Infolink user respondents perceive that, on the average, they have earned close to USD 15,000 per annum on account of their investments in interorganizational ordering systems. These net effects are about 0.3—0.5% of the users' turnover, as the 71 companies have a total turnover of about USD 700 million and the total value of their alleged savings is about USD 30,000.

Figure 3: Annual Average Turnover for 71 Dealers
(Grouped by their Usage of Interorganizational Ordering Systems)

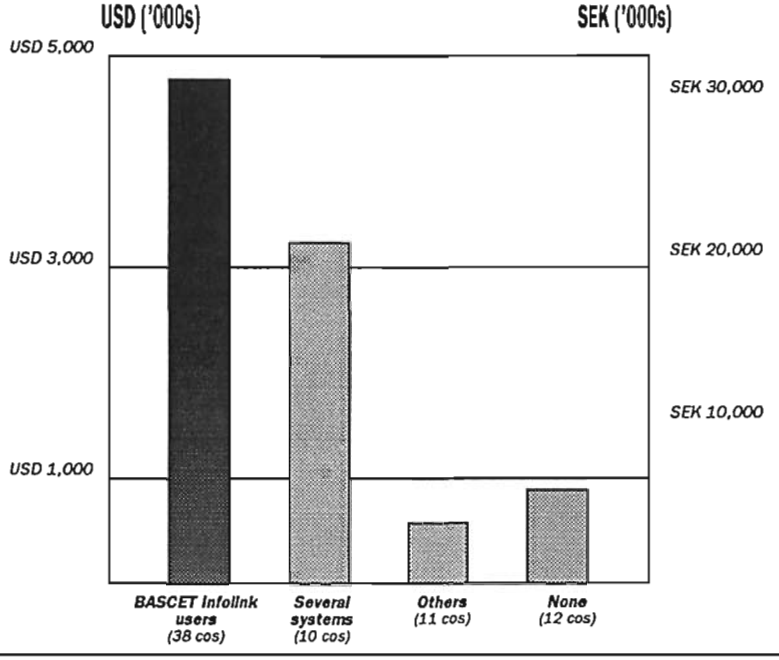
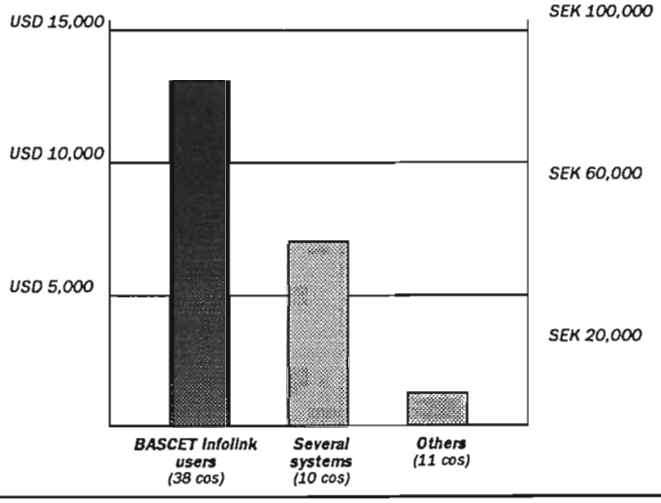


Figure 4: Annual Average Net Effects Due to Use of
Interorganizational Ordering Systems



It's important to remember here that the length of use of BASCET Infolink systems and similar services is a factor with explanatory power.

When the respondents verbally express the improvements they see due to the use of BASCET Infolink systems, they claim that these services: make it simpler and faster to order; decrease inventory levels; lead to fewer incorrect orders; and result in better working routines. Users also feel they are gaining spare capacity.

These perceptions do correspond to the driving forces for EDI in general.

To sum up about the perceived effects: not only do the users save money by using the systems, but they also feel they are able to improve the quality of the service offered to their own customers.

Perceived Importance of Interorganizational Ordering Systems

It is vital, I think, to relate the relative importance of having efficient interorganizational ordering systems to other factors that may effect the dealers' competitive position. Therefore I asked them to rank the three most important factors when it comes to gaining competitive advantage. Among BASCET Infolink customers, 18% do rank effective ordering systems among the three most important competitive factors. Corresponding shares are, 45% among the ones that use many systems, 18% among users of other systems, and not surprisingly merely 8% among non-users.

Perceived Key Factors for Success in the Hardware Industry

Probably you now ask yourselves: What factors are perceived by the dealers as most important for success in this industry? Results are shown in Table 3.

I computed the responses like this: the most important factor scored as three points, the second choice as two points, and the third factor as one point.

Table 3: Perceived Key Factors for Success in the Hardware Industry

Factor	Share of Points
High Service-Level Towards Customers	29%
Skilled Personnel	28%
Good Product Knowledge	11%
Price	9%
Good Personal Contacts with Suppliers/Customers	8%
Wide Range of Products	5%
Fast Delivery to Customers	4%
Effective Ordering Systems	4%
Other	2%

As you can see, retailers feel that a high service level towards customers and skilled personnel are the two most important factors for success.

