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Preface

Information may be measured, but just in its most trivial form, the number of bits that occupy a computer memory or a communications link. When these bits are read out, we get chunks of information that have to be interpreted, which are related to a context, which may help us gain knowledge.

That context is value loaded at least in the sense that only certain types of information and knowledge are acknowledged as important or interesting. Thus perception is conditioned by culture, and Richard Dawkins has proposed calling those recurrent themes of knowledge, of information, which range from trivia to proverbs to theological dogma, by the term memes. His analogy is with genes, those selfish genes that have but one purpose: to survive, to thrive, to duplicate – if need be, with some adaptation, even mutation.

The innovation process – the translation of an idea into a success – might be described in terms of the idea's fitting into a meme landscape, a meme ecology. Of course, memes are directly related to our artifacts, to the material world, including technology.

Thus information technology is meme dependent for its development. At the same time, however, technology development changes the conditions for that meme ecology, most obviously in the case of new media.

This book contains several articles, written for conferences or as comments to specific developments. They have, however, as a common theme the interaction between information technology development and context changes, meme transformations. The various scenarios included all pertain to a particular information technology development, that of groupware or computer supported team work, a collaboration possibly carried out over large distances.

Collaborations between members of different organizations and perhaps from different cultures call for an understanding of underlying meme patterns. I was invited to write a piece on our common European basis for communication, given a certain historical framework and future technological trajectories, for "Europe by Nature", a book that is the result of an international conference to which I was invited. The contribution to that book was co-authored by Ben Waumans of Philips, and what you find here is my own initial background paper.

That paper is oriented towards the domain of general culture. For the conference "Technology Management and International Business", held in Stockholm in June 17–19, 1990, Professor Ove Granstrand asked me to summarize and combine a series of different studies on transnational companies and their employment of information technology. It

turns out that quite often these companies see their early plans of gaining economies of scale stifled.

Instead, they gain something that I, at the conference, called technonomy of scope, which means that the economy of a product cannot be realized without its adjacent technical features, which most often also have to be adapted to local culture and regulation, to customs and ways of communicating, not to say perceiving. One might rephrase it in claiming that memes are combined and redefined, and that's where the economy is. I am grateful to professor Mark Casson of Reading University who pushed me to have this article published, now in an edited, enlarged, and revised version.

The third paper beside the scenarios is neither as general as the one on European memes nor as full of practical detail as the one on "technonomy". It was presented at a seminar, arranged in conjunction with the International Switching Seminar held in Stockholm in 1990 (and I am grateful to Gösta Lindberg of the Ericsson Corporation for inviting me to speak[1] as well as to IMIT for publishing the article in its series of working papers). It aims at describing the future of telecommunications, but in contextual terms rather than in extrapolations of traffic volume, costs, or technological features. Thus it deals with the recent metaphor or meme of networks and networking, alternatively called social fields. When it affects the social fabric, it enters definitely into the realm of memes and meme production, even meme conditioning.

Bengt-Arne Vedin

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[1] Talking of new media and Europe: the whole seminar was recorded and transmitted as an educational TV program over the EuroPace satellite network

Information Technology and the Technonomy of Scope

Summary

What problems might face companies trying to reach competitive advantages by being industrially active in all three major areas of the industrialized world? Many have learnt from experience. Thus, here we meet three companies that have concluded such an expansion recently. In addition, three technology procurement projects between companies on different continents exemplify innovation attempts barred by obvious obstacles. To see what might be expected from information technology in easing the way for such attempts to span the globe, we have interviewed 95 companies in Japan, the US, and Western Europe. There is, finally, the backdrop of three large corporations, veterans in performing their research and development on a global scale.

While the three companies that rounded out their global representation recently all did so in the hope of reaping benefits from economies of scale, they found that whatever their gains were, they were not based on mass production.

Extending the technology base turned out to be related to reliance upon economies of scope, to the sharing of knowledge, of experience, contacts, and risks, all in relation to the various single markets. Sometimes, the same technology, or technological combination, was gainfully employed to serve entirely different markets, at least different niches. Different countries, niches, etc., were – contrary to expectations – not necessarily converging but experiences from one market might reveal how to court another. The same held for different trajectories of technical development.

It turned out to be outright misleading to look upon the profitability of just one single product. It is the profitability of the company, the business unit, and its activities over time that count: the *technonomy*, defined as the economy emerging from a balanced flow of a whole portfolio of new products, exploited in many markets.

In development projects, the more inventive the project the higher the uncertainty. Through the pooling of experience, and through the stepwise exploration of different niche markets and of different techno-

logy options, the whole organization, and its component parts, could reduce the cost of uncertainty reduction. When time is a vital competitive factor, i. e., reaching the market before or, at worst, not much later than the competition, the pooling of experience and of resources again make for an important competitive edge.

To an ever larger extent, technology relied upon becomes multi-technology, so the company must master leading edge technology not just in one but in several fields. The same holds for more basic knowledge, for science.

Speed, new approaches, but also costs, require new ways of performing research and development: in consortia and other collaborative arrangements.

The need for testing, test marketing, for recognition, and for references can be met more easily.

We have found some organizational means being underlined as interesting, such as the establishment of centers of excellence, with a subset of "corresponding members", employees of the center though located at other, distant units of the company; research projects encompassing several units, located apart; shadow groups, working on parts of a project or responsible for following it, making it easy to transfer knowledge.

All three cases of procurement may also be regarded in terms of changing and increasing scopes, technology-wise but also market-wise.

New means of communication and new information technology applications may be called upon to allow for this larger scope. Information technology companies are research and development intensive and themselves obvious grounds for introducing new information technology applications.

Cementing a new acquisition, gaining economies of scope, developing and maintaining a common corporate culture may call for information technology investments to which research and development functions become party.

Some customers are demanding that specific information technology systems be applied. Where time, or development speed, is a crucial competitive factor, that technology will be adapted early on, for simulation, messaging, gaming, groupware, etc.

A trend to vertical dis-integration, or, more generally, to networking is bound to increase the allure of information technology solutions to "social" or link-up needs. This, then, holds also for research consortia or other formal network organizations. When several units produce the same product, there is the commanding requirement that designs do not diverge

The need to develop just software, or perhaps also software dependent hardware, has in some instances led to the development of full scale network organizations or the establishment of company units located where particular individuals with important competences live.

This is a study on how transnational, multinational, or multidomestic corporations attempt to gain from being active in several continents. More specifically, their reliance upon emerging new opportunities offered by information technology is scrutinized.

The material has been compiled during 1989–1990. One survey extracted information on new and requested applications for information technology, not least telecommunications services, from 95 companies in Europe, the US, and (a handful) Japan. Three in-depth studies of information technology procurement projects across the Atlantic provided some historical material. Three more shallow snapshots of companies that have recently become "trilateral" (i. e., established themselves in the "Triad" of US, and Japan, from a base in Europe) offered views of the struggling to achieve some economies from "globalization". Finally, three traditionally multinational corporations, performing research and development in many countries, serve as a backdrop.

Outline

The aim is to generate some hypotheses regarding the application of information technology to research and development in technology based, transnational corporations.

First, three companies that have been performing research and development with an international scope for a very long time are introduced. The brief descriptions are intended to serve as a reference when describing a changing scene.

Second, three cases of companies that only recently have taken the final steps to globalization, at least in research and development, are presented. These companies have themselves experienced some challenging problems to obtain expected gains from the interaction and the scale of operation now established.

Third, three cases of information technology systems procurement, across corporate and across national borders, are reviewed. The study rationale would be that information technology is developing so rapidly that it induces additional strains on communication and thus serves as a "litmus test"; and that communicating across both national and corporate borders is more cumbersome than just within one company or just one culturally homogeneous country.

Fourth, a summary of some predominant trends in international corporate research and development, as suggested at a conference in 1989, is presented.

Fifth, the results of an interview survey with some 95 corporations in a dozen countries are summarized. These companies were asked about their experiences, plans, and needs for advanced information

technology and telecommunications services, not just in research and development.

The first set of tentative conclusions pertains to the rationale for globalization when economies of scale seem not to apply, at least not in the traditional, simple way. There are two dimensions to this, to what we call technonomy. Experiences cross-pollinate, and development is dynamic in the sense that the entire flow of new products, services, etc., must be regarded. This flow also surpasses different regional and functional markets, as does the knowledge flow disciplinary borderlines.

The second set of conclusions, or hypotheses, relate to what might be expected of future information technology and telecommunications applications in the research and development of transnational corporations.

Three Traditional Settings

The Joch company is truly global. Development thrust is different between the several tens of laboratories that have been established, all around the world. Sometimes these specialities have been chosen to conform with the unique competence of gifted specialists.

With changes in technology, some laboratories have been forced to find a new role. All this is being worked out in accordance with a global view.

Laboratory activity is not linked to production specialization in the vicinity, however. This is partly because many products are manufactured in several locations in different continents. Thus, when a new product has been developed, several factories might use the blueprints, make their own calculations and costings, and put forward a bid to produce.

With such mechanisms, Joch is dependent upon good communications. Electronic mail and computer conferencing are utilized in the early stages of contacts between laboratory and would-be production sites. Blueprints are, in fact, transmitted electronically, as data on diskettes and via communication lines. Simulation is a standard technique.

While the different production facilities may be regarded as competitors, they are also members of the same company. They have good reasons for sharing experiences and for ascertaining that their common designs do not diverge over time. They all have similar needs for instruments, parts suppliers etc.

Joch features an electronic messaging system that is heavily utilized. One possibility is for research and development people to advertise problems, and quite often there is an exchange of full-blown or part

solutions to the problem between different corners of the organization in distant parts of the world.

For rapid design tasks, Joch has been using videoconferences, linked by satellites.

The Aspres Corporation has a traditional central laboratory, carrying the main responsibilities for research and development. Here, strategic decisions are made as to where a new product should be introduced first. That market is selected on the basis of demographics and economics. Production capacity is the internal determinant, the market decision being the external, when allocating manufacturing tasks. Thus we may regard the process as the tuning of the corporation to its environment rather than as the result of a bidding process on a market, as in the case of Joch. But then the Joch products are introduced simultaneously everywhere.

"Local" development (and subsequent production) is taking place where there are very early and demanding Aspres customers. Defense contracts might serve as an obvious model, though there are other sectors as well. Here, communication needs are lesser.

Our third example, Millas, has, traditionally, operated with independent subsidiaries in the US and in Europe. It is only recently that it has proven profitable to exchange designs, experience, expertise, and to join forces on specific projects, or, for a period, transfer solutions and designs.

Traditionally, certain general areas, such as security and environmental issues, have been subject to joint, global efforts. Here, the "center of excellence" approach has been applied. It has now been extended to general scientific or technology areas forming the basis for joint product development projects.

The Millas Corporation has stumbled onto an interesting but troubling observation. In the effort to shorten development times, the question was raised, jokingly at first, "How do we proceed when we pursue a development project?" Everyone knew, but when discussing, it seemed as if everyone knew different things. Therefore, a group was given the task to investigate and define the actual procedures applied.

Only now, after several years of discussions, Millas managers have a coherent and generally accepted map of the development process. This process description greatly facilitates electronic communication.

Millas has been relying on video conferencing for a long time, rather enthusiastically. To a large extent, it is now also using simulation and computer modelling to reduce development times drastically; this is a natural extension of CAD procedures.

CAD will have a profound impact on the whole system of suppliers. They are being drawn into the development process, more to save time than money, and they are forced to adopt Millas' electronic messaging systems standards to keep their customer.

What Happened to Economies of Scale?

Turgid is global in scope though still somewhat uncomfortably heavy in their country of origin. Turgid-X is the world leader in its speciality, and this group is the only part of the huge combine to be truly multinational than its parent corporation, active in all corners of the Triad. Nor are the Turgid-X centers of excellence located at the Turgid corporate research center.

The market for Turgid-X products is highly qualified. Customers look for qualities and features, not for price. Service is an important quality, and costs associated with the service organization means that there is a rationale for having a full hand of products that can underwrite a good enough network of service centers.

Traditionally, this is a field where contrasting competencies have to meet. With the development of computers and associated software, the spectrum of varying professional backgrounds necessarily has become even more colorful.

Production is customized, which makes for small batches of components, instruments, systems modules, etc., which can be linked together to function as custom made systems, where some of the parts have been tailored and the software dedicated.

The market is totally dependent upon certain government, cultural, and institutional restrictions. This means that selling points, arguments, and cost-benefit calculations are completely different between Europe, the US, and Japan.

In one of the four countries where Turgid-X research and development is performed, the subsidiary was acquired quite recently. One of the most important assets was the entrepreneur, running the company. To safeguard this asset, corporate management goes a long way to meet his requests, to keep him happy, to make him stay.

This creates some tension between the units ("favoritism"), eased by the fact that the entrepreneur's abilities are generally accepted as outstanding. He himself is aware of the potential tensions, making sincere efforts to avoid monopolizing research or the most interesting development projects.

Another reason for this recent acquisition is its proximity to certain knowledge centers and to certain important component manufacturers, the fountainheads of much new technology, critical for new features and qualities.

Prose Inc. is also serving an institutionalized, special market. There are no governmental or other regulations here, but history, geography, and demographics make for systems that vary within the Triad. The qualified components that constitute Prose's business are made in small batches.

A large share of those components is sold internally, to the mother company or other parts of the Prose Group. Such customers are no less demanding, however.

Again, the combination of three Prose companies, active in the same field and now under the same umbrella, is a new phenomenon, brought about by a series of mergers, acquisitions, and buyouts, restructuring the whole industry. Contrary to what was expected at the outset, no substantial economies of production scale have been recorded, no rationales existing for consolidating the production of specific component varieties to one or the other factory.

A problem, as well as a long-term boon, is the need for standardization and harmonization between previously diverging product designs. The opportunity is to take the best of every design and the challenge is to harmonize without disruptive generation shifts or other confusion being created in the market-place.

While Turgid meets a market that can be said to feature an inherent multidisciplinarity, Elne Inc. has always thrived on spanning the borderline between two disciplines not normally combined. In recent years, the company has gone further in this direction, establishing itself through a substantial acquisition in a third field of competence, market-wise closely related to its previous activities.

Furthermore, this development has made Elne a truly global company instead of a national company selling abroad. Some of its best products were developed in international collaboration. Now such development efforts are taking place within the company in all three regions, Japan, the US, and Europe.

The odd combination of specialities would seem to benefit from the various strengths of corporate and academic communities in the three parts of the Triad. Especially in Japan, the problems of transcending disciplinary borderlines are less severe.

The markets for Elne's products are quite varied. The sub-markets are distinctly different, and they are different in various European countries as well as in different parts of North America.

Contacts with academia and research institutes are important in this business. That is where several new ideas emerge. Parts of the market are found here, and academia exerts a profound influence on the reaction of other, perhaps more lucrative markets.

These three companies, Turgid, Prose, and Elne, all claim to struggle to gain profits from being global. They have no clear-cut answers so far, and on rainy days they feel that the idea of leaving the national or regional base may have been a questionable one at best. But they offer some tentative gains that they feel point in directions that they should pursue.

- One such gain would be *access to "multi-domestic" networks*, i. e., plugging into universities, research institutes, consortia, and so

on, in Europe, the US, and Japan. This can only be done with local research and development activities offering active participation.

- *Sharing market and customer reactions.* Even if markets are distinctly different, because of regulations, product liability rules, etc., there are ways to abstract, interpret, generalize, and then adapt experiences from one market to another. The adaptation requires development, if not research. Customers can be attracted by knowledge and track records obtained under other circumstances.
- *Getting different viewpoints.* To see a market, or a development process, functioning differently from what you are accustomed to, might be a painful or a liberating eye-opener (or both).
- *Accessing different strengths in different disciplines.* Because of different histories, environments, contact networks, entrepreneurs, etc., the strengths might be complementary as well as overlapping. Even some overlap, some internal competition is seen as useful.
- *The patchwork markets of Elne* tell an interesting story of advancing stepwise, using various experiences, in different market segments, with different products, etc., even recycling failures as it were, to advance in another market, gain new experience, then go into yet a third market, and then perhaps close the circle by returning to the first market.
- *The network of suppliers,* providing in kind what scientists and universities provides in knowledge: new ideas as to components, software, etc. The obvious case in point is the establishment of units close to Silicon Valley to gain access to new key components early on. The multi-disciplinarity of a Turgid-X or an Elne seems to call for establishments in several such vicinities; an idea carried out in reality.
- *Access to unique individuals.* Previously, in the Joch company, we met the phenomenon of a giant company establishing a laboratory to satisfy a gifted scientist that the company wanted to keep. Now we are confronted with the case of Turgid-X, not just incorporating within its larger structure a company that has been acquired, but accommodating the entrepreneur behind it.

What, then, are the organizational ideas pursued by these companies? Here are some of their own answers.

- Some sharing of responsibilities, i. e., some duplication of work but also some conscious complementarity. For more basic developments, the creation of centers of excellence.
- A concern to avoid to cut individual laboratories up into too small or fragmented operations. To be able to combine technolo-

gies, or to operate in very different markets, the need for multi-disciplinarity must not be forgotten.

- One way of doing this is to allow for "members" of one center of excellence to be resident in some other place. To make it feasible for him or her to participate in the work regularly, computer conferencing, electronic mail, sometimes video conferencing, of course fax and telephone, are rapidly growing in importance.
- Even if costly, some projects may be truly transnational, with the benefit of faster adaptation to local market requirements, well ahead of competitors. The "many diverse viewpoints" may prove advantageous. Communication needs are met much the same way as when "outplacing" from a center of excellence.
- When alternative routes to success are feasible, allocate their exploration to different locations. This certainly applies to software development.
- When projects are focused on managing for time, i. e., when project development times must be cut short at any cost: alternative routes are pursued simultaneously, electronic communication in real time allowing for coordination and the sharing of experiences.

Information technology systems procurement between continents

Case 1: An electronic PBX

The emergence of electronics made telecommunications exchange manufacturers and telephone service providers experience a major conceptual shift. Though the advent of the transistor was foreseen to impact on telecommunications systems "sooner or later", the swiftness in the changeover from electromechanical to electronic systems turned out to be unexpected as well as unprecedented. Customers turned out to request the latest technology, even if it was "uneconomic", mostly because the new technology was seen as opening entirely new vistas, allowing for entirely new features.

What was to become the private telephone exchange PBX 345 is a case in point. Back in the 70's, Swedish Telecom, Televerket, was, like so many of its counterparts, a de facto monopoly. By the mid-70s, Swedish industry expressed deep unhappiness with available sub-

scriber exchanges, which were electromechanical. These bulky systems required just too much space, a high ceiling, often even a separate building or at least a room of their own. They took some six months to install and considerable lead time even before installation work could start once an order had been placed.