Having shared with you some of the early results on the use of present-day ordering systems in the hardware industry, I will now turn to the history of interorganizational data communication in the hardware industry, as this gives insights into current structure and performance.

A Brief History of Interorganizational Data Communication in the Hardware Industry

In the field of interorganizational data communication in the hardware industry the wholesaler Luna has played a pioneering and leading role. So the history of interorganizational data communication in the hardware industry is very much the history of Luna's efforts in this field.

Luna Started In 1977...

When Luna started in 1977 with installing CRT terminals (Sperry) at customer locations, Luna chose to show and expose their internal information systems, even though some of the information was blocked.

The diffusion of Luna terminals was successful. Within two years there were about 80 terminals at customer sites. At this time the Swedish Telecom Datex network didn't exist: Luna's customers were using fixed lines for data communication.

In the beginning of the 1980s other suppliers and wholesalers—such as Järnia, Göteborgs Bult and Atlas Copco—could also be reached from Luna's customer terminals and through Luna's ordering system. But since Luna was perceived as a litigant party there was no real traffic to the connected competing suppliers.

Luna's Second Boom

The Swedish Telecom Datex network was installed in the mid-1980s, which resulted in a second boom for the diffusion of Luna terminals at customer locations.

In 1986 Luna and one of its mother companies, Järnia, decided to make common cause with each other in the field of information systems and transaction-oriented communication systems. Luna and Järnia started a separate company called Infolink for these purposes. Infolink's ambition was to replace the externalized internal systems with user-friendly systems.

Infolink now constitutes half of the present BASCET Infolink company, where Infolink still is a file transfer service.

Motives for the Foundation of the BASCET Company

In the mid-1980s the wholesaling companies Luna and Järnia were heavily dominating the area of electronic communication in the hardware industry. The major suppliers in the industry felt that they

were going to be "caught in a communication trap". Since they were careful about their integrity they didn't want to "sit in the lap of their competitors".

Some of the motives for the BASCET companies to found an own common "third party" communication company—"the manufacturers' half of today's BASCET Infolink"— were to:

- "break up Luna's and Järnia's communication monopoly"
- acquire a competitive advantage by a hermetically sealed communication system, which meant that suppliers that didn't compete with existing suppliers were approved to join on the supplier side and
- attain images of being progressive companies

Four ex-Luna employees formed the company Informationsgrossisten which took the operating responsibility for running the electronic communication of the BASCET companies. Informationsgrossisten, with BASCET as a majority owner, was founded in 1986.

Informationsgrossisten started with online transaction systems, taking care of communication mainly between IBM machines and also Ericsson machines.

During 1986—1987 when there were two competing systems—run by Infolink and Informationsgrossisten—the prospective users were playing a waiting game: they didn't want to be connected to two systems.

When potential alternative third-party companies emerged on the market, the owners of the two competing communication systems companies decided to merge and create an industrywide electronic communication system. In late 1987 the two information broker companies merged: Informationsgrossisten with their online communication and Infolink with their online and batch communication formed the BASCET Infolink company.

The Creation of an Industrywide Data Communication System

From the perspective of Luna, the merger of Infolink and Informationsgrossisten meant a third upswing. A changed price philosophy, as well as a number of other meausers, raised the number of customers connected online, from 180 to a present number of 280 (out of a potential of about 500 customers). At present all of Luna's largest 200 customers have online terminals.

At the moment (1988), some of the retailers are installing PC networks which will enable them to have personnel communicating online with ordering systems such as BASCET from more than one work location.

Communication with small "handheld computers" has been in place for a long time in the hardware industry, but now (1988) the first users soon will be able to use their computerized inventory-control systems for file-transfer ordering. The files sent from the users with

their orders are stored in "mailboxes" in BASCET Infolink computers, where suppliers can tap their mailboxes. One impeding factor for this service is that very few suppliers are ready to receive electronic orders of this kind.

If the users perceive that they benefit from computer-to-computer communication then the following question follows very naturally: why is the diffusion process then going so, relatively, slowly in the hardware industry? Let's turn to the sellers' different points of view.

Interorganizational Data Communication — The Sellers' Point of View

The host of suppliers who own the BASCET Infolink company quite naturally have different motives for engaging in electronic communication. A range of factors are influencing their levels of committment: their types of products, their distribution policies, and so forth. For example, the buying process is very different for industry necessity goods and for production tools. The requirements for production tools are higher, and fast delivery is crucial.

Through interviews with representatives for BASCET Infolink companies I have collected views on the actual forces that have been impeding the scope and speed of the diffusion of BASCET Infolink's interorganizational data communication systems. Before I continue with a discussion of these, I would like to emphasize that all factors of course are not valid for each single supplier.

Some Impeding Forces on the Supplier Side

Even though many of the BASCET companies are multibillion MNCs, it's their Swedish daughter companies that have been responsible for the BASCET Infolink and, before that, Informationsgrossisten committments. The BASCET companies *resources* have therefore been *limited*. Some of the suppliers have had group information system projects that have had higher priorities.

A couple of the BASCET companies have invested so much as more than 1 million SEK (USD 200,000) in order to adapt their internal information systems to the BASCET online service.

BASCET Infolink has plans for reducing the impeding adaption factor. The suppliers will be given the possibilty to connect to the file transfer service (Infolink) without doing any internal administrative adjustments. This will be achieved by equipping suppliers with a PC and suitable EDI software.

This is, by the way, a parallell to what Åhléns plan to do. Åhléns, one of Sweden's largest department store chains, is going to combine their centralized ordering activities with providing 3,000 of their suppliers with a PC and an EDI software package. This will facilitate the placing of Åhlens' orders to suppliers throughout the world.

Another impeding factor is that *the standards on the information systems are very varying*—on the supplier side as well as on the user

side. That's one of the explanations for the lengthy debate between the BASCET companies about the choice of systems and technology.

Some suppliers claim that the main impeding factors for the adoption of the communication systems are the *inertia of the humans* and the inertia of the organizations. The individuals in the companies easily agree "this is right, this is the future", but when it comes to the practical day-to-day life the de facto actions by the involved are not in accordance with their statements. The BASCET suppliers, who have done considerable investments in the BASCET Infolink company, have even themselves experienced big problems in the process of adjusting to the electronic communication systems. It takes time to reach understanding and acceptance.

Information systems personnel and implementation is another problem area impeding the success of computer-to-computer communication. Some top managers among the owners of BASCET Infolink argue that information systems personnel are using their technical power—speaking a language that noone else understands—aiming at not losing their influence in the company. One of the top managers, possibly slightly provocative, says: "It's a long way to go, to get information systems personnel to adjust to the world of the company, to adjust to other companies, and to get them to subordinate under a total system—and the larger the company, the larger this problem is".

So, therefore one very relevant question to ask is: How do you get information systems personnel to work in the direction that management has pointed out? One solution could be to decrease the information systems knowledge within the company and substitute it with increased reliance on outside experts. Top management of one BASCET supplier drastically fired the whole Information Systems Department consisting of 15 persons, replacing it with one single employee and at the same time decentralizing the information responsibility.

One of the explanations for why suppliers haven't succeeded is that they in many cases they *haven't asked prospective users what they need*. The BASCET supplier companies have experienced that it's a big problem to motivate their customers to use their electronic communication systems. According to some of the suppliers reluctance to use electronic services has very little to do with efficiency. Instead the main reasons are the customers' wish to sustain personal relations and to maintain traditions.

Some of the suppliers are doubtful whether batch communication will be successful or not because they believe it takes away too much of personal interaction—not only for the purchaser, but also for the salesman and the incoming orders clerk. They all have an interest in sustaining their personal relations.

Furthermore there has been a lot of time-consuming *technical problems* during the work of solving communication between different computer brands.

Some Effects on the Seller Side

Some of the suppliers argue that additional sales due to the use of the online system have been marginal. Instead the positive image effects and the valuable experiences gained have been more important for them.

From the point of view of a seller such as Luna there hasn't been so much internal efficiency benefits the past few years because already in 1986 a very large proportion of their customers had handheld computers or were using online communication. In recent years the proportion of users connected to Luna has increased, but on the other hand they use telefax to a higher extent.

The diffusion of electronic communication with Luna's computers has reached the level that Luna had expected. As representatives of Luna perceive it, there are economic and practical limitations for further expansion. Today, approximately one third of Luna's orders are received through online communication, one third by file transfer orders, and the remaining third by mail, telephone or telefax.

One of the early advocates of the BASCET Infolink systems thinks that all suppliers have failed with the marketing and implementation of their communication systems. The same source adds that Luna has been the company most successful in this respect mainly because they could benefit from the novelty value they created.

The distribution process has changed due to the BASCET Infolink systems, since for example the Luna and Sandvik assortments of products now are available for ordering at the same "selling spot".

Some Concluding Remarks

Let me sum up.

The *retailers* in the hardware industry consider that they gain economically from using interorganizational data communication (EDI). Moreover they state that they can offer higher quality services to their own customers, which in turn is a competitive tool for them. Interorganizational data communication is therefore likely to have effects on the retailer structure.

The *suppliers* in the hardware industry don't consider that they gain economically from engaging in interorganizational data communication (EDI), but on the other hand they don't dare to stay out of it. It's considered as one of their competitive tools, but from the supplier's perspective it's still viewed more as a service and productivity enhancing tool than as a merchandising tool. The productivity gains will increase when more distributors have EDI.

In the future there will be a race between *third-party* electronic communication *providers*. In this race the standardization issues are crucial. Showing credibility and resources are other important factors. The trend of decreasing prices (in real figures) on hardware and software is an important driving force for increased diffusion of EDI services.

From *BASCET Infolink's* point of view, larger volumes of data through BASCET Infolink computers are necessary for survival in the long run. The communication systems used by BASCET Infolink in principle can be applied to any industry, but in practice there is a tendency that the EDI documents are defined in different ways in different industries.