To balance the national telephone monopoly and to act as a pressure group, Swedish business had formed The Business Telephony Committee, Näringslivets Telekommitté, or NTK for short. Their mission was to press for better telecommunication services, including better subscriber exchanges. As a stopgap, an electronically controlled relay station was developed, but it was seriously handicapped by the fact that it could accommodate just small organizations, up to some five hundred connections.

The pressure from NTK, in conjunction with new signals about market orientation, changing ground rules for telephone businesses all over the world, etc., created a strong impetus for Televerket to do something, and quickly. All internal development resources, including those of Ellemtel, the joint development company with Ericsson, were already tied up, so procurement from the outside was judged necessary.

More pressure came from abroad, calling for free trade, i. e., the close links existing between Televerket and Ericsson might be questioned in the future. Therefore, it was judged important to make the procurement process almost demonstratively free from any bias.

The project was in a hurry already from its start. In 1974–75 specifications were established, and documentation for the invitation to bidding was developed concurrently with specifications.

The Swedish specification contained many problems. In a Swedish local exchange, for example, to get to the switchboard, you should always dial 0, not, as in many countries, 9. This was a "must". And of course interfacing with the Swedish telephone system was another requirement, as was the Swedish numbering plan.

Then the product chosen should be produced within Televerket in Sweden; what was called for was, first, a development project in the sense that adaptation to the Swedish system took place; and, then, a technology transfer project.

Already at the outset, the evaluation team was quite familiar with the six bidders and their products. Thus this list was easily reduced to a shorter one, with three companies remaining. There was no second round request for more specified bids (there normally is).

The three remaining quotes were extremely different, qualitatively. One company had an exchange that was already on the market and that functioned well. It was rejected on grounds typical of the rapid development in electronics: it was already out of date. With the pressure building up from Swedish business, and with the partnership with Ericsson to take into account, Televerket could only buy a product justified as modern enough.

Another worldwide company was only very early into its develop-

ment process. "They had a dream and a vision, but the only thing they could show was overhead transparencies." It seemed too risky, and also too long term, to opt for this system.

So, in reality, Televerket was left with just one possibility, Northern Telecom (NT). Theirs was a solution with a very advanced telephone exchange in the latter stages of field trials in Canada (where the company is based). A few early products were in use, but series production had not started.

Northern Telecom was a new acquaintance to Televerket. In fact, NT had just started its expansion to become one of the few major international players.

The contract agreed upon consisted of two different parts. First, a development contract, requiring the joint development of the subscriber exchange to become the "345", and, second, a license agreement for production in Sweden. Development would include redesign and partial substitution of hardware. Furthermore, the software had to be rewritten. Everything had to be adapted to Swedish and European standards.

The problem, seen from NT's side, was to assess the ability of the Swedish production plant to adapt to and then introduce the new production processes accompanying this entirely new type of product. The story is not unusual: it turned out that machinery, equipment, plant, training, personnel, organization, were all geared towards the old electromechanical production. Experiences from NT itself, if nothing else, demonstrated what kinds of difficult and demanding investments would be required, not just in machinery but also in attitudes and knowledge.

To get the Swedish order was of course positive news for NT. But there were problems too. The expanding development department was already more than tied up with other major projects, and here came yet a large one. It seemed impossible to recruit enough people of the right caliber in all of Canada.

Silicon Valley would be an option, however. Competition for people was tough there, but could be found. And Northern Telecom had already toyed with the idea of establishing a development unit down there; it would be well placed to follow important new developments at close range. The 345 project became the triggering factor for establishing what had only been on the wishing list in Toronto. To have the Swedish project as the initial backbone seemed ideal: it was a well-defined project, with clear goals, and with funding.

By the end of 1976, a formal contract was signed. The project plan was very detailed and thoroughly thought through. A joint reference group was established.

During 1977 and 1978, about ten Swedes from Televerket were constantly in Palo Alto – not the same Swedes always, so there was a larger group that participated in the project both in California and in Sweden. The NT team had to be told first-hand – there are limits to

written directives – about Swedish requirements, standards, and specifications, and the Swedes were there also to acquire knowledge to be transplanted.

When documenting hardware, all documentation had to be translated into a new documentation standard. During 1977–78 production technology was transferred. Some test procedures were unchanged, but most of them had to be adapted, some only later, in Sweden.

It turned out that the share of the hardware that had to become uniquely "Swedish" was very large. By the spring of 1978, specifications for circuit boards were ready, and early production started.

While development work continued, more and more focusing on software, field trials started. The trials were carried out on a small exchange, 500 lines. It required not just hand holding but even "artificial animation", and a couple of Californians had to spend Christmas in Sweden – literally at the site of the exchange.

In the spring of 1979, another subscriber exchange was delivered and installed at the Televerket plant Teli in Nynäshamn, very close geographically both to Televerket's production and its corporate headquarters.

Previously, production plants – such as the one in Nynäshamn – had been just that. Now, testing and other tasks required much more skilled people, and the need emerged to recruit various experts to be engaged permanently. This change has been judged "traumatic" – together with the intense requirements for retraining. One important conclusion was that from now on, production units must become much more autonomous, no longer just lines of machinery, controlled from somewhere else.

During the heyday of the project in Palo Alto, there were at times ten Swedes among 60-80 people. In 1981, the buildup had resulted in a staff of 200 at NT/Palo Alto Labs, and the "345" was no longer the dominating project.

The "345" had its share of hiccups. It was conceived, initially and for a long time, as a stopgap only. Soon Ericsson and Televerket would come up to speed with another exchange, and the "345" was expected to be produced in a series of 30 to 50, representing perhaps 30 000 subscriber lines. However, by 1989, 500 exchanges had been installed, representing some 0.5 million lines.

The reason for this deviation from "plans" is that the "345" is a good product, and the product designed to substitute it, the MD 110/A 335 (MD 110 is the Ericsson denomination) was delayed.

But delays were something hampering the "345" development too. When the A 335 had been specified in 1976–77, and development had been going on for about a year, a subsidiary decision was flouted, "let us kill the 345 project, money is just pouring out". After all, the A 335 was more ambitious, more powerful – and expected to be ready by 1980...

Personal contacts are judged of prime importance in a project like this. The idea flow tended to be in both directions; NT had never given

a license before, so they were in a learning process, totally "innocent as they were". By contrast, Televerket was a very experienced licensee. One particularly important lesson that they taught their supplier was better order in the documentation (previously, NT had had half a dozen different subcomponent numbering systems concurrently!).

Case 2: Custom design integrated circuits

The semiconductor industry has two standard bearers when it comes to products: microprocessors and memory circuits.

The microprocessors have come into the spotlight because their new generations herald new generations of microcomputers too. Apart from these volume products, however, there are other volume products, for the telecommunications industry, for example. And apart from the volume products, there are specialized circuits, for special purposes – in computers, telecommunications, but also for inherently low volume applications such as space and defense.

The features of an integrated circuit are determined by its technology. By this we mean the basic design of the various components, from the silicon substrate over different insulation methods, integrated into that substrate, to the creation of islands equally integrated into the substrate, and to the actual interconnecting of components and islands and electrodes on the surface of that substrate. The substrate might be gallium arsenide or (in the future) diamond instead of silicon, or sapphire or silica underneath the silicon, again allowing for new variations.

This diversity is motivated by a corresponding diversity of applications. For a space application, ten circuits or less may be needed. This is a completely different ball game than the production of literally millions of memory circuits or microprocessors. Furthermore, space applications might require different and, compared to standard circuits, very peculiar signal levels, cooling, or hardiness against cosmic radiation – requirements that may be met only with particular configurations of substrates, silicon, insulators, and metals.

To each such family there is a corresponding production method. The crux of the production process is the design of the circuit. This is performed through the production of a sequence of photographic pictures, "masks", which offer windows for the various processing steps changing only selected parts ("unmasked") of the silicon surface.

If the particular design to be custom made requires just a very small batch to be produced, then the actual design of those masks – between ten and twenty of them – might turn out to be too costly. But there is a shortcut. Instead, the circuit might be designed as consisting of building-blocks, modules, taken from a library (the cell library), so at most a few details and parts of the whole circuit have to be designed afresh. This has the additional advantage that those modules have already been tested and tried.

The ABB Hafo semiconductor plant outside Stockholm is one of a handful in the whole world that produces silicon-on-sapphire circuits. They have other specialities as well. To these specialities, they have their own corresponding cell libraries.

Being so specialized requires worldwide marketing. There are a number of customers who have a beaten track to this supplier, since they produce systems operating in environments where the ABB Hafo technology is advantageous, perhaps the only way out.

There are also a larger number of potential customers who do not know that this fairly exotic technology might offer them completely new opportunities. The problem is to reach out to them.

The first type of customer is the one where there is already a relationship: the technology that ABB Hafo is associated with is established as one possible way of solving a problem. Frequently, the relationship is ongoing, and one solved problem leads to a new project. Customer and supplier work together intimately, and the ordinary process of "invitation to submit an offer–tender offer–selection" does not apply.

The second type of customer is an obvious problem. It happens that ABB Hafo enters the bidding process after offers have been collected, the open bidding concluded. In one case, some hundred companies were bidding, among them ABB Hafo. Out of these, seven qualified for the final round, ABB Hafo excluded. After some arguing, and one might say education of the customer, ABB Hafo was back into the race again, and, finally, given the contract.

In cases like this, the selling proposition is never price but features and performance. References would be a strong point: it is reputation that sells. ABB Hafo has more than a hundred customers in total, and some two dozen ones active at any one time. Depending on volume, prices vary greatly, and each project might fall in the range of between 1 and 10 MSEK (approximately 150,000–1500,000 USD).

A strong point is the pre-study, the feasibility study. Since what is requested is something difficult, it might turn out to be impossible, perhaps a task unsuitable for this particular type of technology. Therefore, ABB Hafo offers its prospective customers such a feasibility study for free – i. e., the customer pays nothing if the project cannot be realized by ABB Hafo, not even if it is feasible but the customer chooses another solution finally.

Since circuits are custom design, they are unique and involve, each of them, development work. Some customers place orders for systems that just barely can, or cannot, work. Consequently, in some instances the circuit designed might not work the first time. The iterative process to make it work is included in the price quoted initially, the risk being that there will be a delay. Pricing is based upon market value, the value of performance and qualities, rather than upon "cost plus" calculation.

Some orders are even more innovative, and the customer might participate in what becomes multiple stages of research and development. One example is CERN, which is interested in radiation resistant

circuits. The first step was to develop and test single transistors, the second step to design integrated building blocks, and the third to proceed to the solution of the problem – when the previous steps had proven successful enough.

ABB Hafo puts large emphasis on "the chemistry between people". Management tries to see to it that the person responsible for the project with the customer and his counterpart at ABB Hafo get along well. If not, ABB Hafo would substitute their own man. The importance of this is evident since very often ABB Hafo comes to work as an in-house supplier. "We will have to plan for our customers."

To ABB Hafo, the problems of collaborating with customers abroad are no different from with domestic customers, apart from travel and language. Why then a US operation? One reason is that many American customers, themselves operating in the US market only, find it awkward, complicated, or uncertain to telephone and make contacts abroad.

A second reason is that many purchasers of technical systems would judge a distant Swedish company as just too unreliable a source for some key components. It is the location in the US that counts. It helps American customers that they perceive the operation as domestic, so they can come and visit, participate in design work, etc., with few obstacles.

The telephone is an obvious communication tool. Telephone conferencing is of increasing importance. Another important such tool is the fax, which is very rapidly emerging as a bridge between the two sides of the Atlantic.

Case 3: Monitoring system for the Swedish power grid

In November, 1965, New York City suffered an electric transmission system breakdown, "the big blackout". This caused reviews within power companies of all types all over the world: could the same thing happen to them?

Though the Swedish power system seemed to be more robust, the worldwide debate was screened, and two years later, the Swedish State Power Board (Statens Vattenfallsverk, SV) commissioned a study on the prospect for a new monitoring system for its national power grid.

To initiate a concrete discussion, the tentative outline of a potential system was presented. As a starting point for debate, it was far from the blueprint for a complete system. New suggestions emerged, the report being revised repeatedly.

Early 1969, preliminary decisions were taken to develop a system along the lines emerging. A project organization was established, which was to remain unchanged for as long as until 1977. The main

task was subdivided into six sub-tasks, allotted to working parties.

Early in 1970, a functional scheme had been established. The system, Tidas, had been defined, including its subsystems and their different functions. The next step was to formulate a specification for tender offers. What functions should be specified, and in what sequence of sub-systems might the full system be developed? What functions would exceed existing computer systems capabilities?

The procurement specification was divided into two parts, one for data collection/transmission and the other one for data processing. It is the latter (Tidas-D) that concerns us here, but there was of course a problem in defining the interface between the two, and to adhere to this definition.

This being a totally new field for SV, the basic concept was to be wide open to all possible systems suggestions, and the invitation must thus reach out to every potential supplier. Specifications should be open ended, not excluding different systems alternatives – surprises were invited! The main parts of the specifications were functional descriptions of applications, while the hardware configuration was left completely open. The only detailed description was the one covering the man-machine interaction envisaged.

A benchmark was included in the specification. This was requested to be run on the systems proposed, the results enclosed in the offer.

Specifications and invitations to tender offers were issued in the summer of 1971 and sent out to twenty prospective suppliers. Offers should be given before Nov. 1, 1971, but suppliers intending to tender offers were demanded to announce their intention two months earlier. As a consequence of demands for prolonged preparation time, the final offering date was extended to Jan. 10, 1972.

Before the latter date, discussions with candidates were frequent but SV declined to discuss systems suggestions; the only subject was specifications and clarifications as to functions. During this period, the evaluation procedure was also defined and shared with would-be suppliers. Additional expertise on computer systems was called upon, in preparing for the evaluation procedure. Some of the potential bidders were asked to test a new benchmark for its realism.

Most of the invitees chose to offer solutions. The first test was whether a proposal met the minimum requirements. About half of the proposals did so. The remaining options were ranked according to a weighted point method. The seven people in the evaluation team had difficulties in agreeing. The total costs were calculated for introducing the system and establishing three regional centers, including a seven year period of operation.

Some suppliers could not tell running times without a stopwatch, some told of incredible overheads, some arrived at different time consumption in different subsequent tests with exactly the same configurations and parameters.

The most advantageous choice was the TRW system, based upon

DEC-10 from Digital Equipment. But TRW wanted to protect its collaboration with Xerox Data Systems (XDS, previously Scientific Data Systems, acquired by Xerox). It turned out that the DEC-10 solution had been offered only as a last resort. SV was not happy with the system solution based upon the computer XDS Sigma 8, which would hamper the implementation of new applications both with regard to the operating system and memory protection. Then TRW suggested – with the support of XDS – a solution based upon Sigma 9. After some haggling this became the chosen solution.

In retrospect, the substitution of Sigma 9 for DEC-10 was unwise, since XDS later went out of business.

In the summer of 1972, the Tidas system was calculated to generate a benefit of 134 MSEK, and three weeks later a formal "go" decision was given. By the end of 1972 a "letter of intent" was signed with TRW. This was so voluminous that it was nicknamed "The Book of Intent". TRW were very surprised; they had never encountered anything like this host of detail. "The Book" must be regarded as a preliminary outline of the final contract.

The idea was to have ASEA – responsible for the data collection system – act as the main contractor, TRW serving as a subcontractor. But because production planning development within SV would take too many years, this arrangement was later complemented with a separate contract with TRW for the product planning package. The projects were linked and performed within the same project organization at SV. Under one contract, TRW was a supplier to ASEA, under the other it worked directly for SV.

The technical solutions turned out to work well under these agreements, but they created legal difficulties.

The two contractors formed a Systems Office, carrying the technical responsibility for the system but with no rights to change technical, economical, or time plan details. So this was just a coordination function, decision making residing within the other organizations.

TRW appointed a project manager, managing a hardware and a software group. Within the ordinary TRW line organization, the project manager was very distant from those within the different groups (software was divided between several groups, one for each functional specification, such as data base, man-machine, etc.). This created both communications problems and problems in allocating resources.

Over time, the different groups were substituted by an integration group and, later, also a test group. Integration and testing were not clearly defined, neither was subsystem integration or subsystem testing. It turned out that the tests agreed upon could most often not be realized. People from the two groups accompanied the system to Sweden, to assist in the final installation and acceptance testing. All these tests had already been performed once in Houston, before shipping.

From the very beginning, SV allocated overall responsibility with

one project manager. He had a secretariat that ensured an appropriate information flow between everyone involved. Interfaces between and responsibilities of different task forces and project groups within the SV organization developed only later.

For close to a year and a half one person commuted between Stockholm and TRW in Houston, Texas, while the group he managed was initially placed in Houston. This did not work out, since decisions had to be taken on a daily basis. So the commuter had to stay put in Houston. Fortunately, Stockholm and Houston each had its data coordinator and complete register.

It is underscored as a serious problem that despite close contacts and although the Swedes in Houston knew their home organization, different objectives and different problem perceptions developed. One result of this divergence was that SV did show incoherence in its dealings with the supplier.

Within the Swedish group, contacts were free, informal, and open, and the problems seem to have been related to the communications distances involved, preventing daily contact of sufficient quality. The initial goal was for this group to learn from the contractor and to get trained on his software. Soon, however, the task became to see to it that contractual obligations were fulfilled.

Within TRW, contacts were more hierarchical and formal. Initially, all communication between the hardware and the software groups had to pass through the project manager. But when it turned out that hardware and software was incompatible, direct contact was permitted.

It is stated that two strong line units were working in parallel, each sustaining its own perception of reality. Project management was simply too weak to enforce a common vision. The initial problems just mentioned so damaged the image of the project manager that he could never completely regain his credibility among the software engineers. The lack of specified subsystem integration and testing steps meant that there were no established checkpoints as to the progress of the project.

Occasionally, friction between SV and TRW was a problem. What was the role of the SV people in Houston? Didn't they meddle too much? The SV people thought that they had a better picture of project status, because of their work involvement, than had the TRW project manager.

Generally speaking, TRW did not take the contract specifications overly literally. Thus SV had to monitor and criticize design work, and press for very thorough testing, so thorough that TRW thought it ridiculous. Furthermore, SV asked for contract changes to improve the system and correct early misjudgments in their specifications; while TRW asked for less rigorous contract stipulations, or, at least, less rigorous interpretations of them. Irritation was constant.

At this time, telex and telephone were the dominating means for communicating – apart from travelling. When SV found "progress reports" from TRW tendentious, neglecting important points, an SV

internal monthly review process was instituted. Apart from the checking of milestones and problems, a list of undertakings was included, defining who internally would be responsible for reporting on this at the next meeting.

TRW reported on software status weekly. These meetings were too loose; most things were just reported "on schedule". TRW executives concentrated on economic cost control, not technical advance. Annual budget cycles and accounting requirements affected resource allocation, at times creating a stop-go situation.