Some industries closely related to the hardware industry are the automobile supplier industry, with their ODETTE communication, and the building materials and building contractor industry. It's strategically important for BASCET Infolink to succeed in taking care of future data communication in these industries. An important question for the company therefore is: What other industries are likely to use their communication systems? For a successful diffusion in other industries I believe it's essential to have owners who have no interests in the goods sold through the communication systems.

The new communication infrastructure will change distribution flows in the hardware *distribution system*. In a not remote future there will probably be a number of end-users connected directly to any of the two BASCET Infolink services, especially when it comes to purchasing standardized products, which means that end-users to a higher degree will buy directly from the suppliers. This give rise to the question: Will this be a threat to today's distributors? My belief is that it will have only minor effects for distributors, since the information systems are only one factor among others in complex distribution relations. A number of retailers will probably be connected to BASCET Infolink services in their capacity as sellers and local distributors to end-user companies.

In the long run electronic computer-to-computer communication will be as simple to use as the telephone. But until then, there are a lot of lessons to be learned...

The Store of the Future

P G Holmlöv
Stockholm School of Economics

Preamble

I come from the field of economic psychology, which includes looking at mass communication and economic behavior at micro-levels—in particular, looking at consumer behavior. Working at the Foundation for Distribution Research, we are concerned with how goods and services are brought to the consumers, and how these react to information and to diverse product offerings. And really, the theme of one of our projects is, How will new information and communications technology impact the distribution of goods and services. This project is quite fuzzy, it is large and long-term, and it was not very sharply defined from the outset. It has resulted in one report[1] and—which is even better—in being the basis for a more detailed study which is being conducted by Odd Fredriksson, and on which he has commented here a few minutes (pages) ago.

I will deal with the consumer side of Distribution of Goods and Services in the Information Age. This is not pure research—not mostly and not only. It is not an original empirical work, it is more a compilation of what is going on, glimpses that we get from conferences such as this, reports from magazines and journals, and from talking to people in the field—both practitioners and academics.[2]

When you are talking about how information technology would impact the distribution of goods and services, I think that foremost you come to think of from-home shopping—shopping from your home, ordering things through a computer or a computer terminal in the home. However, we have identified equally important, certainly more successful, applications where new information technology serves to support customers and sales staff in the store and helps to deliver information, service, and advice so customers can find goods fitting their taste as well as their wallet.

You see, information technology could play a number of complementing roles in the distribution of goods and services. It could be used for automating procedures in warehouses, streamlining and keeping track of transportation, and also automating goods movements within

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1 Odd Fredriksson, P G Holmlöv & Claes-Robert Julander (1987): *Distribution av varor och tjänster i informationssamhället* [Distribution of Goods and Services in the Information Age]. Foundation for Distribution Research, Stockholm School of Economics.

2 This presentation owes much to several chapters I have authored in: Odd Fredriksson & P G Holmlöv (ed, 1990): *Framgångsrik användning av informationsteknologi i distributionen av varor och tjänster.* [Successful Use of Information Technology in the Distribution of Goods and Services] TELDOK Report 57.

stores. There is some talk in Japan about store automation, comprising automatic carriers, ham-slicing robots, electronic shelf displays, and things like that.

Also, information technology could be used to offer information to customers and to enhance service—not only to consumers in their homes, but also in-store and in public areas such as shopping malls.

Furthermore, new technology can be utilized to give middlemen and makers of goods more information about their customers. I noted that Greg Schmid, in passing, touched on this when he mentioned information being brought to either the retailers or the producers from computerized cash registers. These cash registers could also be used to help sales staff give customers product offerings, rebates, coupons, etc. The computer could trigger a salesperson to ask the customer why don't you buy a more expensive this or that, wouldn't you consider buying an extra one, or purchasing additional goods. It could also trigger the salesperson to offer the customer, or the machine itself could print out, a coupon that the customer could use to claim a rebate when paying for the goods.

Consumer Problems

I think it is fruitful to base this overview—of the kinds of technological applications retailers and producers can roll out to induce consumers to purchase their offerings—on the notion of the various steps consumers go through when preparing and completing their purchases as a series of potentially very real *problems*. These are problems that have do with scarcity—scarcity of time, of information, of ideas, often also of money.

Today's consumer on the average has to shop for groceriers two or three times a week, spending perhaps half an hour in the store each time to purchase—often without having made a shopping list in advance!—nine or ten items together costing about SEK 100, to prepare 15 or 20 meals *every* week.[3] At the same time, consumers are now pressed for time perhaps more than ever—for one thing, the number of households where both adults are employed outside the home have increased, as has the number of single-adult households.

Furthermore, in the store unhappy consumers are facing what Janet Workman, an entrepreur in the food business, calls a "visual clutter" where 10,000 stockkeeping units need to be exposed and promoted along narrow aisles—although, as Claes-Robert Julander and others have pointed out, they are *not* stocked and exposed to give the consumers any real help and advice as to how to prepare 15 or 20 palatable and nourishing meals a week.

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3 Estimates were taken from a paper by our colleague, Professor Claes-Robert Julander (1989): *What's in the Basket? Receipt Analysis for Marketing Decisions: An Exploratory Study*. Preliminary version. Foundation for Distribution Research, Stockholm School of Economics (mimeo); and from a book I have co-edited, Odd Fredriksson & P G Holmlöv, *ibid*.

We have heard a tenured professor, now a company president, lament that, due to central policy, in his local grocery store he was unable to purchase, and even to order, pieces of china that were produced in a factory perfectly visible from that store and owned by the same grocery chain. Now, information technology could offer in-store terminals where this poor consumer, and others, easily could spot in which store, or where in the store, a certain item is; and to order and pay for items that will be shipped from a central warehouse.

Or new technology could help by offering recipes and other information in-store, at customers' requests, so customers can find and purchase the essential ingredients for the meals they are planning to prepare. Or IT could help by letting customers electronically order items from their homes or offices.

And IT can do more!—I will now turn to applications that at least promise to salvage some of these consumer problems.

Applications

From-Home Shopping

As I said, when you consider electronic retailing, you often start thinking about applications enabling customers to shop for goods from their homes. "As computers can update information and keep track of masses of data, they can certainly be used to close sales transactions", we wrote in a report in this subject area.[4]

Videotex has often been hailed as a way of realizing from-home shopping; although critics pointing to the marketing debacles in this area, especially in the United States, have called videotex a "multi-colored wastebasket". Videotex typically stands for cheap, dedicated, dumb terminals; used by consumers and professionals to log into an easy-to-use database; where information and advertising is presented on screen-sized "pages"; enabling users to fill out "forms" on the screen to order goods, and to send text messages to other users or to service providers. In Sweden, IBM, Esselte, and Swedish Telecom plan to launch a videotex service—with dumb terminals and smart-card readers—to tens of thousands of households in early 1991.

The world's most viable videotex service is in France, where millions, mostly householders, have received small "Minitel" terminals to access an electronic telephone directory as well as tens of thousands of dedicated databases ("Kiosques"). The large mail order corporation Trois Suisses promotes Minitel as a way of ordering goods from the company's 1,000-page catalogue. Only a small share of all orders are entered on Minitel terminals; but these orders are easier to process for Trois Suisses, and videotex customers are more lucrative for the company than other customers.

Prodigy is an American videotex service, launched in partnership by retail giant Sears and IBM, with 150,000 subscribers or members by end-

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4 Odd Fredriksson, P G Holmlöv & Claes-Robert Julander, *ibid.*

of-1989. Prodigy caters for the ten million PC homes in the US. The service costs only USD 9:95 a month (plus, possibly, fees for subscribing to and using some of the services provided by banks and others through Prodigy).

One of the services within Prodigy is provided by Grocery Express, a small San Francisco-based home shopping corporation. Grocery Express lets a few thousand San Francisco residents shop for groceries by phone, by computer logon to Grocery Express's database, through Prodigy, or by fax. Grocery Express owner-operator Mary Garvey stresses the importance of ensuring high quality, and letting customers leave very detailed orders. We saw a demonstration of how to order groceries from Grocery Express through Prodigy and we agree with Mary Garvey that videotex shopping seems more cumbersome than phone or fax shopping.

One of Sears Roebuck's rivals, JC Penney, established Telaction, another kind of from-home shopping venture, in some of the cable networks outside Chicago. The 30,000 Telaction users had to switch to the Telaction basic cable channel and to dial Telaction. After having identified themselves, users were able to select merchandise and groceries to be presented—as still pictures and sound—on the TV screen, and they could then opt to order some of these goods, all simply by pressing buttons on a push-button telephone. Ordered goods were registered in a "virtual shopping cart", the contents of which the customer could view and alter until midnight when sales were closed. Unfortunately, 15 households had to share one "frame grabber", which means they had to wait if anybody else used the service, in which case they could see what that person was ordering. Evidently, JC Penney were not able to roll out their cable shopping applications cost-effectively and met resistance from cable industry. At last, senior management stopped supporting Telaction, and Telaction was closed down in April 1989.

A number of non-interactive, socalled televised home shopping networks seem to be rather more viable in the United States. Home Shopping Network and others also use basic cable channels to reach their customers, who simply dial an 800 number shown on the screen to order the merchandise presented on TV at that precise moment. Product offerings continue around the clock, although they are not scheduled in advance, and each presentation only lasts a limited time, after which the offer doesn't hold. Middle-aged women are frequent Home Shopping Network users, who often have their TV sets tuned into the televised home shopping channel so as not to miss a potentially exciting offer.

CompUCard is a mail order venture that markets thousands of low-cost appliances from hundreds of vendors. Most of CompUCard's millions due-paying members order appliances by phone, but the service is also accessible through electronic mail networks and databases such as Dow Jones, The Source, and CompuServe.