TRW management got monthly overviews, but the most productive – according to SV people – was the internal auditing, performed irregularly. This could be extremely good – if performed by the right persons. Actually, some outstanding individuals saved the project from the sad problems caused by lack of incremental steps and tests in well-defined stages.

Systems integration did not function well because it was not well thought through initially. But then specifications aimed at the final functions of the whole system, not at the component parts necessary for this functioning.

Among the strong points, underlined by the project manager, is the fact that when the system finally was shipped, it was very well tested.

The communication problem in the physical sense turned out to be one of the stumbling blocks. The time difference between the US and Sweden was a particular problem, the time zones being seven hours apart. Intermittent visits were just not sufficient.

TRW were contracted for software support in Stockholm for a one year period. This was crucial in the start-up phase of the system.

It was quite clear when the project started that the process to be controlled, the power grid, the object of the whole project, the power systems and the data characterizing it, were not fully defined and would change dynamically over time. But the problems associated with this aiming at a moving target were underestimated.

Functional requirements called for new ideas, new solutions, new development. The fact that most TRW group managers had not been allowed to see for themselves the whole contract and the functional specifications can only be termed a detriment to innovation, as well as to the execution of more mundane development tasks.

While the system was inaugurated in February 1977, less than two years before – in May, 1975 – a delegation led by the TRW President arrived at SV to tell that the requirements could not be met! There were only two solutions: killing the project or changing its specifications. In the latter case, penalty milestones must be changed or TRW would opt for killing the project anyhow, since their schedules were indicating maximum penalties, i. e., 27 weeks delay.

All in all, TRW asked for 49 contractual changes and got 44, two of which affected time plan or costs. The corresponding figures for the customer, SV, were 72, of which 49 were granted and ten affected cost

or plan.

Through the backup of the SV team in Houston, several important improvements could be suggested instead, and a month later, in a new meeting, some 25 undertakings were outlined that seemed to save the project. The time schedule was revised. By mid-1976, when the computer parts of the systems were accepted, the delay was fifteen months for these parts, but the whole system was only two months late. The end result was a very compressed time plan for integration, training, and acceptance tests.

The TRW system covered by this study (Tidas-D) was guesstimated to cost 20 MSEK by mid-1972; the contract for it was for 18.2 MSEK in June 1973, and on delivery in January 1977 it was, finally, 19.4 MSEK. The project is, in retrospect, regarded as very successful by SV.

Future information technology demands

When interviewing 95 companies about their present and future needs for advanced information technology and communications services, we deliberately abstained from asking only about research and development needs. It seemed important to locate what concerns might trigger new installations, on which research and development could piggyback.

The most urgent strategic concerns were linked to the perceived market fragmentation. There is no longer just one mass market, but rather a host of niches. At the extreme, these fragmented markets are seen as consisting of single individuals. They are also shifting and changing rapidly.

Increasingly, studies and reports and analyses aiming at discovering, defining, and describing such "fragments" are based not just upon written descriptions and demographic and other statistical tables but also on live pictures of, e. g., the behavior of teenage groups, the interior decorations of successful new restaurants, excerpts from the most popular TV programs, etc. And the data may be used to simulate public opinion much the same way as CAD simulation works; bordering to or developing into manipulation[2].

With such disaggregated markets, the extreme case would be products and services tailored to each individual customer. That extreme might involve the ultimate elimination of service delivery: the customer being invited to design his or her product him- or herself.

But the trend to customer designed – as distinct from custom design! – products has already started, albeit with limited applications. Using

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2 Perry, Roland: *Hidden Power*. Beaufort Books, Inc. New York, N Y 1984

the tools of CAD and CAE (= "Computer Aided Everything"), air transport companies themselves are designing the interiors of the planes they order, but still within the limitations given by the overall design of the aircraft. This limitation is now being transcended. Pioneer customers contribute even in designing the body, the wing flaps, the door openings, on, for example, the Boeing 777.

When products and services become more individualized for specific customers, they also get more intertwined, the customer becoming more dependent upon relations with the vendor, the vendor selected on previous experience or reputation. Relations are, at the end of the day, more between people than between anonymous entities.

Such relations between people make for the communication necessary in developing and designing the product, or the product-service package; a package possibly including education and training of the customers' personnel to smooth delivery and rapid deployment of the new resources; support after installation; and service and maintenance. The product features are certainly important, but bad communication might destroy potential goodwill, while good communication provides information for product improvement.

Apart from the call for new organizational structures – when design cuts through research and development, design, production, marketing, and sales functions – the customer may be operating his CAD display in one corner of the world, the producer located somewhere else. If the latter is producing for the whole world, this is even a necessity and a truism! So – telecommunications.

In the kaleidoscopic shifts in markets as well as in the opportunities emerging from new ideas generated by new and old suppliers, the key to competitive advantage is more and more expressed as being speed, thus time. With markets changing fast, and competitors picking up new ideas globally, the time to recuperate development investment is cut short. Development must be rapid, and market introduction too – on a global basis. This global view is reflected in the need for development efforts in many places to secure adaptation of the new service/product to local variations in culture, fashion, and demands.

Fragmentation of markets – would that entail fragmentation of the corporation as well? Sustaining a corporate culture is an important countermeasure, internally and in customer relations. On the one hand, it is obvious that the concept of corporate culture – values, visions, symbols, myths, precedents, models – is closely linked to human perception, interpretation of reality, and thus to communication. On the other hand, one might ask to what extent semantics and concepts are linked to telecommunications.

The answer might be that while telecommunication can never be a substitute for those thoroughly human communications means, it may often supplement them:

- One company, in the process of merging and subsequently sharpening and developing a new – necessarily clear, coherent, and consistent – corporate culture claimed to have been in dire need of live video conferencing for this process, including interaction; they now have sad experiences of misunderstandings and misinterpretations
- One company, operating worldwide, depends upon video conferencing to stage global get-togethers ("beer busts") just so that the core of their culture is certain to stay truly global, even if local taints must exist
- One company uses video communication for the rather peculiar task of job interviewing, especially when hiring people that are expected to interact broadly within the organization

One company, aware of the fact that it is the living example, the case, the precedent, that creates the culture, neither orders nor edicts, relies upon broadband to communicate a selected number of precedents while they are in the process of happening, inviting a discussion about them so that "headquarters" can see to it that the interpretation really comes out as intended globally; but staff all over the world also perceives this concern, which constitutes a "precedent" in itself; the immediacy, the "live thing" is essential.

Global activity, swift changes within and outside the company may cause several problems in securing the corporate culture. How to interpret an acquisition? What about a shift in business emphasis? How to reconcile different national and business environments that call for adaptation?

A prominent characteristic of an intelligent network is that it must not be dedicated – in fact, economy may even require that it be more versatile than that. Therefore, we have seen it used for the introduction of a new product, but in three different ways.

- There is the general information to the staff of the company, telling why this product is important, where it fits, how it competes with what other companies offer.
- There is the more specific information to the sales staff, telling of important points to stress, marketing support details, availability of auxiliaries or, possibly, of the product itself initially.
- There is also the direct sales pitch, made in a market introduction, to all customers, or at least to the most important prospects. In general, supporting sales representatives may prove highly efficient and profitable.

These are not visions; several companies were employing such tactics. Why, then, not through live conferences, video cassettes, or ordinary sales trips plus marketing campaigns?

- Globalization makes it necessary to really reach out, and to reach out preferably by a message from the CEO or some other prestigious and credible person.
- The play for time: there is not too much time to recuperate the costs, and thus marketing must proceed with highest speed. Before that stage, research and development is more and more geared towards "competing in and for time".
- The need for interaction: customers are invited to stress concerns, ask questions, and they may now meet the top brass who can give authoritative answers.

We see a pattern forming. The directness, eye-to-eye, and the interaction and the immediacy, to save time, come to the fore in these examples.

It is easy to point to specific industrial sectors, one is retailing, others represent certain investment decisions, construction, and petroleum exploration projects, where such advantages might be truly important.

We have been able to trace another type of communication, where high capacity information technology services were judged truly instrumental by our interviewees. "Strategic communication" is the term they prefer. It is even so strategic that they preferred to withhold details. These few companies know that they have a distinctive advantage, so they do not want to share it!

We might call it "selling and buying in spot markets". (In a way, it is the reverse of some clever retailing companies' video and computer conferencing based shedding of unattractive merchandise, "spot unbuying".) The window of opportunity exists for some days only, even a few hours. Several people in various parts of the world must be called upon to discuss a particular offer. And it is essential to be able to read the distant negotiators' faces.

Several people emphasized that in crisis situations, broadband communication, live face-to-face meetings, would be highly beneficial. The problem is that there is a reluctance to accept even the possibility of such crises. In a way, this is the case of a spot market – very obviously, in time. And it constitutes the ultimate managerial challenge...

Education and training were also been mentioned. These fields are already transparent, not least as demonstrated by US and European educational networks in the process of becoming solidly established.

Culture; selling; managing in general – in research and development, two sources of telecommunications needs are obvious, face-to-face interaction and data transmission. In the latter case, computer simulation is one important emerging feature, but also the transfer of live or taped laboratory experiments is judged important. Researchers will need to discuss those, and experts will be available only at a distance.

While several companies reported that whenever a visitor from another unit arrived he or she would first log into the electronic mail

system, research and development communication needs are also related to networks outside the corporation itself, to ad hoc professors or regular partners in research centers or collaborative schemes or institutes.

The obvious suggestion is that institutes and similar organizations establish broadband links to their partners-underwriters-customers, a suggestion that certainly has been pursued. One company found Picturephones beneficial for design and development tasks performed within the same department, but with the team located on different floors of the building. Quite a few companies rely upon groupware of different vintages; some have even tailored such tools to particular needs.

Several companies feature CAD/CAM/CIM/CAE with enormous potential and some of the potential paid back quickly. A customer may order tailor cut products over any distance, discussing face-to-face at the same time as complicated sets of drawings, parts descriptions, tooling requests, warehouse availability of components, etc., all are processed and made available in real time at every location involved.

There are variations to this theme:

- Research and development projects spanning laboratories in different locations and especially when live experiments or computer simulations of a complex kind need to be part of the communication
- Joint development of computer software between teams also at a distance and where huge amounts of data as well as live faces have to be transmitted
- Design tasks, for example in the garment industry, or for that matter in air transport (the design of airplane interiors) or architecture, again with the combination of human and computer interaction; in the near future, also 3-D structures will frequently be commanded in this way ("desktop manufacturing")

One of the companies we interviewed was developing twin combinations of one computer in one location, communicating with a "slave" computer in another location. The master would be the designer, teacher, or demonstrator, but in response, the receiver at the "slave" computer might add new program segments or whatever feedback or other reactions.

There is a distinct need for combining several different modes of communication at the same time. It may well be necessary – or at least desirable – to communicate on a dozen different lines simultaneously. Window techniques may allow face-to-face discussions over computer graphics, while photographs and video films are displayed in another corner or are on hold; data banks and incoming data streams are also present, hidden but on-line, or on visual display. One company had established an "intelligent building complex" where more than ten

different channels were open simultaneously, available as "windows" on the terminal.

One of the companies is based upon high tech and working on large military contracts. Their development projects require the frequent exchange of opinions between researchers and engineers involved in the same development project; between the company managers and their Defense Ministry clients; and again internal conferencing for decision making. At the production stage, communication needs are heavy, too.

Their decision to install more than half a dozen video conference rooms was a great success. Here is a case of evaluation being straightforward, demonstrating that the investment paid for itself in a couple of months, at the cost of between a quarter and half a million dollars per room.

A product can be developed relying upon the CAD system, and production can be simulated, to be launched with just one other command, within the larger CAE framework. But if there is a direct link between development, design, and manufacturing, what about those who cannot be present to supervise the production cell? Answer: They may partake in computer simulations by high capacity broadband, but they can also be present by means of a satellite video link to the production facility.

Another defense contractor is responsible for custom designed, in this case even customer designed, integrated circuits. They have regular links to several specialized producers of chips, and they have sufficient internal knowledge to design according to demands and specifications. Development and design would include the generation of computer data for the production of diffusion masks (cf. ABB Hafo and its cell library above). These data may (in encoded form) be sent over telecommunications channels or as floppy discs or magnetic tape to the mask producer. This may well be a separate entity from the establishment performing the production steps known as diffusion, and this again separate from the steps of cutting, encapsulation, and measurement, which are operations that may be performed offshore.

Since the chips are non-standard, their design may be on the verge of attempting something impossible, and data obtained, sent back by satellite, are therefore integrated into the process and design parameters, calling for a new improved design and possibly also adjustments in the process at, for example, the diffusion facility.

General trends in international corporate research and development

The current business environment is said to be one of growing uncertainty. The factors contributing to this genuine uncertainty are, first of all, macroeconomic. Furthermore, there is technological uncertainty, caused by the proliferation of new products and the shortening of product life-cycles. The most pervasive change may well be the revolution in manufacturing, induced by information technology.

Contributing to technological uncertainty is also the fact that natural laws, as traditionally perceived, are being challenged. Cold fusion and high temperature superconductors cast in doubt established laws. These discoveries, in turn, result in a technological sensationalism that makes it difficult to assess their true nature and effects. The cold fusion phenomenon, for example, was advertised at a press conference, effectively short-circuiting the established peer review process of science. Electronic mail and computer conferencing might tend to do the same, and journalists may listen in.

Technology is one factor behind the third important field of uncertainty: markets. Fads and fashion comprehend the globe. Trade pressures and frictions sometimes distort market forces, and multinational companies try to be good citizens wherever they operate.

The conclusion is that companies attempt to organize to respond quickly to change. Decentralization is a definite trend that may strengthen accountability but weaken synergy. Thus complementary measures are needed, communications facilities being of great importance.

Enhanced flexibility calls for relationships that do not necessarily just entail the allocation of funds. Here are also ways of acting globally without staggering costs. We see the emergence of cooperation between competitors – most often precompetitive research, but also market-oriented development. Most probably, this will imply less proprietary knowledge pertaining to a specific company, resulting instead in the impetus to speed the translation of research results and new ideas into practice.

One effect is the development of network organizations. At the extreme, they would neither need their own laboratories nor production facilities – just agreements. There are some examples of this, such as the European Institute of Technology, or computer "manufacturers", which in fact do not manufacture, not even themselves assembly the products they sell.

Smaller, dedicated profit centers are more agile. The number of organizational levels is cut sharply in most companies, from fifteen to five in a typical giant company. This means that every manager will have many more subordinates who are no longer subordinates in the sense of being soldiers following orders. They are rather independent team members, contributing their own "management of themselves". The manager will be less the shop steward, more the coach, the teacher, the communicator.

These network organizations are in some instances odd-looking creatures. We have the Italian company where ninety per cent of the activity was given away to the employees, in a great number of "cells", turned into independent companies, resulting in better profits for the remaining "ten per cent" than for the previous one hundred, and in profits for the surviving independent cells as well.

While multinational corporations tend to specialize in certain fields, they allocate the task of being the center of excellence to one of their several, globally distributed research laboratories. At the same time, the integration between different disciplines calls for efficient links between these centers of excellence. Some of the most successful recent innovations are attributed to actions geared specifically to create cross-fertilization between traditionally separate disciplines.

The next type of interaction is that between company and university. Because of development speed, this is increasingly seen as a two-way street. The US industry, for example, contributed 2.6 per cent of the total funding of academic research in 1970, up to 6 per cent in 1987. In several countries, separate government research institutions exist outside the university sphere. These too are, by necessity, more frequent participants in the general network of research collaboration.

The need to build a technology infrastructure and to secure the technology base in areas judged to be essential for survival has forced competitors to enter collaborative schemes, unthinkable until recently. In the US, they required major changes in law and federal legal practices, because else antitrust regulation would prevent such cooperation. Thus we see the establishment of sometimes more, sometimes less loosely knit networks; collaborative research funds, depending upon universities for their actual research and development execution; new centers and institutes; and even companies that are given the responsibility for developing new means and tools for semiconductor production, like Sematech.

So far, of course, Western Europe has been represented by a large number of nations, but the European Community is approaching a joint profile. Several hundreds of harmonization measures have been put into effect, in fields like standardization, procurement, competitive policies, and trade. An additional five countries have indicated their interest in joining the Community, some of them having filed their applications. Since 1976, research and development have been added. The joint research and development programs are judged remarkably

successful although Europe lacks some very high quality educational establishments, such as the MIT or Stanford University in the US.

Obviously, communication tasks are large. When such cooperative schemes are international, so are communication demands. One typical solution to the problem of transferring technology developed in a joint effort to a participating company is by having a "shadow group" at the home base, emulating the project and thus developing the competence and the understanding that are necessary to implement what has been developed, when the time comes to "bring it home".

Also pure commercial links between companies are on the increase. Japanese corporations are opening laboratories in the US and in Europe. Companies enter so called strategic alliances and technical alliances, to develop specific product lines jointly, while at the same time competing in other endeavors. Over the period 1977–1988 the number of joint corporate activities US–Western Europe increased by a factor four, those US–Japan by a factor five, and those Europe–Japan by 4.5.

The problematic need for pluridisciplinary approaches transcends just about every field: research and development are multi-science, technology multi-technology and even more than that when man-machine interfaces call for psychological and sociological knowledge to be taken into account. Consequently, the employees must be multi-skilled. And markets are no longer mass markets but a kaleidoscope of niches – and multi-markets, rapidly shifting.

While creativity becomes a prime competitive factor, questions about its foundation and roots surface. What links might exist between creativity and forms and methods of group collaboration? Between creativity and language? Between creativity and communication methods?

Competence is being suggested as a balance sheet item. Then the investments in corporate culture, trust, and networks should merit to be included, too. But research and development efficiency are bound to be audited more closely, as is corporate culture, for creativity, customer orientation, and competence development.

Research will be more like production, laboratories more like factories. The reverse is true of production, too. With everyone involved in the results of research and development, knowledge has to be made more visible.

In 1988, no less than 55 per cent of all product lines in the US semiconductor industry were connected to some type of technical alliance, and out of a sample of 28 companies, 82 per cent had entered one or several alliances. In that year, around 30 per cent of all development was performed in technical alliances, up from some ten per cent a decade earlier.

Nissan and Toyota have both established research and development establishments in the US and Europe, Ford has entered nine joint efforts within the automobile industry, some forty in total.

The car is becoming part of a larger system. The Prometheus project, jointly carried out by a larger number of European firms and institutions, attests to this. Apart from the car, the "electronic road", and the bureaucratic structure of standards, norms, and rules are becoming component parts of this larger system.

In aerospace, technology transfer is sometimes a separate budget item. In Japan, transfer of technology is taking place through the transfer of people, while in Europe, the prevalent forms are reports and meetings.

Previously, the number of parts fitting into a new airplane design at first (prototype) try was just under fifty per cent at best, but recent CAD systems make it supersede ninety per cent.