Extended Assortment and New Ideas

Information systems can quite easily give access to a wider variety of goods. "Assortments can easily be presented by computers, and advertising and promotion can be delivered through new information technology", we claim in an earlier report.[5]

There are several examples in in Japan where consumers and/or sales staff can consult a terminal to see in which store in a chain of stores one can find a specific item. Also in Japan, customers in the outskirts of a city can consult a video disk in a public terminal to look at merchandise, which they immediately can order by sending a fax message from the same terminal to the department store—Matsuzakaya—in Tokyo's fashionable Ginza district.

ByVideo on the San Francisco Peninsula and the sibling companies Intermark and MarkitStar on Tenth Avenue in New York City are small entrepreneurial firms who cultivate what may be regarded as a niche in retail: information systems bridging the gap between in-store display and packaged goods marketing to exploit what ad agencies according to them have neglected, that most purchase decisions are made in the store.

ByVideo produce refrigerator-sized kiosks with interactive video, printers and touch screens, sometimes even with credit card readers. Kiosks are placed in stores, where customers press "buttons" and areas on the screen to look at stills or commercials and to place orders for products shown on screen. For example, 500 Florsheim Shoe stores use the Florsheim Express Shop kiosk made by ByVideo to extend their assortment, from perhaps 4,000 pairs of shoes in-store to the million pairs stored at the Jefferson City, Mo, warehouse. Florsheim Shoe have cut delivery time from Jefferson City to the stores, from 14—30 days to two to five days. Some stores report a 20% increase in sales.

Intermark design shelf-attached computers to fit store displays for in-store promotion of packaged goods. and merchandise. The computer display holds a few lines of text, used to query customers for their preferences. Customers respond by pressing a button that corresponds to one of four or five alternatives; and after a series of questions are recommended one or several items from the manufacturer's product line. When Noxell introduced the cosmetics series Clarion, displays and computers from Intermark served to make this what Noxell and Intermark label the most successful cosmetic introduction in history. However, shelf display computers sometimes have advised customers to buy the least expensive brand from a manufacturer, in which case that brand was later erased from the database and also moved to another shelf in the store.

Advice and Consultation

It is perfectly logical to talk about consulting the computer, computerized consulting, personal consulting. Consumers could turn to an

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5 *Ibid.*

information system and receive information that helps them make a purchase. It also enhances service aspects that—according to industry analyst and one-time Intermark president Tom Rauh—retail industry for decades have tried to teach American consumers to forget.

I have seen one Japanese system in Tsukuba, the scientific city outside Tokyo where there was a world fair in 1985. At the Seibu store in Tsukuba, which is called the robot store, they have a little device where you can electronically try out kimonos. (Kimonos are really very important things in Japanese society, they are highly sophisticated dresses that women are supposed to wear at all kinds of festivities, and they are extremely costly, thousands of dollars, I guess.) A prospective customer will be photographed, whereafter the photo of her body will appear electronically on a monitor that the salesperson is handling. The salesperson uses a joystick to cut out the head and the body and to bring into the picture stored picture elements including the materials, colors, and patterns of kimonos, to try them on the picture. And when we were looking at the system it did not look good at all—the face was greenish and the body was not very good-looking either.

A more publicized example is Elizabeth Arden's huge cosmetics computer Elizabeth, where the customer can look at four digitized versions of her own face while a skilled salesperson applies different shades of makeup to these faces. From a technical point of view, Elizabeth is a stunning achievement, and the computer appeared in several news stories and television shows. However, the computer was mainly a marketing device; it could not possibly generate the amounts of sales needed to recoup development costs. After Faberge aquired Elizabeth Arden the new management discarded further expenses on cosmetics computers.

Customers In Databases

While new information technology, as we have seen, can be used to present product offerings and price cuts to customers, or specific segments of these, the rationale may be not just to increase sales, but to get a good handle of *who the customer is*—what s/he shops, when, how often, for how much, etc. "When transactions are stored in a computer, this increases the possibility to conduct analyses to glean knowledge on consumer behavior", we wrote in an earlier report.[6]

US corporations Procter & Gamble, Donnelly Marketing and Check-Robot jointly own Advanced Promotion Technology, a company specializing in what increasingly is referred to as "micro marketing"—in-store marketing—and/or "database marketing". APT test runs a frequent shopper program in selected Dahl's and Super-Valu stores using smart cards, where data on consumer purchases are stored. Frequent shoppers are rewarded points when they choose groceries promoted in-store or at checkout and can use these points to gain rebates when ordering goods from Vision Value Club catalogues.

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6 *Ibid.*

IRI—Information Resources, Inc—in Chicago is one of the globe's leading market analysis firms. IRI draws its expertise from a number of very large consumer panels, whose purchase patterns and viewing of TV commercials is minutely recorded so IRI can advise packaged goods manufacturers regarding the effects on various consumer segments of different kinds and levels of promotion and marketing. Recently, IRI have developed and are testing the VideOcart, a shopping cart with a video display on which the consumer can watch commercials, or read nutritional information, concerning groceries in the shelves s/he is just walking by.

Why Applications Still May Fail

So as not to let you feel flooded by pure technological fascination, allow me to conclude by briefly mentioning a few of the factors that have hindered, and perhaps long will continue to hinder, a more rapid penetration of from-home shopping and in-store electronic retailing applications.

The store of the future is quite likely to be a store of brick and mortar, rather than just an inviting database, since retailers rely on the physical store environment to promote groceries and merchandise. The totality of their product offerings is felt to be much more visible in store windows and aisles than in a catalogue or, certainly, on screen. Also, most purchase decisions are made in the store, and consumers rarely use comprehensive shopping lists. Consumers make up their minds what to buy first when they are walking around the store, and here they are helped—or influenced—by store layout, space allocation, shelf displays, and other in-store promotion.

Furthermore, for years retail have taught customers to do most of the logistics themselves—to find goods in the store, to put these in a shopping cart, in Sweden, to bag them, and finally to carry them home. From-home shopping would seem to put much of this burden on retailers, although it is conceivable that computer-ordered goods may be picked up by consumers rather than trucked to their homes.

There is little evidence that established retailers are interested in opening up electronic ways, outside of the store, to promote and sell products. However, retailers may be induced to install systems in-store that deliver extra information, extend assortment and enhance service.

The brick-and-mortar store sometimes is perceived also to play a "social role": some consumers on an average day meet very few people other than store clerks, mailmen, or post office staff, it is argued. Senior citizens may frequently belong to this category. Interviews we have made with users and service providers in a small Swedish from-home shopping trial using videotex indicate that senior citizens frequently go into the grocery store, perhaps to be able to see and talk to other people; that they are the customers that store management like the least, as they represent very small sales yet stay in the store for very long; and

that they find it hard to adopt new information technology.[7]

It is not likely that all customers—not even all who are still relatively young (or young at heart)—will want to try new technology, whether from-home or in-store. Consumers may not always trust the advice given by computers, or that an order sent from a computer will really be honored. They may worry about the quality of computer-ordered goods they cannot inspect before shipment.

There are long lists of the kinds of groceries and merchandise that cannot be solely marketed through an electronic channel, at least not through a text-only medium. Famed professors Eleanor May and Stephen Greyser—who, on the whole, see a future for from-home shopping—note that among the goods not suited for from-home shopping are: "...items that need to be tried on, whose color or texture needs to be observed, whose quality or value needs to be directly judged, or whose other physical aspects require an in-person reaction... items whose important characteristics may not be consistent across all shipments... items that are either first-time... or one-time... for the customer, and items that need personal selling support... and items for which the consumer perceives quality must be judged for each purchase... new products, as well as those purchased infrequently".[8] However, marketing of these kinds of items may well be profitably supported by electronic systems in the store.

The penetration of personal computers suitable for from-home shopping—at the very least, equipped with modems and communication programs—is still limited, as is the use of electronic mail and conference services that the owners of these PCs can subscribe to. Also, commentators have criticized the human–computer interfaces and human factors designs of several applications, not just of those for from-home shopping, but also for in-store electronic retailing. There is also a valid fear that computers may hang up or break down, and that naive users may inadvertently destroy delicate machinery.

When discussing applications of information technology in retail, we have met resistance and criticism from informed academicians, who feel that while from-home shopping is a real problem-solver for consumers who are pressed for time, electronic applications in the store may make the store appear like a zoo or a circus, and consumers feel like robots or minors.

However, I must conclude that although at this point in time ideas and scenarios for the use of new information technology for realizing the store of the future seem to outnumber viable applications, working

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7 This material will appear in: Marie Bergholm (1990): *Hemdistribution med hjälp av datorkommunikation* [Distribution to the homes supported by computer communication]. Economic Research Institute at the Stockholm School of Economics (in print).

8 Eleanor G May & Stephen A Greyser (1987): *From-home shopping—where is it leading?* Paper presented at the Fourth International Conference on Distribution, Universita L Bocconi, Milan, Italy.

technology is at hand and will slowly enter stores and homes. If there are even slim chances of success, entrepreneurs will continue to launch applications. As employees continue to work more and more from-home, and increasingly to use computers, an infrastructure of communication will emerge on which profitable shopping applications may eventually be piggy-backed.

Thank you.

Concluding Remarks

Bertil Thorngren
Swedish Telecom

I am here in three capacities. First, I am the Planning Director of Swedish Telecom. One of my responsibilities is to keep updated on the R&D activities that continuously go on in the company and also to try to influence that those activities are in line with the overall planning. With me today is also Dr Hans Bergendorff who is the Secretary of the R&D committee of Swedish Telecom.

Swedish Telecom spends about 1 GSEK (160 MUSD) per annum on R&D. Most of this research, quite naturally, concerns technology. In order to try to balance this my department has, for some years now, initiated and/or supported research projects with a social sciences approach to the use and economics of telecommunications. We hold the opinion that such research is a necessity, both to Swedish Telecom and to society as a whole. Telecommunications in Sweden will not develop into a truly useful tool for our business community and the general public if we do not have independent expertise in the country who can evaluate the need, use and economics of telecommunications inventions.