Materials companies have been forced to integrate vertically, to get profits from added value. New horizontal entrants offer tough challenges. Global action is essential.

Market pull equals problem-solving for the customer. The previous three alloys in an aircraft wing have been exchanged for seven. Economies of scale are vanishing and manufacturing flexibility is essential.

In order to tailor materials and products to customer needs, the following prerequisites must be met:

- quantitative knowledge on materials characteristics
- qualitative understanding of manufacturing, possibly through CIM
- advanced modeling, including materials behavior.

In mechanical/electrical engineering, most ideas emerge in the market-place. Customers must be persuaded to participate in development projects, since everything cannot be just simulated. More and more, engineering is dependent upon other sciences and technologies, foremost electronics. Cooperation with competitors is a must, for basic technologies.

Any electronic component or system larger than the integrated circuit is, in fact, multinational in origin. Systems houses discontinue in-house production, opting for strategic alliances instead.

Scope rather than scale

We have been confronted with a number of "new" influences, affecting the organization of technology based endeavors, even making some technology based that, previously, were not. "New" is of course a vague word in the sense that no trend happens just overnight.

When SV attempted to automate the Swedish power grid, it meant something entirely new, involving technologies that were new to SV,

and in entirely new applications. The real challenge for ABB Hafo is to broaden the scope of their customers, or rather that of their would-be customers. At the same time, ABB Hafo itself must widen its scope, marketwise over the globe, marketwise also in trying to get a feel for new applications. The problem confronting Televerket was the unexpectedly rapid development of solid state switching, and also the need for broadening the scope, from being an "administration" and a "monopoly" – the one single basic supplier – to become just another company among several in a competitive market.

Our three companies in disguise, Turgid, Prose, and Elne, had all hoped to reap some substantial benefits from economies of scale. Instead, they found that whatever gains could be reached, in mass production they were not.

- Their markets were the same, and yet market structure and market were undergoing fundamental transformation. Significant virtues in one market were almost insignificant in another. But the consolidated technology base, extending outside the technology base required for any single market, made for other economies, economies of scope, of sharing knowledge and experience and relations and risks.
- They may now find suppliers that contribute significant new qualities, innovative software, and alike. Some rationalization in consolidating warehousing or exchanging temporarily scarce components might also be reached, with overall corporate profitability in mind.
- Entrepreneurs constitute a scarce resource, and while it is difficult to motivate an entrepreneur to stay within an organization once his or her independence has been compromised, the larger scope might serve as an inducement. Provided, though, that the entrepreneur does not feel walled in.
- In development projects, the more inventive the project the higher the uncertainty. Through the pooling of experiences, and through the stepwise exploration of different niche markets and of different technology options, the whole organization, and its components parts, can reduce the cost for reducing uncertainty.
- When time is a crucial factor in competition, pooling of experience and resources again make for an important competitive edge in arriving to the market before or, at worst, not much later than rivals.
- Since the technology relied upon becomes more and more multitechnology implying that the company has to be at the leading edge not just in one but in several fields, there is the requirement to be close to suppliers as well as to knowledge sources at that

cutting edge. Previously, one laboratory or other unit might have been sufficient; no longer.

- Before the technology phase, and when it comes to testing and evaluation and assessment, we have knowledge creation, science, research. Again, the challenge is to combine different disciplines, which may be represented by institutions located continents apart.
- Speed, new approaches, but also costs require new ways of performing research and development: in consortia, in European Community programs like Esprit or pan-European ones like Eureka; like in the Japanese Fifth Generation Computer Project, or the MCC or Sematech in the US.
- Sometimes, the same technology, or combination of technologies, can be gainfully employed in serving entirely different markets or at least different niches. Different countries, niches, etc., are not necessarily converging but experience may tell of how to court one market, given the experiences from another. The same might be said for different trajectories of technical development.
- The need for testing, test marketing, for recognition, and for references can be met more easily. The appetite of one market may be more easily satisfied when something has been introduced in another – or sometimes this serves the strategic objective of slowing down the sales of a competitor, since uncertainty is being created about the future validity of his offer...
- The opportunity to get a different viewpoint because of cultural and other environmental differences simply cannot be underestimated. – We may call this the courting of economies of scope, not scale. It is, generally speaking, the scope of knowledge, be that expressed as reduced uncertainty, market experience, science, or technology. In the corporations we have studied, it all resorts to technology. Thus we have seen what might be termed the economy of technology scope in a dynamic development, or the *technonomy* (technology based economy) of scope.

When it comes to organizing, developing, and supporting that larger scope, we have encountered some means:

- The establishment of centers of excellence, with a subset of "corresponding members", i. e., excellent researchers, engineers, etc., who are employees of the center but are located with some other installation of the company, or even outside it, in some other part of the world
- Research projects encompassing several units, located apart
- Shadow groups, working at the home base on segments of a project or responsible for following it when the full effort is per-

formed elsewhere, making it easier to transfer knowledge and experience, and also to inject particular viewpoints emerging out of a particular local market, technology, scientific etc. environment

- Laboratories and research groups which resist knowledge fragmentation to allow for a view characterized by coherence and comprehension; should this cause duplication of work, such duplication has to be regarded as useful
- Meaningful competition as well as the sharing of tasks especially when it comes to problems related to software or software combined with hardware; these lend themselves to electronic communication
- New communication means such as electronic mail systems, electronic messaging boards, and computer conferences and alike, more generally, "groupware", that allow for problem solving across all organizational borderlines.

Information technology and the technonomy of scope

Going back to our three cases of information technology procurement, we have found several instances were the latest information technology qualities, had they been available, might have proven very beneficial.

- In developing, or adapting, the PBX, much design work, not least of software, might have been done electronically. The same holds for testing and hand-holding in the early stages of practical implementation. Information technology tools might also have come in handy in training and education. Travelling would have been less, and perhaps some systems could have been developed for the automated translation of numbering and other standards dependent features. Examples would include the latest development of aircraft, such as of the Boeing 777, or the collaboration between Apple in California and Sony in Japan on the development of the PowerBook laptop computer.
- In a way, the ABB Hafo establishment in San Diego might have been substituted by an international 800 number. In the section on advanced information technology applications, we encountered a company that commanded a production system that was highly vertically dis-integrated. They relied upon information technol-

ogy, telecommunications, as well as the transportation of data carriers and on simulation, for their development and production processes.

- In the development of the power grid, we were confronted with any number of communications problems, not just between supplier and customer. The telex so frequently used would today be electronic mail and fax. The time differences between Sweden and the US that were so frustrating and detrimental would be spanned electronically, at least partially. The cumbersome decision making process within TRW, with a project manager without enough clout and a hierarchical system first to mount to be able to descend through the ladder of command again, might be cut short electronically. Of course, the inherent uncertainty could never have been eliminated, but it might have been handled more coherently and systematically. The communication with software developers, systems integrators, and internal technical auditors could have been more efficient with the information technology tools now available. But please remember that without sufficient power, without an adequate organizational charter, without the permission to cut through the organization electronically, electronics is still no solution. Not in itself! The linking of laboratories in dozens of countries to partake in the same project within Ericsson would be but one recent example.

Judging from our comprehensive series of interviews, and from our case studies, we might establish some hypotheses regarding the application of information technology to the corporate innovation process:

1. Information technology companies themselves constitute an obvious testing ground for introducing, trying out, and then, with information, case studies, etc., spearheading information technology applications, not least in research and development.
2. Attempts to reach economies of scope lead to a natural inclination to utilize information technology. The wider the scope, the larger this inclination would grow, i. e., the more numerous the dimensions included.
3. Some customers are just requesting information technology to be applied unconditionally, e. g., in supplier networks, defense ministries, etc. We have also seen that in certain markets, customers do not judge companies as serious enough if they aren't equipped with certain information technology paraphernalia, productive or not.
4. Information technology applications and networks may be introduced for more efficient warehousing, marketing, selling, specific design purposes, or what not. Research and development will be able to piggyback on such systems, which have been motivated

primarily by some other corporate function.

5 Where time, development speed, is a crucial factor in competition, information technology will be adapted early on, for simulation, messaging, gaming, groupware, etc.

6 If specific sequences of the development process are becoming very fast, such as in manufacturing with very brief tool setup times, the time squeeze will be on other segments of the whole production or development process too.

7 Cementing a new acquisition, gaining economies of scope, developing and maintaining a common corporate culture, may call for information technology investments to which research and development functions become party.

8 A trend to vertical dis-integration, or, more generally, to networking is bound to increase the allure of information technology solutions to "social" or link-up needs.

9 The same can be said for research consortia or other formal network organizations, where sometimes electronic communication and other information technology novelties are part of the structure (e. g., expert systems).

10 The need to develop software, alone or in conjunction with hardware, has even seen the emergence of full scale network organizations or the establishment of companies and company units located where competent individuals may be found – F International; software companies in India working for Scandinavian or US corporations.

11 When several units produce the same product, there is the commanding requirement that designs do not diverge; information technology can be an important, sometimes compulsory, tool.

12 Convivial systems obviously have the upper hand, as demonstrated by the classic telephone, and, today, by the fax and the cellular radio.

13 A specific project may offer enough benefits for the establishment of, e. g., a communications network or a simulation computer; these then become part of the daily life of the organization, and of its infrastructure.

14 A less tangible resource comes out of the establishment of a description of the company's development and change mechanisms, generally accepted within the whole company and serving as a common language and frame of reference. Within such a framework, the risk for misunderstanding and miscommunication that might else kill a new information technology system (as well as other endeavors) are reduced.

15 Pioneering individuals, irrepressible entrepreneurs, may be the

ones convincing management to go the information technology route, and then they are the ones who prevail to see the installation succeed.

Conclusions

Increasingly, companies compete with qualitative features rather than price, commodities being an exception only to the extent that no service provides qualities here too. Thus product development scope has to comprehend various aspects of service, such as information and knowledge provided before selling, installation, and support and maintenance, as well as add-on items or add-on knowledge.

Most such advantages are by nature ephemeral, as they will be copied by the competition, sooner or later. Image and trust serve as temporary buffers, and there is the competition for time. One might say that rather than gaining cost advantages along a learning curve, companies strive to create new learning curves before the competition gets settled along the previous ones.

It is a banality to talk about the dynamic nature of this economic development. Rather than looking upon the isolated profitability of a discrete product, what really counts is the profitability of the company, the business unit, over time, that is the flow of products as a dynamic process: the technonomy. If features are unique, it is prior performance, image, trust, and the reliability associated with this or that producer of products and services that might be key to customer decisions.

More robust are advantages based upon the combination of normally remote competencies and thus inherently difficult to combine. Just the mapping of such competencies within a corporation might demand substantial effort, sometimes several years. Then to manage what traditionally are less than compatible combinations is a trick in itself.

Generally applicable tools for such team work are electronic mail and other types of groupware. They are employed also for another type of scope enlargement: bringing people from different departments together on one project, often under headings such as concurrent engineering or simultaneous engineering, the departments being research, development, design, production, perhaps also marketing and sales. Here groupware centered on CAD or CAE systems is particularly powerful.

Bringing products to the market faster is one side of the coin, briefer product life times the other. Therefore, national boundaries must be spanned, the more frequently and the more widely with the aid of telecommunications and various types of groupware. Agents, as part of

the selling and marketing process, but also alliance partners, who might otherwise be competitors, are brought into the loop.

One way of managing for the broader scope is to delegate the actual combination of incompatible competencies and specialize in the management of scope. This is the famous Japanese reliance upon hierarchies of suppliers, these suppliers being responsible for entire, self-contained sub-systems rather than diverse components. Such suppliers partake in the development process and again they communicate electronically with their customer, or, rather, their partner. Sometimes electronic payments systems substitute for invoicing.

We have seen that the earliest stages of this knowledge creation process – research and development – are those where "scope" would seem to involve most dimensions to be described, while it often is "pre-competitive" also, making for industry-wide or national collaboration. National boundaries are transcended, as are disciplinary and organizational borderlines, and those between the world of profit and non-profit universities and institutes. With research and development as a pioneer in relative openness, computer networks and groupware applications are bound to be tested and introduced here early on. Corporate development projects have been reported to gain enormously from the application of such methods: time and cost gains of some 90 per cent!

Finally, the customer is brought into the system as well. The ultimate result of the dictum "the customer is always right" might be the individualization of each and every product. Again, communication is indispensable. That closes our circle: we are back to the discussion of knowledge and service provision as part of the product. Obviously, expert systems, "hot lines", intelligence built into hardware, electronic mail, and other information technology tools might help leverage service, CAD systems allowing for individualization, simulation enhancing quality and cutting lead-time, etc.

One would prefer to get to some measurements of scope rather than just discussing it in qualitative terms. We have been able to establish a number of dimensions: corporate borders, national borders, from corporation to non-profit organization, encompassing several disciplines and competencies. Applying these dimensions requires adaptation to the particular industry under scrutiny, however. By the same token, the relevance of information technology tools varies considerably, and changes and grows as new such tools are coming to the fore, emerging out of the needs associated with the technonomy of scope.

Five scenarios

TeamWhere for TelePresence... now it SMELLs!

A visit to the MetaScope MeetingVroom of the year 200X

She found it somewhat hard to concentrate at first. Then she pushed the button for coffee herself, and her apprehension abated. She had now localized the smell: it came from that man who represented the Australian team, what was his name? Terse, Terse Statement his badge read.

The addition of smell to the TeamAnyWhere system was so new that she hadn't adopted to it – as yet. Knowing that this Australian – she couldn't refrain from thinking of him as Aastrilian or however his pronunciation would be spelled – that this mate – mite – had recorded his contribution a number of hours earlier was of no concern to her. That she had adapted to a long time ago.

Actually, he seemed to belong to the Sir L. O. school. This denomination stemmed from a Business Week article the other week, where they had introduced a classification of presentation styles currently popular with people participating in TeamWhere sessions.

People had gone to school in droves, to participate in courses to make their presentations more lively and convincing, and their teachers drew upon the best artists. Even if Britain was sinking into the North Sea economically, the psychologists and the anthropologists had discovered that the styles employed should be described as patterned upon a handful of artists, almost all British, including John Cleese, Alfred Hitchcock, Winston S. Churchill, and Sir Laurence Olivier. Business Week also gently ridiculed those many project leaders who had lost their own natural personal styles while attempting to emulate such convincing orators.

While all this went through her head, she did not miss a beat in the Australian's presentation, which was pretty interesting once you got over his Sir Laurence manners and the aroma of Australian brew. She made some notes in her handwriting to the computer, most of it on the yellow "legal pad" part of the screen, i. e., for her own files only, some also for her own team, on the pink background.

The reason for the theater training was of course the revelation of the age-old knowledge that body language and prosody provide much more impact than words and their content to the presentation of a message. The medium was not the message, but rather the individual

style. Like with the Business Week article and its findings, she had gotten pretty uptight about this at first, but then learnt to relax. She hoped that those who now felt exposed by the Business Week article (available and distributed in electronic format mostly) or just awkward trying to emulate some of these very best orators – best for other times, other media, and other messages, mind you – would also come to relax eventually.

She knew that all those concerns had in turn created worries that TeamWhere would go nowhere because people would become so flustered about appearances, or involved in reflections on appearances, or in reflections on reflections on... and so on, that content would get lost. But most often, once the TeamWhere conversation got going, the fascination with the theme took over.

After the Australian presentation, Terse Statement and his team would stay frozen in their chairs, or they would fade away, since they were not present in real time. She would then lead the discussion between her team, and the other three from North America, and the two from Europe. It must be pretty late over there, she thought. That Frenchman was trying to conceal a yawn.

While the Australian was winding up, the blue part of her computer screen lit up. Her pink part was already pretty full of notes from within her group of six people, and now the first message came in from the German group.

The left hand corner of her pink screen already displayed the rough structure of the silent computer contributions that had been filed. In white, the structure proposed by the Australian was featured. She could already spot some differences here, but they were perhaps less of principle or philosophy, more related to practical matters. And, after all, their joint task was to develop a tailor made rapid transit system for parts of Mexico City, taking into account both telecommunications opportunities and air traffic in to and out from the city.

The German message was also on structure, and its point was a direct suggestion that made much sense to here.

– Thank you, Terse, she said to the smiling Australian, who would be able to see their meeting, again recorded, the next day. But he had prepared a gimmick; Terse didn't stay frozen. He had anticipated the courteous "thank you", and had saved some famous last words:

– Just a minute. Since we have spoken about our approach to the Djakarta problem, let's pay a visit there. Let me assure you, it takes just two minutes.

And his almost live 3-D image in the chair, and that of his team in the background, where they, appearing diminished, looked like placed in a doll-house, all faded away. Instead they, she and her team of teams saw the three-dimensional simulation of how the tricky parts of the Djakarta transit system would be solved in practice. And then they faded away also, to be substituted by exactly the same reality that had just been simulated, only that now all participants could share and

appreciate the real difficulties encountered by the Australian team.

She noted that her green window began to fill up with suggestions for the Australians to act upon. Especially the Mexicans were very creative.

– The meeting is called to order, she said, which was as unnecessary as always, since everyone knew the need for discipline in this type of conference. – My name is Turgid Prose, she continued, and this was equally superfluous, since they already knew that.

Then she did don her electronic glove, and went around to shake hands with all the team chairmen, those that appeared to her as present in the room in full natural size, their team members remaining in the background, projected in 3-D to be sure, but in dwarf size. Apart from when they spoke.

Making the tour, shaking hands was not necessary, but it was her style. The Frenchman blew her a kiss, knowing that she would understand how he deplored that he could not stand by his country's kiss on the cheek tradition. Not yet.

Turgid started out with the suggestion from Germany. Thus she called upon the data bank for a live presentation of the cultural differences between Indonesia and Mexico. Here, smell came in handy. They were shocked by the air quality of Mexico City, which made it easier to accept the odors of Djakarta. Next, economic differences and similarities were covered, but that could be done mostly on the screen, since the point was comparing demographic and economic data.

Now for the real meeting, she thought. Contributions were piling up on her different windows. Some of her own team members she knew she would like to see the comments in the original handwriting, others were intelligible only as interpreted by the computer...

The orange window presented the three different agendas that she had requested the computer to try to compile, on the basis of inputs before as well as so far during the meeting. As a matter of fact, there were only two agendas; the third was a minor variation of the second. With some deft handwriting and arrow symbols, she consolidated them all into one, and the meeting started.

She already knew that they would begin with structuring their problem area. Next, they would try to define the few basic problems they had, and then they would try to get behind those obvious problem formulations to arrive at the very basic underlying problems. They had ProbForm software to help them do this.

Almost at the same time as they arrived at the final problem definitions, all available data pertaining to such and such a definition would be available in the fact window, the yellow one. She had decided that for each problem they would also become immersed for a minute or two in the real environment of the place. They would listen to the traffic noise in Mexico City, for example, while experiencing being bumped and thrust through the crowd in the present subway.

Actually, she did this because she had learnt the importance of creat-

ing if not a common culture – that could not be done at a distance – so at least a common framework. She had been careful to brief the facilitators that the points made implicit should be of real relevance and not just touristic or other oddities; and she had been careful not to experience it herself in advance, because she wanted to share the awes and shucks with all the others. Else there would be no common ground, only perhaps some feeling of manipulation.

She also laid out the Whisper function on the screens. So the minute after the Experience of Mexico, they all just listened to a hasty mix of the various exclamations and comments that had been made orally, and anonymously (though she could distinguish the French, Spanish, and German accents – she thought; but there were Hispanics in her team as well...).

For the fact selection and discussion, she submitted the chairpersonship to the Frenchman. To generate relevant criteria, she led the discussion based upon morphological analysis and relevance trees; but then she had already divided her team of teams into some groups that used brainstorming instead, to design a raw wishing list. Finally, the whole group consolidated, discussed, organized, and rated the various criteria involved. Collectively, they submitted the list to the Management Chairperson, who would have to discuss with the customer, Ciudad de Mexico and the Mexican president.

The meeting had been going on for quite some time now. Surely, the Europeans were signed up to work through the night, if need be. But that would not be efficient, nor would it be right from a motivation point of view, keeping them away from their families too long. Save that for the real emergencies. She opted for handing out a number of brainstorming sessions to be performed in parallel in all groups, and then thanked them all, and asked them goodbye and au revoir.

Her own team stayed on to continue directly with their brainstorming. This included of course Benito Zapata, who was on site in Mexico City, and Junipero McCarthy, who was temporarily on an assignment at La Jolla.

The Swedish Model Redivivus

Once upon a time, there was something called The Swedish Model. First held in awe, then somewhat of a laughing stock.

For a quarter century or more, Sweden was perceived as a model. Peace, welfare, egalitarianism, tolerance, consensus – and, as the foundation for it all, a competitive industry, a thriving private sector that fed the welfare state.

The centerpiece of that foundation was the harmony characterizing the labor market. With more than 95 per cent of all blue collar workers unionized, and, unbelievable enough for an American, an almost similar degree of organization for white collar employees of 80 per cent, one might have expected the chaotic situation of the UK in the 60's and 70's. But to the contrary, in a country where even chief executives sometimes were union members (though the membership was 'pending'), collective bargaining served to create little uncertainty and less strife in the workplace, and in corporate planning. Equally surprising to the foreigner was the fact that the employers also were unionized!

Several reasons have been suggested why the Swedish Model ceased to function. As it foundered, however, the consensual labor market harmony fell apart too. First people stopped going to trade union meetings, then they opted out of the movement. Centralized collective bargaining, where all white and blue collar workers had been party to one or a few single contracts, interlinked, lasting one or more years, gave way to deals that were specific, first to the industry, then to the company, finally to the individual.

Protestant work ethic, good infrastructure, bad climate, innovativeness – those were some of the other causes suggested for the Swedish Model's success. That Swedish innovativeness often equaled importing ideas form elsewhere, and making them work, profitably. Ericsson is a case in point. Now, thanks to an American invention, the Swedish Model may be bound for a comeback.

That invention is something called groupware. Surely you have experienced it, though not necessarily under that name. Electronic mail is a simple form of groupware, a k a computer mediated group work, a k a technology supporting team collaboration. As soon as you are a small, or a large, group of people, relying upon electronic mail for coordinating your activity, to exchange ideas and viewpoints, you may say that you use it as groupware.

Sometimes you may call it an electronic bulletin board instead. Then you would underline the opportunity for open announcements so as to find other interested parties out of all board readers. Sometimes you would talk of computer conferencing, underlining instead continuity in the exchange of facts and ideas and views over a longer period, and within the same core group of people. And if you are into research and

development, another catchword would be work flow, stressing perhaps the continuous recording of important discoveries, decisions, contemplations, and so on.

The Swedes have just been through their very first bargaining process, utilizing a full set of groupware. You should realize that this is quite a revolution, since there has been developed a culture for such bargaining, much resembling the traditional American political wheeling and dealing. The chief negotiators would always wear each other down into the wee hours, and the bargaining would come to the brink of collapse. Then some new idea would be thrown in, and the collapse would happen some days, or rather nights, later. Time for government appointed mediators to intervene. New tough bargaining, night after night, and, finally, grudgingly, around five o'clock one morning in June, close to the midnight sun, both sides would finally agree and shake hands under the smiles of the mediators.

How might this ever be emulated by computer software?

The answer is that groupware allows for communication over time and distance, but not necessarily. It even allows for transcending one's personality.

When unions saw their membership shrink, they were aware that what kept membership loss down were the insurance functions that the unions had taken on. New members, however, might be attracted by competing insurance offerings instead.

One of the white collar unions took the lead in establishing itself as something of a service company, catering to several of the members needs, also those traditionally not associated with union membership. The strong point of that offer was the union's presence on the workplace, always represented by a colleague to the prospective member, and also, quite simply, the totality of the offer.

In addition, there is the function of a professional society. Experts and professionals certainly both need and like to be in touch to exchange experience and develop competence, regardless of affiliation. The unions' groupware facilitates such communication too, displaying features to safeguard confidentiality and proprietary knowledge.

But the real lever was the clever utilization of computer communications, and associated groupware. Members were given the opportunity to simulate for themselves their personal situation, and a family might play through, at home, in front of the PC, several different options for insurance coverage, savings arrangements, travel packages, etc. They might easily use that computer link to discuss with other families in similar situations, and they might also call upon the expertise of the union. The high incidence of PC's in Swedish homes was a social prerequisite for an equitable use of groupware "for and through the people".

Then but not now, however, the union would stress the utility of groupware for traditional union activities. Instead of holding meetings in the flesh that no one attended, some meetings are now on-line, oth-

ers off-line, some geared towards facts and question-and-answer sessions, others at discussions on issues related to the individual workplace, company or industry practices, or general questions, pertaining to all or at least most union members.

If nothing else, Swedish union officials always used to be very well versed in rules and formalities for holding meeting; what propositions to put against what other propositions first, and so on. Groupware offers some brand new opportunities that they played around with like wild for a while. You may vote, rank, prioritize, affix various points or percentages to different suggestions, etc.

The groupware developed – the most well-known carrying the symbolic name 'Ombudsman' I, II, III, etc. – allowed for people from the same workplace to communicate smoothly; groupware replaced some of the previous "union bureaucracy". Depending upon the problem, they might do so off line and from different locations. This was a boon particularly for the growing number of people working out of their homes or cars or at times that suited them.

Co-determination or labor participation in workplace decision making has a long history in Sweden, and it has also been instituted in laws, covered by the Swedish acronym of MBL. Consequently, there was a groupware package developed under this very label. Previously, MBL was seen as too formalistic and bureaucratic; it had the potential of creating a consensus like in Japan, but that potential was frustrated. Now, groupware is believed to have performed that feat.

There are also questions, however, that require face to face contact. Again, groupware serves to simplify voting, judging, brainstorming. If such person to person meetings previously drew few participants – sometimes none but the chairman and his secretary – groupware has heightened the interest drastically, since face to face is prepared off line. Also, these meetings now allow everyone to participate and contribute; groupware prevents that a few talkative monopolize the meeting.

There are three specific attributes that make for the extra utility of groupware. The first is the option of anonymity. For touchy problems people may well choose to enter their views without revealing their identity. There has been the occasional discussion when such viewpoints have been judged just appalling, but no one would really propose leaving them secret though alive and well. Openness has rather offered opportunities for tackling previously hidden but important problems, culturally or otherwise off limits.

The second feature of groupware is spectrality. Even in a discussion or a meeting, you may choose to play a role, to conceal your real self. Role-playing is much facilitated in computer mediated electronic media. Previously, top union leaders were elected for their ability to stir a crowd, quite a few also for their endurance in those nightly negotiations. Another quality would be their intuition for the membership's feelings and concerns.

Electronic media allow for a distinction between these different qual-

ities. One groupware feature is the polling of attitudes and requests from the members, and thus there is the development of a team of "pollsters" that rely upon groupware to probe into the feelings of the constituency. Groupware does not exactly lend itself to stirring the crowd; it is a rather cool medium, so the crowdpleaser might be frustrated and even miscast in trying his or her tricks there. The application of spectrality thus means the distribution of roles according to abilities. The negotiating skills we will return to.

The third feature is the intelligence built into groupware. Brainstorming; prioritizing; voting are some of these features. Others are the automated recording of arguments, questions, issues, sorted, sifted, and organized according to quite clever software. This even takes into account conceivable badmouthing or other incidents in meetings that might cause undue friction (as apart from those intended to cause friction, to encourage the troops, or unsettle the counterpart).

Given these features, the negotiation process has become quite different. For a long time, there was the development towards centralization, and the sunset for the Swedish Model was accompanied by the breakdown of that centralization; to some extent, the decentralization was centrally controlled.

The new process – epitomized by a groupware package named Saltsjobaden – cannot be called neither centralized nor decentralized. It does not even call for fixed one or two year contract periods. It is rather the question of an intricate web of groupware mediated contacts and communication.

Most people would contend that it is bottom-up, though some of the real power pertains to those designing the groupware and the communications networks. The latter are open to anyone with a PC; that is, every Swede. Communication is actually not restricted. The sour point to quite a few critics is rather the information available, such as various types of statistics, and the software shaping the conditions for its utilization.

There are several "circles" or subgroups. The leadership of the unions, or for that matter of the Swedish Employers' Confederation, may address either select groups or individuals, their whole constituency or some of their "ombudsmen".

Everything is not technology, software cannot go it alone. It is rather the interplay between different communications forms, where different persons display different strengths. All depends upon the context, and the purpose.

What about the mediators? They are still there, but now, there is a multiple-tiered groupware program that some claim have substituted them. That is clearly overstating the case, but much preparatory work before mediation is done through the computer. And since the negotiation process is a constant feature and since many more aspects of people's life portfolios are covered, the mediation process is quite different from under the traditional Swedish Model.

Media used to play an important role in the good old days, and they still do. Then, they were one important arena for gaining understanding for the claims of this or that group, and for preparing the ground for the ultimate weapon: the strike or the lockout. Newspapers and television played a role, and they still do, but now much more in interaction with what is brought to bear on the computer networks.

Perhaps the downfall of the traditional model to some extent was caused by the emergence of competition and struggle rather between different unions than between unions and employers. This is a phenomenon that has not completely abated, reflected in the development of different, targeted, and customized groupwares. The complex overlay of individual, group, professional, industry, etc., aspects make for less clear fault lines between different groups, but of course groupware has not eliminated what used to be called tensions or basic differences between capital and labor.

The point is that a new Swedish Model has developed, succeeding in establishing working compromises on these different fronts. Question is, how far will this model work, and for how long? Will this one too contain its own seeds to destruction?

Go join the others on the... of history

In the early 80's, in a Swedish seminar on "understanding society", there was made an analysis of why some of those forecasts pertaining to future applications of information technology had not come true. There were several reasons: competition for money but also for time; competition for the present from the future, as promised in bright colors. There was also the ignorance of human information behavior.

A renewed analysis today would provide further examples and underpinnings to this reasoning. There were several examples of information technology that surprised the forecasters, such as the successes of video games, spreadsheets, and desktop publishing. For every such example, there were also one or some examples of sure successes that failed miserably: the Picturephone in the 70's, the MIS ideas even before that, artificial intelligence's extravagant promises, promptly repeated after every setback.

To this, we would add something, which, in those early days of the 90's of the last millennium's last century, went by the name of groupware; though a host of other names was also suggested.

The idea was seducingly simple: computers might be relied upon to improve team work productivity vastly. Electronic mail and computer conferencing were seen as just the very early, and crude, steps towards a growing universe of "soft software tools", allowing for people to run meetings much more effectively.

In fact, every human activity was for a while seen as a team effort. Why not? The delivery of a product or a service might be described as nothing but the team work from the mining site, over rail or other transport to storage and to factories, and then on to the user and service, maintenance, and waste heap. These people certainly were in different places, and they were not in action simultaneously. But sometimes it might be wise to allow the customer access to the whole production chain, and the clever producer might like to ask the end user.

The apparatus of service and product delivery had other features, however. Organizational entities, inside and outside legally defined boundaries, called strategic alliances, corporations, collaborative programs, etc., had to communicate and to work in consort. Sometimes in the same place, though not so often. Most often, rather, in different places, with a mixture of synchronicity and different times.

Those were the foundations for the ideas that went into the development of groupware. Innovation and procurement, quality and just in time, service management and multinational activities; they all fed into the growing number of soft software attributes. Creativity got a new chance. Communication got a new meaning. Culture took on new organizational shapes.

To be sure, there were the ordinary carriages before the horses. When word processing was introduced, salesmen of the new technique tried to persuade companies to reorganize around this function, because else it would not make sense economy-wise. Early installations of groupware took on a similar importance. A tool that expensive, setups that sophisticated just had to be utilized. But this was to be a transient phase, just like in the case of word processing.

A fad, groupware? *Groupwarp*, to parallel the artificial intelligentsia? Certainly. But not just that.

Those artificial intelligence dreams of the 50's, they didn't come true. Well, some of them actually did. Interpreted literally, spreadsheets would in those early days have counted as AI. What not with desktop publishing, database management, simulation programs, computer aided design? In a way, AI is like the proverbial pot of gold at the end of the rainbow: it is still glimmering, but always, and only, at a distance, forever evading your grip.

Electronic mail and computer conferencing have slowly emerged into today's electronic forum. In the process, they have absorbed many of the features of groupware, a number of software tricks, intended to improve functionality.

So that's part of it: groupware didn't happen because it wasn't needed as a freestanding concept, as an icon in itself.

Another point refers to the one brought up initially: people's ways of using information, and thus information technology. Much like with television, it wasn't that simple and convergent.

It wasn't convergent in the cultural sense. TV turned out to have very different impact on people's media behavior in different parts of the world. The US, France, and Japan, for example, never converged. The reasons were multifold: different history, different culture, different organizational, legal, and political settings, and so on.

The same turned out to be the case for groupware. The French created their *Créunion* system, which with government backing, and implemented in the Minitel system, gained some prominence (and quite much snickering, because of some the more doubtful uses; doubtful not least to born-again Pentecostals). The Japanese added groupware to all other communications media, and spoke pleasantly about it, and early reports warned that they were taking a huge lead in this technology, but then it turned out to be indistinguishable from all other Japanese group oriented communication practices.

The most interesting thing with the Japanese system, at least to the Westerner, was its ability to allow for the Chinese, or Kanji, characters. But if this certainly was important enough to the Japanese themselves, and to some export successes in the Asian markets, it was not possible to make economic sense if it in a Western context.

And so on. Groupware was first regarded with skepticism and outright hostility in many Swedish organizations, because there was the fear of manipulation and also of tampering with various estab-

lished and negotiated ways of setting up meetings and reaching agreements between different parties. After a while, groupware had essentially been defanged to a combination of database access and computer conferencing tools, data base however being interpreted as something broader than just formal databases of the off-the-shelf type.

In the US, where adversary processes are instituted, groupware came to be seen as a way of adopting some of the Japanese ways to consensus. This turned out not to be a bad thing, but when a famous professor then proclaimed "must we really have to resort to machines to get away from the abuses of the American way of doing business?" it dawned upon people that either groupware was a manipulative tool for getting away from something only some wanted to avoid, or else there was actually consensus that adversarial processes were not the answer. Then why not start from that premise afresh instead, applying tools and means as fit, but not necessarily groupware?

In this way, groupware became a liberator, but one whose utility vanished once the discovery had been made, thus a catalyst. The most profound effect might actually have been the one on Capitol Hill, though this, then, was largely indirect, pointed to, almost before the fact, in a famous article in the 1999 Fall issue of The Information Society.

Quite a few observers contend that this particular article was what had the impact, not the experience of groupware itself. In the same way as when just reasoning about experts systems created new ideas about different kinds of human knowledge and expertise and competence, that speculative article's sound reasoning was convincing enough. In addition, those who needed an excuse for a conversion of faith could point to technology, which always creates the impression of dead-sure proof.

The other part of the reasoning of the article, however, was a not-so-new rap-up of what was known about the dynamics of humans interfacing with each other. Not everything was there – partly because not everything was known; and it still is not – but it was a fair summary.

As most readers will know, the questions covered by this highly useful and influential summary were typically: How may different types of meetings be characterized? What may be mediated in what ways? What different personality types exist?

What do we know about different parts of a problem solving process, of creativity, of spotting new patterns in a chaos of signals, of creating new concepts to describe new frameworks? How might communication modes impact upon decision making structure?

What are the essential elements of a human discussion? How do these fit together? What might be the effects of the utilization of one communications mode upon other modes?

How do people who first meet by electronic mail take to each other, versus if they first met in Picturephone meetings? And so on.

Thus the ideas of groupware had spurred an intensive activity to

learn what really went on in meetings between people. It was just as when artificial intelligence called into doubt the body of knowledge about human intelligence, first causing the term intelligence to be thoroughly dissected, then much deeper thinking to be vested in what should, could, and might be learnt. Some of which also *was* learnt, some causing new light, and new shadow, to be cast upon old and established truths.

In many ways, old truth gained new weight: it is not what we say but how we say that counts; cynics gave Ronald Reagan credit for having implemented this old but oft-forgotten truth into political practice. Less than ten per cent of the impact came from the meaning of the words, but the body language and tactile communication were still largely forgotten, or impossible to take into account in studies.

Of course new books, the likes of "I am OK – you are OK", "The One Minute Manager", and "Communicating Effectively", sold these new truths in scores, effectively preventing straightforward manipulation. The Latin ways of kissing and hugging seemed to have taken on a global importance, kissing, however, restricted to the cheeks. Managerial retreats turned from mountain climbing, hiking, and river barging to cave discovery and team night jogging through the forest.

If the Japanese groupware added to the mystery of the Japanese, the experiences of air conditioning Japanese "intelligent houses" with different scents made a much more clear impact. It was quite a race whether Odor Power™, Inc., the Louisiana-based corporation, would climb faster than Compaq had to the 1 billion dollar mark, inaugurating the new era that Fortune proclaimed: "The New Age of Sensual Signals".

That smell was powerful was well known long ago. Someone pointed out the significance of the name of the fast-growing company, its location to an old French-speaking part of North America, and the book "Le Pouvoirs de l'Odeur" way back in 1988. Others pointed to the famous discovery by Drs. Buck and Axel of Columbia University, published as long ago as in 1991, on how genes and smell sensors are linked into an intricate sensual system.

Actually, that discovery was incomplete, but it opened new vistas for the eventual explanation of how the brain easily can recognize more than ten thousand different smells. It turned out, for example, that the most important programming of that incredibly sophisticated system takes place with the very first imprint of a new smell on the brain, or its olfactory system.