Therefore, in Swedish Telecom's best interest, we nourish good relations with and sponsor independent research from Swedish scholars. Right now we are financing, among others, research at the Stockholm School of Economics and the Industry Research Institute and is doing that with very few strings attached. In the future, we may be funding research at other universities and schools in Sweden.

Secondly, I am a former professor at the Economic Research Institute (EFI), the host of this seminar. There I spent the first 15 years of my professional career.

Thirdly, I am the Chairman of the Editorial Board of a venture called TELDOK. In the early eighties, the Board of Swedish Telecom took the initiative to this foundation. TELDOK, short for *TEL*ecommunications *DOC*umentation, has an overall objective. It commissions and sponsors documentation, as early as possible, of working applications of new telecommunications and information technology. Dr P G Holmlöv, one of the organizers of this event, also happens to be the Secretary of the TELDOK Editorial Board. Other board members come from different quarters, such as science, vendors, user groups, unions, etc.

The TELDOK documents cover developments in the use of communications and information technology, in Japan, Australia, United States and various European countries, as well as in Sweden of course. Most of the eighty or ninety reports so far published by TELDOK are in Swedish, but some of them are in English and we are happy to send copies to those interested.

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B Office Automation in Europe. February 1983
C Office Automation in Japan. February 1983
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Closing Remarks

Karl-Erik Wärneryd
Stockholm School of Economics

In concluding this symposium, I would like to pick out a few topics in the discussions that I think are especially worthy of attention.

My first point concerns predictions of the future. Forecasting the future acceptance or use of a technological innovation can be based on extrapolations of earlier behavior or on more or less subtle ways of questioning present and future users. Economic psychologists like myself tend to think that stated preferences and attitudes are important and useful if rightly handled. While economists usually maintain that preferences can only be studied and depended on as they are revealed through actual choice behavior, psychologists are optimistic about the use of verbal statements. They may even claim that stated preferences can be more true than actual choices since the latter may be adulterated by situational factors.

It is a good thing that we have had the opportunity here to meet some of the new thinking in this area and to learn about the existence of sophisticated methods. Maybe we can in the long run convince the really inveterate economists that they can use stated preferences if they collect and treat them wisely, not the way they have often been used.

Now, that was my first point. Maybe I should say, about economic psychology, that when Folke Ölander and I started developing the field, formulating it, some thirty years ago, we had one definition which we thought was preferable. We said, if it looks like an interesting problem, it is part of economic psychology. So everything that was interesting from a research point of view to us as researchers was defined as economic psychology. And that gave us quite a lot of experience, of different theories. They are a little bit stricter today, I would say, but there was something in it.

My second point has to do with macro and micro level studies of users and uses of information technology. Macro level data mostly lag behind actual development and fail to disclose many interesting relationships. When there is a question of making policy regulating the fate of new information technology, there is normally a widespread interest in how different population or business segments will be affected. Since macro level data cannot be broken down into data for segments, there will be wide room for loose speculation, unless new data is gathered. Individual cases are often picked out and used to illustrate problems. Few care about whether the cases are in any way representative of population or business groups.

The difficulty remains if for example a clinical psychologist or a practising physician is asked for an opinion. Those may be willing to generalize their observations to the total population or a large segment

of the population, but such micro level data should certainly be handled with care. A further difficulty is that when observations are made they usually fail to be systematic and unbiased. The use of surveys based on samples that are representative of the population segment of interest are commendable. It should be noted that it takes some expertise to carry out good surveys and that they tend to be expensive.

My third point again concerns the macro level. We have heard during these two days that there are structural changes in society and that these changes are important and must be considered in the attempts to analyze the future of information technology. The emergence of new business to business relations has been mentioned. The role of intermediaries can and will change with the new technology. We have discussed examples of new services like those offered by information brokers. New and unexpected uses of the new information technology appear every day and they give rise to development of new functions that may be improvements over earlier execution or solve problems that are newly defined.

We have not discussed very much the potential and coming changes in the public sector. In welfare societies there is increasing pressure to improve the efficiency of the public sector. The expanded use of information technology is a prerequisite for such efforts.

Finally, a word about the individual who is a consumer and a citizen. It has been pointed out that the household budget is a restriction on the adoption of new technology and new services. The possible trade-offs can to some extent be studied as has been demonstrated here. There are demographic and social changes to observe. What will the effects of improved basic education and of continued education be and to what extent will it be necessary to continue one's education and training over the whole life cycle? Will there be life-style changes, for example involving more interest in information and knowledge and less interest in entertainment that is just entertaining? There are many interesting possibilities in the future.

Teldok

TELDOK was initiated in 1980 by the Board of Swedish Telecom to facilitate *early and easy-to-use documentation on the use of telecommunicating information systems.*

TELDOK's aims include, to...

- Document, as early as possible, applications of new telecommunicating information systems at work
- Publish, distribute, and—where needed—translate to Swedish, while comparing to the Swedish situation, information on the use of new telecommunications systems at work
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