In comparison, taste was quite simple.

The previous experiments on smells and pheromones with apes, bees, and other animals took on new importance. Initially, the fragrance business prospered even more than before, but then more sophisticated ideas, like Odor Power's Scent Organ™, made their impact. The Swedish communications conglomerate Telia quickly established a subsidiary Teledoft that got the European distribution

rights, which turned out to be "the most important Swedish business decision of the year" the bi-weekly Veckans Affärer concluded – but three years later, when the verdict was in.

In addition, the findings boasted in Superlearning, where "non-figurative music" had proven to improve learning abilities vastly, were implemented. It was no question (but initially) to introduce Muzak, abusive to many, but rather various types of sound backgrounds that turned out to have an effect upon human contacts and communication.

Having taken this step, psychologists suddenly found audiences ripe for the old message that visual signals are thoroughly influential too. It is not just a question of a color or color combinations, but also of visual imagery at large; of how the horizon is broken; if there are open spaces or closed rooms. Of course multimedia programs, including those for groupware, took such cues into account, but the real impact was upon architecture and landscaping.

As we have discussed previously, one important factor in human communication, greatly affecting its outcome, is the distinguishing, choice, definition, and tainting of concepts constituting new and old frameworks. This statement provides a link between the background audio signals that mixed with the apparent talk and noise. "Concept" is a concept that might be enlarged to encompass not just abstract or verbal meanings, but melodies, smell combinations, and then the combination of different sensory inputs.

This discussion about the establishment of a useful concept also provides a link to the reasoning about what was once a concept-to-be: groupware. Certainly people communicate, today more than ever and certainly more than when this concept tried to get established, in the late 80's and onwards. Certainly we use computers and telecommunications systems, not least in communicating scents and sensory signals, including tele-presence systems, which are so obvious today that we do not need to bring them to attention.

But if team work is ever more important, if information technologies are called upon to improve it, the concept of groupware has vanished. It turned out to be a less than useful concept. Other means of communicating took prevalence than those which were highlighted with that concept.

Today, there are some new concepts trying to make their way. The question is not whether what they stand for will not be useful. The question is rather what whole concept, what gestalt, makes most sense. That, again, depends on human information behavior, but not as isolated from but rather as seen in a social and cultural and historical framework.

IMIT Research Project # 4711:

Hyperchapter: Communications Tools

We have been tracking the Telia Excotel project from start to finish. It has been one of networking, collaboration, risk taking, and uncertainty reduction. Given the public and safety aspects of the undertaking, emphasis has also been on careful recording of each and every step of the project.

Our report is divided into several hyperchapters. What follows is the chapter dealing with the communications tools employed for the project. Other chapters are dedicated to describing the actual institutions involved; the background to and goals for the project; the theoretical framework for the project itself; for our research on the project; and for our theoretical description ('from uncertainty to risk to payback chart') of it. Hot links in hypertext are provided in the shadow manuscript, so the reader can freely jump between this chapter and the others, to see what is described in one framework against a different one as well.

Telia Service has been responsible for, and financing, Excotel. The project has involved a great many companies, institutions, and individuals, most closely Telia R&D, Ellemtel, and Erisoft. The basic link has been with the collaborative effort of the MIT, New Millennium Telecommunications, most often referred to under its nickname Abyssoft. Some of the other involved parties will be introduced when the tools for interaction are described and commented upon.

Even though it is off limits to call the Telia Decision Room the War Room, this is the obvious connotation. It is used for Telia Board and Executive Committee meetings, and has the standard set of simulation programs, decision support software, telewriting, telewalls, all sorts of conferencing facilities, etc. Since the essential task of Excotel has been geared towards the development of telecommunications network tools requiring the coordination of software, hardware, and concomitant social processes, the War Room equipment was allowed to be amended to make for a description of the salient project features early on. These additions were kept there for the duration of the project, so that Telia executives could review progress regularly, which they had asked for, recognizing the importance of the project.

The various comments and questions of different Board and Executive Committee members were thus recorded and analyzed by standard Metatext software. Subsequent presentations were geared at responding to the concerns thus expressed, and to do so in a presentation form, and in a language, that suited the different members. Thus

memos, notes, simulations, etc., looked a little bit different to each member, due to individual tastes and wishes.

Independent judgment, also outside the function of project controller, has long been regarded by Telia top management as indispensable. Thus the system was linked to Expercom, allowing for the random access to independent expertise, to get to know whether the risks taken were worth taking, and whether some important points might have been overlooked. This had to be done in session, and on the spur of the moment; Board members invariably put questions of a different nature than project management did, using the same feature but other experts.

Staffing of the team was regular procedure; that is, everyone was hand picked for her or his individual qualities, and also, with the "producer" at the helm, with the overall concern for everyone's ability to work on this particular team, with precisely these individuals. Some people were even lured out of retirement, for example Bertil Thorngren, scarred veteran even from those all but forgotten days when Telia was known under another name. Two people at the SICS institute and one at the little Metamatic consultancy were also engaged.

Initially, they were all brought together for a breaking in teamware session. This lasted exactly 16 days. The idea was to work on a similar, but "synthetic", project, not smaller, not easier, but one where the computer made for a 40 times gain in time. You might call it simulation, but problem solving, interaction, working was absolutely real.

The point was, as usual with breaking-in teamware, to learn about what personal traits might cause friction, and to reduce such future friction on the basis of this knowledge. One person just did not stand the stress, and another just did not fit the team structure – neither he nor the remaining team members felt the least taken aback by this. Better to discover it beforehand!

Given the immense importance of the project, a three shift operation was foreseen. As you will learn elsewhere, it might actually be described rather as two-and-a-half-shift, with some people tying in with the Californians, the Indians, and the Japanese at the wee hours. Anyhow, this explains the meticulous care going into the creation of the Excotel Cooproom, for cooperative environment, which was shared by all members of the team at all times. Much like in a Japanese factory, the walls were soon full of information; but here, no company slogans but rather soft plans, recent problems and breakthroughs, and of course on crystal solid displays, not on wallpaper.

When the whole team available felt like it, they might go into a collaborative session, using their whole environment. Especially for brainstorming, this was felt to gear the group up to a communality of understanding, which was useful when they somewhat later contributed individually to either a structured groupware session, perhaps through morphological analysis, or an unstructured session, perhaps through synectics or brainstorming. Input was then mostly through

pencilling or icons.

Much in the same way as questions and statements from the Board and the Executive Committee were dissected, organized, and used for controlling that no important aspects were left out, the various concerns and individual traits of the team members were catered for in the information, or groupware, or workflow, system. The various meanings of a conversation were analyzed immediately, and a great many questions were thus necessarily resolved that otherwise would not have been. To these people, there was no magic in it; they were so used to it that they often might anticipate the questions.

The teamware was also equipped with corporate memory functions. One part is called the project information repository, PIR, allowing for all interventions to be stored, automatically classified and thus retrievable in a selective way. Some were also automatically marked so as to appear compulsorily in certain contexts, e. g., Board decisions, American regulatory requirements, etc.

Another part was the Autoquery function, asking for the reasoning behind each and every step and decision. Confessedly cumbersome at first, this as well became second nature to most project members. They now had a keen feeling for when to answer "intuition" as the rationale behind a certain design choice, and a firmer intuitive idea of what that intuition really might be was also forming, according to our interviews.

Concomitant to this memory function there is the backward alert, that is, an automatic signal when a problem had already been attacked previously. Parts of the memory went far outside the company, particularly into the MIT project, Abyssoft, see also below. Since the rationale behind signing up for Abyssoft was precisely the opportunity to get useful input to Excotel, no wonder that we find many overlapping problems; if Telia solved such problems, it was part of the contract that solutions be fed to the MIT consortium. All other consortium members were to do the same.

Part of the team functioned as a shadow group to the MIT project. There were certain extremely interesting and challenging goals at Abyssoft, and to implement the solutions in the practice of Telia swiftly promised to be extremely profitable. Thus the shadow team partook intimately in the development in Cambridge, Massachusetts, to be able to transfer the new findings rapidly and efficiently; some team shadow members worked within the Excotel team in Stockholm.

Telia had its own electronic mail system around the world; in fact, they had several systems. The Abyssoft project had created another powerful such network. The most obvious function of these is still the classical: to send messages, now stored not just orally or as text but rather like with the fax – since what was once fax and once computer communications have by and large merged.

But a more interesting function is what has been termed software arbitrage. The electronic mail system allows for signalling that there

might be some interesting data to be acquired, some important rights to be negotiated, and so on. Speed is crucial, but so is good judgment. Therefore, electronic mail initiates the organizing of a video conference with the usual compuphernalia; i. e., computers tied to each other for the smooth demonstration of the various aspects of the proposal, project, idea, etc. Videowall, that age-old video conference catchword, is still alive and well.

The particular utility of an electronic mail or a computer conference network has not changed in another aspect either: it is possible to find partners and contributors with specific knowledge and experience without knowing that they, those particular individuals, exist. The network provides its own catalogue, you just advertise your need and interest and you will almost certainly get some good contacts. In this case, we have enumerated some of the Excotel Swedish contacts, but should add, for Europe, France Telecom and Association Descartes; for the US, Institute for the Future, Pacific Telesis, Wharton, NEC R&D, Interclass, and Bellcore; for Asia, NEC, Osaka Labs, and Kyocera. And Rao Mediware in Delhi.

Thus these various institutions and companies have agreed to share information to a certain degree; that degree is determined contractually, but they have all profound experiences of each other and know how far trust will go. There is also very little of competing interests within the group, which helps.

First, they all share all of their external, open information, i. e., what may be available from open sources, even though it may be hard to come by or even to know the existence of. For the Japanese material that NEC and Kyocera reside on in abundance, the new translation programs have proven essential.

Second, they all share internal, proprietary reports pertaining to the area of collaboration. These are exchanged through a separate set of software, allowing for brief announcements, tailored information, and select searches when a problem crops up. Without this software, going some generations back to the information lens once developed at MIT, the amount of information would be insurmountable.

Third, what has been said already about problem solving and corporate memory applies also, but in a selective way. One reason for this is information overload, the other corporate strategy. Frustrating as it may seem, there are occasions when the system only tells, say, Telia that, say, Osaka Labs has been working on precisely that problem. Then there can be an exchange as to the appropriateness of discerning that information.

To conclude, the efficient and timely execution of the Excotel project would simply not be feasible without Teamware. That Teamware, in turn, has the computer and telecommunications network as an underlying assumption, even if telecommunications aren't always relied upon.

Obviously, electronic mail and computer conferencing resemble

what they looked several years ago; what has changed is the value added, the various functions for searching, sifting, adding impulses to a brainstorm, for automating information handling and suggestions directly out of the network, because its links to the project's repository of information and its corporate memory of concerns – as well as to more general information. Color, high resolution, speed, sound also make for more colloquial messages than just signs on a screen.

At the same time, people's inhibition in communicating via a computer has become even more reduced. The only problem is with oral communication, partly because the computer still has problems with natural language and especially speech, mostly because in a work environment, a lot of whispering might be disturbing, especially in a concentrated brainstorming event.

Sometimes computer conferencing may be performed in real time. This we have not mentioned explicitly, but quite often, the type of discussion does not require face-to-face quality but rather simulation, brainstorming, lateral thinking, or cross-impact structured input. There is a whole range of software for this, and most, perhaps all, of what is available has been applied within this project.

One example is something functionally resembling the team breaking-in groupware for Excotel; the CultCom method, attempting to create a communality of framework and language between people in different settings, national, institutional, professional. It was applied early on in Abyssoft.

It is virtually self-evident, after the fact, that different communications media have different impacts and follow different behavioral codes in different cultures. So, early on there were a great many misunderstandings, to use a modest word, between people with different backgrounds. This being the case in encounters face to face, it is hard to understand that people did not realize that this would be the case even more in electronically mediated meetings!

Sometimes, however, face-to-face would seem indispensable. That is when video conferencing applies; again, some useful communication has actually been recorded off line also. There were some great communicators in the project, including some in Japan!

Finally, we are back to the same place, different time application of the Excotel project room near Stockholm. Which may also be used for same place, same time efforts, as indicated. It would be pointless to ask how the project might have been carried out, lacking these technical tools. It would not; it would not have been organized this way, and it would not have been completed in this short time span.

The Everyware Society

An organization is controlled by its owners. Well, not quite. What about owners versus management? But, then, what about the employees? – Organizations play several roles, and interdependencies rule their daily lives. Stakeholder theory enumerates an even larger number of interested parties than the three just mentioned.

What, then, about the delimitations of the organization? If suppliers and customers are stakeholders and if suppliers have suppliers and customers are employees somewhere? What about consultants, and collaborative research institutes, and industry organizations? It is all a web, a network of connections. Enter network theory.

Stakeholder analysis and network description are but two ways of describing a complex, interdependent reality. There are several more. Rather than mutually exclusive, they are interdependent and complementary. But all theory is gray if it isn't applicable, in practice.

Network theory certainly is. There are examples of companies, and other organizations, which feature the business idea of organizing networks – there are even organizations that organize companies that organize networks.

Network – that word rhymes with telecommunications. Still, the development of networks and of networking organizations, and of individuals, has not been linked in any strict way to the development of feature rich and high quality telecommunications networks. But with those technologies available, networks have been developing even faster, becoming more sophisticated and streamlining network functions around new and old telecommunications services.

A few years ago, yet another description was suggested for the present pervasive development: "everyware". Formerly described as groupware, various value added services of telecommunications and computer networks have now become so ingrained as features of daily life that such software, services, and technology investments tend to be lumped under this new label for society and its workings. Together, these services constitute an indispensable and almost invisible infrastructure, and the concomitant habits and market rules simply seemed to call for a new headline, indicating the basic mechanisms of organizational and corporate life.

Thus the mechanisms of the economy itself are described by that word "everyware". "Every" clearly indicates pervasiveness, not just geographically but in time and activity as well. "Ware" is a pun, hinting at computer software but in a broader sense, like when educational material or various types of entertainment programs are denoted software.

Groupware, which, as we just indicated, used to be the descriptor, is rather seen as characterizing the particular programs, but not the economy's functioning in a larger context. The point is that individuals use

groupware to find, e. g., like-minded souls, and then to discuss, brainstorm, collaborate, and to exchange information and experience.

On the next level, whole teams do the same. Of course, teams are constituted of individuals, but any team features some type of formal or informal cohesion, and then there are groupware attributes to facilitate group work. Given the "every", there is no need for people to be present at the same time or in the same place. Thus they do not necessarily belong to the same culture or language or nation either, which says something of the qualities of the particular groupware employed.

Furthermore, teams of teams are also collaborating. The more formal such a team is, and the more formal the collaboration is, the larger the necessity for recording certain events, decisions, deliberations, priorities chosen, etc. One aspect of the general economic and social development of *everyware* is of course that the borderline between what is formal and what is not has all but vanished. Groupware has developed so as to induce people to apply events recording, organizational memory, team notebook, and other types of formal records that are no longer perceived as frustratingly formal, simply because they now make up part of the software hidden in the groupware accepted in the "everyware society".

Given the very social character of *everyware*, there has been quite some discussion as to its ownership. By and large, it is something integrated as a major function into telecommunications and computer networks. Good software ideas are copied, hard to protect as they are, and there has actually been developed a new type of legal protection. On the one hand, it makes the patent public, not just as the public information of the traditional patent, but it also allows everybody to use it. Not for free, however. The patent holder receives a small percentage fee, but since utilization for the real breakthrough types of software is so pervasive, those fees sometimes reach staggering amounts.

As with all technology, most development is rather of the bread-and-butter type; incremental advances. These are developed by the service providers, by the users, and by just anyone. They are not paid for but used as competitive weapons, with a limited duration of the advantage they may create. With the groupware type of patent, political concern for the emergence of huge imbalances and inequities based upon exclusive access to groupware has abated.

If groupware is crucial to competitiveness, then it is rather education, training, and a certain kind of social awareness that have proven critical to success. There may be every kind of technical feature to assist in collaborating, hard technology like high resolution screens as well as software, but without interpersonal skills no technology would ever work satisfactorily.

One might suspect that computers and other technology would make for less psychology, less expression of human warmth and kindness; it has turned out to be the other way around. So interpersonal

skill should be equated with a feeling for how one should communicate over very different media, under very different circumstances, and the type of problem to resolve or the communication task to perform to be taken into account.

Several types of human communication and development got boosted of course. We may enumerate some of the more important.

Creative sessions: brainstorming was invented in the early 50's and developed further by the Buffalo School in the 70's and 80's – to summarize in one sentence. Groupware gave new impulses and new freedom to brainstorming, and the new variations were given new names such as groupstorming, brainware, ideaware, brain audit, etc. Convergent and divergent phases of the process might now be combined in new ways, and so might also convergent methods, such as morphological analysis, with divergent, such as synectics or brainstorming.

Training and education: the dream that technology might improve the educational process finally came true. Or it did not, because the social element, the group process continued to be at the core. For language training, for example, the computer alone would not do the trick. But when groupware, virtual reality, and telepresence were brought onto the scene, the whole situation changed in as much as the social character of language learning was not just preserved but even reinforced, while the computer stood for method and evaluation and feedback.

Groupthink, group procedures: the only conscious concern for managing meetings has traditionally been the one as to whether certain rules and procedures are adhered to. But what about the efficiency of the meeting? The availability of technologies that initially took on the look of solutions looking for problems initiated fresh approaches as to what is actually going on in a meeting. With that knowledge as a basis, every meeting might, in principle, be improved, also those performed without any technology assistance at all, in the same agora way as in Athens two and a half millennium ago.

Organizational production as a process: if "networks" were substituted by "everyware", new descriptors, new tools for analyzing, new methods for accounting and auditing had to developed. And so they were. The stakeholders, to follow an earlier way of describing, would need new ways both to understand and to assess the kind of interactions they were involved in, and their products, either services or concrete products, or the return on investment and the like.

Assessing cultures and values: the eventual rationale of *everyware* might be found only in global communication, in transcending border-

lines. Apart from descriptors pertaining to different communications situations, an understanding of the influence of corporate, professional, and national cultures also had to be developed. And sex and age had to be brought into the picture.

But that picture turned out to be a changing one – as indicated by the mentioning of different age groups. So the soft software of the groupware of *everyware* had to adapt to the dynamic development of values and attitudes.

Let us now look at some of the groupware functions, making for the "everyware society". The most basic one is that of self-organization. Networks were also said to be self-organizing, flexible, therefore robust. In reality, they turned out to be astonishingly stable and constant over time, with some peripheral attrition. And they were not really all that self-organizing, because the contacts that could be made were limited.

One of the basic functions of groupware is, by contrast, the ability to open connections between just everybody everywhere that shares a common interest. This does not make for complete instability, but some of the functions that we have enumerated, such as skills to overcome cultural barriers (though not always completely), make for more openness and flexibility.

You would not expect people to marry by means of groupware. But associations and clubs always depend upon a common interest, be it professional or hobby. Therefore, many social functions have actually become dependent upon groupware. They would have existed anyhow but contrary to early concerns, the new technology has made for an increase in social contacts and for less strain in them. Family cohesion may now be maintained much more easily over a distance.

The networks of the network society provided the bridge to the subsequent *everyware* environment. Groupware was employed, indeed developed, to ensure smooth collaboration within project groups and teams, within strategic alliances and collaborative research, production, and marketing efforts. Especially for the larger collaborative schemes, some of the joint notes and other information and records were stored in a common database, accessible to all.

When a project or other collaborative effort had been concluded, whither those records? After all, they represented an investment, and a value. After all, they were to be seen in a particular context, and they would be almost useless as they were, having a potential for future refining however, given a certain problem situation.

So here came the establishment of a number of information utilities, first managed as private undertakings, then consolidated into something that finally became a social good, a service accessible to all its members, or to the whole society. Organizational set-up differs a bit between countries, because of different political doctrines and society habits, but whether covered by the national budget, service charges, private contributions, or any combination of these, what initially were private fact collections became public library functions.

With groupware and *everyware*, exchanges for stock, raw materials, etc., took on new shapes. Even such a mundane thing as tax collection changed completely, when tax authorities, and other government institutions, entered into direct relationships with companies or, rather, networks of "everywares". With the transient behavior of the latter, the systems for taxing had to be changed all over the world, the European Community taking the lead, which was one of the reasons why this economic bloc suddenly leapfrogged the world's economic development.

What will come after *everyware*? It is impossible to say, partly because *everyware* still has a long way to go. Back in the 90's, it became fashionable to talk of life portfolios, or just portfolios: a person spent his time in different vocations, perhaps part time student, part time entrepreneur, part time employee, part time hobby this or that. Or perhaps these activities were serially distributed over a lifetime portfolio.

Today, it is the groupware of the *everyware* society that equals the opportunity for a multifaceted portfolio. Such portfolios exist not just on the individual level but also for various types of organizations, professional societies, clubs, etc. If these portfolios are layered on top of each other, we may discern, or rather describe, a several-dimension matrix. It is much like the old Hypercard linking in all directions. In the *everyware* society, portfolio A may swallow portfolio B that might contain portfolio C1. Which in itself contains not just D but also portfolio A.

The network as metaphor and social fabric

The future telecommunications network will be to society like the chimney.

By this I mean not a literal but an analogous relationship.

Assessing the chimney

Before the advent of the chimney, all persons in a home, a family, a household, a clan, or a tribe, gathered around the fireplace, the hearth. Under such circumstances, there were no large social distinctions, no different classes.

With the chimney, houses and indeed castles could differentiate; they allowed for several fireplaces, and, consequently, for different groups to gather in different parts of the house.

Historians and producers of technology assessments propose that the chimney was instrumental in the creation of feudal society, with its contractual and legal differences between groups, between classes. It is suggested that this differentiation, caused by the chimney, laid the foundation for Western individualism, thus the renaissance and its flourish of artistic and inventive activity.

So, it is my proposition that telecommunications networks will change the social fabric of society. Your first reaction should be: no small proposition, that. The second reflection, most certainly: no forecaster would have imagined, beforehand, the long term consequences of the chimney. Neither can I tell of the profound effects of telecommunications networks on values, human relations, language, culture.

Scenario: The robot-like creature is performing an unexpected operation on board a space-ship, mimicking exactly the surgeon back on earth. The surgeon's fingers feel with the fingers of the robot, seeing with its eyes also. This is telepresence.

What time perspective?

What, then, *is* the long term, what is changing, in the short term, in the long term? La longue durée.

This term stems from one of the great men of our time, the path-breaking French historian Fernand Braudel. He described history as composed of three very different patterns, one changing rapidly, another slowly, yet another in between.

Short term, that is the fast pace of daily changes and shifts; the changes in markets, rules of the market, as we see them. Medium term, that is more profound changes in balances of power, rules of the market, as we see them. Long term, la longue durée, that is the conditions that seem not to change at all: the climate, the daily life of the ordinary people, the material life. This changed little, in France or in Sweden, between the mid-thirteenth to the mid-eighteenth century.

Major technologies, like the steam engine, change the medium term, the balances of power, beside their being traded on the market. To the extent that the steam engine really powered the industrial revolution, it might even have affected la longue durée.

I shall try to investigate the impact of telecommunications technology on all three of these levels or time perspectives.

Most forecasting sets an upper limit at fifteen years. That would be short term, bordering to medium term perhaps. Such an outlook stresses change, ripples on the daily life.

I would suggest that while we make future studies, we ought also to study what is not changing: la longue durée. Or, the other way around, if this is really changing, that is much more important and profound than those short term ripples.

Changes in power structures are somewhat more in focus. Do observe that the long term effect of the oil crisis of 1973 and onwards was that the Middle East got its share of the world's oil market cut to half.

The very long term, that is our relation to nature, to necessities such as food and drink and shelter. It is what we eat and our houses; basic technologies and what we grow and harvest, social organization such as money and cities and trading routes. It would be habits and worship and values, not at the surface but so deeply rooted that we may not even see them, not before being confronted with a different culture or creed, displaying starkly different value systems and governing metaphors.

It takes very few business magazines or journals on organization to discover that network is now a towering metaphor. We see companies described as networks. Customer relations are networking problems. Ownership and control are exercised in network configurations. There is even a book named "the network nation", though the point is, in this context, a bit stale, since it is still an old-fashioned nation, not one transcending traditional national borders.

Here we are confronted with the difference among the three time perspectives. If governing metaphors are just fashions and fads, then they merely form part of a market for catchwords. If the concept *network* represents a new organizational trend, profoundly different from

the pyramids of power of old, then we may regard it as medium term change. If what we now see is a profound change in our set of metaphors, representing a major shift in values, rules of thumb, then it holds even for la longue durée.

Nothing exists in isolation. Cities, monetary systems, trade routes were linked. If we were to discern a real new trend in metaphor diffusion, biology might be at its roots. We talk of computer viruses and Trojan horses, of organismic institutions and cancerous organizations, of vaccination against future shock and of neural systems.

The previous source of metaphors was physics and mechanics. The clockwork universe, the computer as a purely logical device. Precisely the phenomenon of neural systems may turn the world upside down. Neural networks learn as the brain – and we know that it has learned but not how. There is no mechanical, logical pathway to follow.

To be confronted with man-made systems that we do not really understand, that is something that might change our world view. World view, that's what we see, register, perceive. The future is our description of it; will the history of the future, once written, be perceived in the same terms? Quite unlikely.

La longue durée

My point here is to say that we might come to regard networks as close to living organisms, to which we will apply new metaphors and new laws and mechanisms of functioning. This is equal to a paradigmatic shift.

Much as telephony and the automobile did not compete but rather function synergistically in the early days – the development of one of these systems spurred the other, if one was held back the other was too, even under the same economic conditions – there will be other synergistics in the future. When will networks offer opportunities for sensory inputs other than those of the eye and the ear? What will be the effects when a person may play different roles, may appear under several guises, also with respect to values and interests, in electronic networks? This is already happening in the French Minitel system.

But whether material life will be profoundly different with a personal telephone in your life – that is for the history of the future to tell. If televangelists will instill new creeds, new values, if the medium will really be the message and the network thus heralds new value systems, that is also for the future to tell, in kind. We are governed by emotions as well as muscles, by our stomach as well as by our intellect.

Actually, the transfer of money in the world's economic system is twenty times larger than the very trade of goods and services. This is to say that speculation, expectations of arbitrage (and its concomitant

opposite, insurance), is by far exceeding trade of anything "real" behind that speculation. With electronic money playing a dominant and fast changing role in this play, perhaps we are entering a network post-monetary age?

But then, what about network love, or network war? Somewhat less ambitiously, what about art? If 300 people in two nations on half a continent can write a soap opera in a computer conference what with new, truly unique art forms? Will we learn to learn in new ways – so far, educational technology has demonstrated dismal results, but what about the simulation networks of tomorrow? May wars be fought out in computers only?

My discussion is intended to be speculative. The point is that speculation is about as far as we might reach. Who would have forecast the effects of the chimney, and how many of us did see those links by ourselves? What we do know is that information technology and telecommunications and switching systems interplay with man's information behavior. Which is not sufficiently understood.

We all handle information daily all right. We are said to live in an overload of 1600 messages, on an average, each day, of which we observe consciously perhaps 80, and can react with any real determination to some twelve. Thus we have a very efficient sorting and sifting mechanism, and we don't really understand how it works.

It is affected by values, by rules of the thumb, by instinct, by root behavior, by intuition. Very often it is not what we think: for a long time, computer screens displayed negative text on a dark background, and with only majuscules, though publishers knew several centuries ago this is no good for readability; anti-aliasing was another such rediscovery of what print media knew already; there are many examples.

There are also new examples to come. That is why cognitive science is becoming so popular.

Let me just introduce another analog with the world of biology, the meme. Richard Dawkins, the development biologist, introduced it as the information and knowledge counterpart to the gene. Much as we see genes as determinants to biological development, we have concepts and popular tunes, clichés and frames of references, rules of thumb and popular myths to guide us.

Fashions and fads are carried by memes. Meme production is also the production of popular culture. But what information and knowledge behavior, what more profound memes and myths, linked to values, may be involved in guiding our *longue durée*? Obviously, we have a hierarchy or memes, fashions the most vividly present, those belonging to the soil of the material life most ubiquitous; memes so dominating that we do not recognize them.

I have been trying to make the case that whether we think of long or short term changes, they are bound to show up within the next ten years, and the question that cannot be answered is whether – or which – of those phenomena that try to happen will actually prevail. I am

rather trying to provide you with some tentative frames of reference, some scenarios, perhaps some memes, to facilitate discerning what is really happening in whatever seems to happen.

The forecaster's perspective

You might think that infrastructure, canals, railways, highways, constitute part of this long term. In fact, mostly, they do not; they are, if really significant, more medium term. Some of what is counted as infrastructure, bridges, steelworks, shipyards, would even be short term.

A telecommunications network – cables and telephones and switches – is, in itself, short term. But like a school system, or like trading patterns, the system, the network, not in physical terms but rather in phone books and behavior and people in the phone books – well, that is something more durable.

New economic laws

We have been taught to regard infrastructural elements as scarce resources. If many people share my highway, it gets crammed and I am frustrated. The same for a port. So I would prefer being alone on the road, though I recognize that its funding is a social undertaking.

The telecommunications network contradicts this normal economic law: it is more valuable the more numerous the subscribers. A single telephone has zero utility.

This social function underlines the fact that the network to a large extent is immaterial. We see this at several levels. First, we have value added networks, intelligent networks, where the switching function of connecting one subscriber to another has been intelligently amended. Second, we have the sheer availability of a large number of networkers. One of the intelligent functions might be to build the diary function into the network, much as computer conferencing and electronic messaging systems constitute their own phone books.

The third function might also be exemplified by the computer conference: it is the development of groupware and of intellectual technologies, i. e., software combined with means of social organization that allow for new and more appropriate social undertakings.

Two examples. To promote better teamwork in a stressful development project, running for perhaps two years, the team is participating in a kind of "psychodrama", working through a similar project for just two weeks, the computer and the telecommunications network providing realism through a simulated acceleration. This increase in speed makes for the discovery of personal traits, and they are as palpa-

ble as when I was first exposed to a video recording of myself: weaknesses and points of conflict are mostly self-evident and can be disarmed beforehand.

Of ultrastructures

The other example, more of a full ultrastructure – the immaterial counterpart to infrastructure – than just a particular type of groupware, may be taken from the Italian textile and apparel region of Prato. Under intense competition from Southeast Asia, companies there started to divest and scale down, since revenues were falling, as was employment. But there also happened to be established a simple videotex system, accessible for all.

What was the use of this videotex system? Jointly, these thousands of companies, viciously competing, could share a network to keep track of changes in fashion. Consequently, they could beat back competition from other parts of the world by responding more swiftly to changes in the market. They used the same telecommunications network to keep tabs on distributors, market outlets and also suppliers, for fabric, for example. Jointly, they could share distribution systems, minimizing costs and losses because less raw materials or products were now out of step with the market.

They also share something else: a dedicated computer aided design system, again something most small companies could not have developed. This was yet another measure to respond swiftly to market changes. The end result has been more than a doubling of the number of companies, thus a reversal of the downward trend.

This was still a geographical region, offering the advantage – when it comes to warehousing as well as to eye-to-eye meetings – of proximity. But will this advantage always prevail, also in the future? Perhaps we will see the breakdown of the concept of region, and of regional infrastructure, and of regional development, and even of the nation state, when organizations, groups, people in various parts of the world discover that they have more in common than with their neighbors?

When will corporate, or professional, or class culture become more important than national culture? Or perhaps we will see a complicated overlay of different networks, one being professional, another being age group and value orientation, yet another nation, tradition, and religion?

The relationship investment

Such networks will change the nature of doing business. In his acclaimed – and controversial – book The Moral Dimension, Amitai Etzioni makes the point that most market decisions are not rational in

the sense of minimizing costs. We are affected by values and emotions. To me, his book is a sign of the development toward a service society where services and products are becoming intertwined and where comparing two products is in a sense impossible, since no two products-cum-service packages are the same. Instead, we have to rely upon relations, reputation, image, past experience, recommendations.

We have to rely upon relations, i. e., communication. While we may see networks where some competitors join forces while continuing to compete, we will also see networks linking suppliers and customers. Again the question arises: why restrict collaboration to a region? There are certainly no restrictions on customer-vendor relations geographically. The composition of the service-cum-product offer will consist of various blends of hand, head, and heart, and information technology will be spicing that blend.

Thus another biological metaphor will be applied to the marketplace, that of an ecology, where different vendors fit different environments. The telecommunications networks will become instrumental in this new relational, ecological economy.

If utility increases with systems usage, there are more breaks with common economic wisdom than just that price is not the competitive edge. With the advent of networks and relations, the notion of "investments" and "balance sheet items" is turned upside down, as that of infrastructure turned ultrastructure. It spells doom or revolution to managerial accounting.

Previously, buildings and hardware were the material balance sheet items, people, wages, training, and education were expense items, as were ads and other image building efforts. Now it's all turned upside down. Now material investments are of scant value without competent people to put them to use and linking them to a market network. The image created by reputation, ads, rumor, experience is what you the customer pay for – take the RJR Nabisco LBO as a case in point, the brands of that combine valued at a hundred dollars per inhabitant in the US of A.

Companies are developing networks of people, within and outside the formal organization, to customers, knowledge centers, consultants, suppliers, competitors, governmental institutions. These are their real assets, together with groupware, data banks, software, and brains.

To keep those assets active, people will be given a portfolio of incentives, some monetary, some linked to their ethics, values, preferences, and individual development. Each person will feature another portfolio of engagements, in several different organizations perhaps, one of them being his or her own little firm.

A technology of choice

This, again, is all linked to networking and to information technology.

We are confronted with a break with the technological tradition still dominating our thinking, the paradigm of Taylorism and Fordism, the idea of gaining economies of scale, of scientific management, of line production. But information technology is no longer characterized by Taylor's dictum of "the one best solution". It is rather offering a multitude of choice, and this creates a problem to the extent that we are not prepared to grab the opportunities.

One important development is the shrinking barriers to entrepreneurship. One potent cause behind the steep increase in the creation of new companies in the US as well as in Western Europe is that information technology has diminished the problems of being alone in the company.

We are given four basic freedoms, in time, in space, in form, and of content. Freedom in space, that is the mobile telephone, cellular radio, paging devices. Freedom in time, that is computer conferencing, electronic mail systems, voice mail more intelligent than just the recorder. The fax – mobile, if you prefer – and the personal computer are important contributors to this new freedom. Form and content are linked: you may talk, to one person or several, or to a machine, you may write a text for a fax or a computer conference, or you may employ video pictures.

Still, this technology needs to become much more convivial, much more user friendly, and much more individually adaptive. What new sensory inputs? Just reflect for a moment: how will the network change with season? With culture? With message? Different odors? Examples that create interest – funny stories.

Perhaps the network will know your preferences for certain modes of expression, be they the mathematical language, the language of artistic pictures, the written or the spoken word, or any other. Perhaps it will adapt to your own frame of reference – some steps in that direction are taken at the MIT Media Laboratory. Theirs is the concept of a system that adapts, and that learns.

We will see new forms of entertainment, immersibles or computer generated worlds where we can live and experience, not just see, very exotic environments, for example governed by new sets of laws of nature. Would this be a mass medium or an individual medium? Borders between such concepts also become blurred, when the network will offer immersibles that are linked together – a groupware yet to come.

We will have to regard the automobile as a computer on wheels. But that is just the beginning. With projects like Prometheus and Drive, in Europe, the electronic highway will be a telecommunications network as well as a road network. The car will be hooked up and information exchanged to speed up transport and ease the strain on the environment. Administrative and regulatory systems will have to be developed to allow for this multi-dimensional network.

This is one example of a logistics system. There are others, where the

distribution of goods for industrial production as well as of finished products is becoming ever more intelligent and, again, hooked up to computers, satellites, cellular systems.

An odd and challenging aspect is offered by telepresence, of which I gave an example early on. By that we mean robots that are not programmed but rather follow the movements of humans, possibly enhanced and empowered even more. Thus, your movements, your actions may be mimicked far away, in space, underground, deep in the see, in a minefield, or just on the other side of the globe. You see with the eyes of your "telepresence", you feel with his fingers in your fingers, and he emulates every your move...

Think some again of the changing meaning of regions. Regions of the brain, of interest groups. The overlays of different orientations.

And now, for the short term

The very short term changes are the ones that we live with, we are all participating in creating, experiencing, and interpreting them. You experience what has been analyzed here, a constant and rapid technological progression, markets developing, like the one for cellular radio, at a breakneck pace.

Many of the developments that I have indicated as having medium term effects do have very important short term repercussions as well; I have concluded that all seeds to the future are hidden in our present. With the Prometheus system and with electronic customs documents, a new market is developing, with short term impact on administrative routines and also on competitive patterns.

Short term effects include strategic changes in company behavior, and, more generally, in organizational thrust. Banking has gotten its industry revolutionized already. Air transport companies regard their booking systems as their real assets, that's a classic. By and large, oligopolies see competition emerging from unexpected corners, and services change in nature as well as in importance. Whole new sets of competencies are becoming crucial.

This has certainly been proven already in politics. Automated, computerized telephone polls were instrumental in Carter's winning in 1976, and to Reagan's victories in 1980 and 1984 – the intelligence behind being good demographic data bases and efficient computer programs, as well as intelligent cable and telephone networks that allowed for targeting different groups.

Just some further observations regarding the short term social effects. Anyone visiting France could not evade the imprint that videotex, the famous Minitel, has made upon society. I am thinking of those ubiquitous ads and posters everywhere advertising this or that Minitel

rose or rouge. With five million apparatuses and twenty thousand services available, awareness and metaphorical impact are, in fact, palpable. But this is just the proverbial tip of the iceberg: for the mail order business, perhaps also for banking, the development is as important, even though not as publicly advertised.

We might describe ordinary point-to-point communications as resembling an epidemic, again, a biology metaphor. It is a private medium. Broadcasting, radio or television, is from one central point and then like an explosion – a sneeze? – in all directions of the radii from the center. It is basically one way. I have made much already of the third important pattern of communicating, the most recent one best exemplified by the videotex and the computer conference, networking.

The short term will be affected by the overlay of these different modes of communicating. Epidemia and networks are obvious, but also broadcasting is hybridizing, just ponder data radio, or computer conferencing or telephoning as means of creating interactivity in, e. g., the broadcast program. Again, we are reminded of the importance of a directory, and that bulletin boards, computer conferences, and electronic mail systems have unique self-advertising properties.

To sum up, the short term effects are thus found in the integration of different systems in society, previously seen as separate. Transportation systems are linked to telecommunications and also to administrative and regulatory structures. The hierarchies are seen as tumbling, though we still lack conceptual tools to distinguish between, for example, decentralization and deconcentration, or between different dimensions of decentralization.

Competitive patterns are certainly changing, entrepreneurship becoming less of a feature of the large economy, more of a lifestyle. And not just the ubiquitous entrepreneurs will feature those individual portfolios, those life as well as reward portfolios.

For the long term, I have certainly failed to recognize what will be evident within the conceptual framework of the future, the new memes that have yet to be developed. In that sense, my presentation is a picture of our time, and thus of the short term future.

What is Culture about Information Technology?

Are there any specific European characteristics when it comes to information and communications technology – in other words, when it comes to contents, to communication, and knowledge?

Once upon a time, our continent saw the birth of that most important technology, print. Given the transportation systems of the era, the diffusion of printing technology happened at breakneck pace. Even the productivity gains of computers and microelectronics are dwarfed by the diffusion speed and the productivity gains from printing, as compared to its immediate predecessor, hand copying.

European the printing press was, emerging from the borderland between France and Germany, and it also provided one important impetus for the fragmentation of Europe: the breakup of the hold of the Catholic church, the vanishing of Latin as the predominant language of cult and learning. Would we suggest any similar basic result of European communications technologies today?

Perhaps only in the profound sense that Europe displays even more of fragmentation now, or, with a more positive word, even more of pluralism, of diversity.

Freedom is Disruption is Diversity

The events at Tiananmen square in Beijing have been called the world's first fax revolution, even though it was aborted eventually. Only future historians will be able to deduce what the role of modern electronic media was in the downfall of the Berlin Wall, and all that.

One obvious factor was the direct media effect. Radio and television transcend borders even as border troops try to confiscate books and newspapers. Another, probably more important impetus was that of computers and communications. On the one hand, powerful computers – and, mind you, the Apple Macintosh was on the COCOM list of export goods prohibited from entering "the Soviet Bloc" – were eagerly sought after to boost the industry in the East. On the other hand, telephone lines were totally inadequate, and even when they existed, access was restricted.

So the free data and information flow, necessary for economic, industrial, and also military competitiveness, was constrained – to make for military secrecy, and to reduce opposition and risks for upheaval.

The computer and communications dictum were one of the forces behind the glasnost and the perestroika. In that sense, there has already been not so much a language or a cultural shock, but rather a political one, triggered by technology. What of samizdat, and copying machines?

Information and communications technologies offer something brand new, nothing less than a new techno-economic paradigm. Frederick Winslow Taylor, the inventor of "scientific management" and of the assembly line, spoke, quite correctly it would seem, of the "one best solution". Technology and economy converged to one single competitive design. But no longer: with today's information and communication technologies, we may speak of freedom in space, in time, in format and in content.

Freedom in space: that is the mobile telephone, the laptop computer. Freedom in time: that is the voice mailbox, electronic mail, and computer conference systems, groupware. Freedom in format: you may choose between electronic mail and fax. And you may, finally, tailor the content after the medium, or vice versa: graphics, video, simulation programs...

Barriers to entry are shrinking, barriers facing new companies or organizations trying to get into something new to them. It may not be true in every industry or endeavor but in quite a few, so new and small companies, indeed even individuals, get a chance. People can participate in team work regardless, or almost regardless, of location. Tightly knit corporations and administrative bodies are being substituted by networks that are both agile and unrestrained by national borderlines.

The vast repercussions of these developments are only slowly dawning upon us, partly because we are trapped in Tayloristic ways of thinking and organizing. This is the new open frontier, and perhaps it is a drawback to be too advanced because that means being too steeped in those good old ways of calculating, planning, and acting.

So, on the one hand, how could ever Central or Eastern European companies under the old regime have been linked as suppliers to Western corporations, or delivered into the just-in-time systems of the European Community without computer links and the concomitant freedom of transmission? On the other hand, when "new" European nations come to the party, with a different techno-economic history, with new approaches, what might happen?

European the message rather than the medium

Bergman, Buñuel, and Polanski may differ from Kubrick, Spielberg, and Disney, but what, then, might be said to be particularly European about information and communications technologies? Of course, European TV viewers benefit from a significantly better system than the NTSC system of the US and Japan, be it the PAL system, developed in Germany, or the French SECAM system. These two are also compatible so far as black-and-white pictures go, which is not the case for NTSC versus the two European systems. But does technical quality reflect upon content?

To politicians, the important question for the future seems to be what avenue to follow when establishing a HDTV system, the very high quality, widescreen TV picture that will finally challenge the movie screen. The Japanese and the Americans may be on their way to fight it out, but initial European money was directed at a system that might become dated and thus unacceptable to the public – or a monument to Euro-protectionism. Or to that inability of pursuing an early lead that caused Europeans to lose the video recorder and much of the video and compact disc business to the Japanese. Concern for quality or cultural connotations seems to be left to the Bertelsmanns and the Berlusconis – until we are confronted with the economic underpinnings for sustaining *la Francophonie.*

Any European concern for electronic media would risk to be reduced to a concern for European competitiveness in the fields of electronics and communications technologies, but not in the least in cultural media. Thus we have seen various ambitious programs, initially national, mostly in France, Great Britain and Germany, to promote the national computer and electronics companies, and, later, international attempts, initiated by but then transcending the European Community, under headings such as RACE, Esprit, and JESSI – and the pan-European Eureka.

France offers the example of a successful videotex system. The videotex idea was first invented in Great Britain, where it failed miserably – at least if we apply the criterion of mass market appeal. Likewise, it has proven a disappointment in a number of other countries, Germany being one.

But the French success would most probably have been unthinkable hadn't the French government decided to embark on a bold plan to equip all telephone subscribers with videotex, i. e. Minitel terminals. This infrastructural investment made for a market, manifesting itself in about 20 000 different services. Is the investment profitable for the French PTT, even given the sizable revenues now reaped from it? That seems to be a question of accounting method, and thus a bone of

contention.

Another such community resource is the videotex facility, or computer network, established in Italy, particularly in the Prato region. Here we are far from the mass market that the 5 million French Minitels provide. The Prato network made for the resurgence of this once crisis stricken textiles and apparel district; an amazing recovery based upon the true sharing of resources by the tens of thousands of companies in the region.

The point is that the network offers channels to suppliers, to customers, so as to feel the markets – most often, in Europe. The common ground was European-wide contacts to customers, suppliers, data bases, intermediaries, even competitors, and to jointly developed computer programs, through an electronics based communications network. The network is more than physical telephone lines or computers, more than conventional infrastructure – it is also contacts, knowledge, understanding, trust, we may call it ultrastructure.

Undoubtedly, the Minitel diffusion has created a basic "computer literacy". More than so, it has affected the whole media picture and discussion, introducing concepts such as "Minitel Rose".

Europe features some of the leading countries in the field of telephony: the Netherlands with the lowest costs, Sweden with the highest penetration, Denmark with a number of social services provided through telecommunications, the Nordic countries with the most well established network for cellular telephony, France with its Minitel network and its huge ambitions to spearhead broadband ISDN services.

On the other hand, Europe has been lacking the kind of information network facility offered by ARPANET and its derivatives in the US, especially to the research community. Still, not even "over there" have electronic mail facilities proven successful on a large scale, simply because there is not one but a host of competing standards.

Coming from Behind

To claim to make a virtue out of necessity is quite often just lip service, serving to turn a drawback and a loss into a verbal virtue. The French pioneering efforts, however, grew out of the fact that the French telecommunications system was clearly very backward up to the mid 70's. Efforts such as the investment program in general, and the Minitel and the cable service experiments in Biarritz in particular, reflect the prevailing political culture in France, aspects of which are centralization and an elite bureaucracy.

The backwardness was combined with the fortuitous circumstance that the telecommunications technology was in a state of rapid development. Therefore, it turned out to be feasible to leapfrog the development, cutting short what would else have been a cumbersome process of investing through a series of generations of technology,

instead at once gaining the economies and the features provided by the most advanced technology.

Would it be wishful thinking to believe that to some extent the central European countries recently opened to Europe may come to emulate such vistas too? No, not really. Already, the Swedish satellite Tele-X has been utilized to provide much needed telecommunications lines to the Baltic countries and Poland – not, of course, because it is Swedish, but rather because it happened to have extra capacity, and because its geographical direction, encompassing Scandinavia, was ideal also for these additional areas.

Now Europe may seem to offer almost as many TV channels as any community in the US or in Japan. The vast difference is that they are, basically, broadcast by satellite, even if finally cabled into the house of the viewer. Satellites provide an expedient means to "cable" a whole area, and what is distinctly European is the fact that such an area is not easily (in fact, of course, not at all) sealed off. So German programs spill over into neighboring countries, as do French, Dutch, Swedish, and so on, as long as they are not coded, well, they spill over but are intelligible only with a decoder.

As much European cohesion might come out of this as of shared programs on New Year's Eve, hit song festivals, or even sports programs, where down hill skiing and soccer provide good examples of nationalism being demonstrated across borders. On the other hand, in this way pop songs and soccer stars become truly pan-European.

Richard Dawkins has launched the concept of *meme* as a descriptor for symbols that capture our minds. A *meme* (from the French "même", the same, or from "memory") is, at the lowest level, a tune that does not leave the ear; a popular saying that convinces us though it should perhaps not; a rule of thumb; at much higher levels of abstraction also basic beliefs and values.

To state that a culture – any culture – features certain "blind spots" might be rephrased in the statement that only alternative memes cause us to question the memes that have us lulled or at least complacent. The diversity of Europe equals a pluralism of memes. A future of increasingly mixed and colliding memes might be seen as beneficial if the result is the creation of deeper insight. Beneficial if tickling our curiosity, broadening our outlook, but threatening if difficult to grasp and seemingly imposing, out of control.

The alternative scenario is one characterized of negative shock – if the result is violent upheavals and strife. Already at the most basic level, that of technology, there are different ways, different memes, as we have seen. Culture, that's those memes that have become perceptual sediments, value structures that are taken for granted, almost part of nature. Technology introduces more evanescent memes, challenging but mostly generated by underlying cultural structures.

Culture is an Old History

For a long time, the common understanding was that American media behavior would be duplicated all over the world, once those same media were introduced and diffused. Culture was to be homogenized, mostly around American memes. Would thus Europe's long term fate be the wholesale adoption of American mass culture, simply because its programming is so inexpensive, based upon the largest market in the world as it is?

It didn't happen that way. While TV almost made the Americans forget to read (only a slight exaggeration), the Japanese increased their consumption of just any type of information, or entertainment, print, broadcast, or other. While the Americans opted for infotainment at the most, the Japanese most certainly went for edutainment.

And the Europeans? Quite a few of them were less prone to accept electronic media as determinants to their lifestyles. This is most vividly obvious in the Latin countries, where electronic media are consumed in the same age old environments as always, in cafeterias, bars, bistros, and restaurants. Even when taken in at home, the TV has not been allowed to disrupt old habits and exchange them for new as has been the case in the US.

And, once more, the point is pluralism. Various cultural barometers show that Britain, the Netherlands, and the Nordic countries are those closest, on some accounts, to the US, and thus more prone to adopt a consumer behavior of the American style. Different political decisions, however, have sometimes prohibited or reigned in the proliferation of commercials that so put their stamp on American TV. And while some of the spillover, not necessarily from satellites but from terrestrial systems as well, may consist of American TV series, some have also been, for example, of Swedish programs into parts of Norway, of Danish and German programs into southern Sweden, and so on.

A vast international survey of corporate culture provides some interesting insights. It turns out that in a company, any company, one cultural factor is that of the particular corporate history. Political regime, planned versus market economy, provides a second distinguishable cultural dichotomy, that may take some time to vanish. The third turned out to be language, in Europe making for distinctions between Slavic, Roman, and German language areas, cutting through countries like Switzerland and Belgium.

But the fourth cultural influence demonstrates the importance of history: there is a measurable difference between areas that once belonged to the Roman Empire versus those that did not – an Empire evidently still making itself felt not just through old aqueducts but also in values and attitudes. Another factor is, especially when leaving Europe, the religion heritage that prevails. In Europe, Protestants and Roman Catholics are, more than in the US, found in contiguous, distinct regions.

The Virtue of Not Knowing

Thus the essence of Europe is pluralism. Language shock – yes. Cultural – even more. To some extent a pluralism that has cultural roots, to some extent variations that stem from different development trajectories, and to a large extent one with its roots in different political and societal decisions at different points in time.

Culture is all that which we take for given, that which we do not see, our values and attitudes, or at least the way of describing and defining different values and attitudes – frames of reference, memes that are ingrained. We only become aware of them when they are confronted with another set of values and attitudes and their expressions in practice, confronted, that is, with an alternative set of memes.

When a leading producer of office technology employed an anthropologist to explore how their products and systems were applied in practice, they were surprised to find that people did not work as they claimed to be working. They said that they were working "by the book", following prescribed rules and procedures, but in practice they worked quite differently, in ways so as to solve problems, problems that almost never fit "that book". And thus technology, the products, the equipment did never fit the actual practice nor practical problem solving.

The point is to say that it is sometimes a virtue to be able to tell the reality from the supposed descriptions of it, memes that might make for the proliferation of myths. The peoples of the new, hopeful but shaky democracies of Central Europe will be able to provide Europe not with less but with much more pluralism, contributing to fresh new lights on how to practice technology, and then primarily technology directed towards information and knowledge contents. One part of this contribution will be additional cultural diversity, another the acute awareness of the freedom of expression and access to information, openness to communicate, etc.

Here we run up against something truly impossible to forecast. Hopefully, it is not just wishful thinking! The forecast would be that people in Hungary, Czecho and Slovakia, Poland, and other countries, including Eastern Germany, will discover how to use computers and telecommunications in completely new and fresh, not to say refreshing, ways.

They themselves would not be able to tell how, not now, not until they have gotten more hands-on experience with these new technologies. These are the people of the samizdat, and this is where focus was, say, on mathematics, "because we can just afford paper and pencil".

We, on the other hand, who know and who have gone through a sequence of experiencing low cost computers, a host of satellite channels, abundant telephone communications opportunities and who cannot even understand why a government would prohibit the production of a telephone directory, we cannot really understand what this kind of deprivation might mean, or the impetus of a single giant

and creative leap into our abundance. We can base some guesses on what happened when the Spanish and Portuguese societies were allowed to embrace openness.

The most important resources will be literacy, work ethics, investment, and competence. All of Europe is endowed with reasonable amounts of literacy. Work ethics cannot be just preached, but examples may be provided, guiding patterns, memes. Some of the investment may be easier to achieve now than historically in the West, as we have just exemplified; if we pursue the Italian Prato example, this is also a way to benefit from a much larger European, and, potentially, global network. Competence is one of the qualities that might be enhanced through such a network; through expert systems; maybe through sophisticated edutainment.

Groupware is a promise. It allows for more voices to be heard, it allows for much more efficient collaboration. It has proven to be a boon in creating an environment boosting quality.

To make for communication to work, technology is no panacea, certainly not groupware. The different histories, cultures, frames of reference in different parts of Europe might create severe obstacles to the application of groupware tools. It might also make for the development of much more sophisticated tools and techniques – once the initial obstacles have been eliminated.

From Mass Markets to the Individual

Then we are back to information and communications technology. Looking upon the telephony system, we are struck, at first, by its enormous size and complexity. At first, that is, because what is happening now is that a host of new developments in those technologies open new vistas for flexibility, for individualism, for small scale. Though still on the basis of a network encompassing the globe.

Western Europe is following, perhaps even leading, the worldwide trend away from mass production for mass consumption towards custom made products and services. Information and communication media will increasingly be employed to bring the customer directly into the design process for products, systems, and services. This basic trend shift requires a profound understanding for diversity, and better ways to listen to the customer, to describe his and her behavior, needs, demands.

The great diversity of Europe, rather than more conformity, means enriching all those companies, organizations, and individuals who

will and need partake in such a development. If this description is correct, then the large US market will also become more fragmented, and the case for low cost production, based upon a large homogeneous market, will be weakened.

New countries, trying to industrialize late, are bound to invent new successful policies for innovation, claims professor Fumio Kodama of Japan, citing German procedures of the late last century and Japanese of later dates as examples. We might add the French Minitel experience.

Creativity feeds on diversity. It feeds upon adversity as well, but of a constructive type, and one that can be reconciled instead of developing into animosity and factional strife. The example of Vienna at the turn of the century, and, much before that, Amsterdam in the 17th century, and Firenze, and Paris... come to mind when we attempt to describe the pluralism that is a prerequisite for a creative environment. Thus, cultural pluralism is one ingredient, tolerance another, a vast repertory of different media yet another.

To pursue this line of thinking, recalling especially the case of Amsterdam, the liberation from oppression, the oppression of one dominant strand of thinking, most often seems to set free a burst of creativity, as developed by Silvano Arieti in his study of creativity.

This would belie any need for a worldwide burst of look-alike American TV series. There may, instead, be the need for a diversity of American, as well as Japanese programs to enrich the full spectrum of European diversity – as there will be needs for different styles in computer programming, in methods for information systems based collaborative technologies (groupware), etc. Though the Roman church certainly dominated Europe during the Middle Ages, the Catalan clock towers were different from the French, and both from those in Bavaria. The same "platforms" of television standards, telephone networks, or computer means of expression will be employed in different combinations, for different ways of communicating, tainted by the different cultures and subcultures of Europe. And then self-willed individuals will make their imprints.

To conclude, we may envisage two opposing scenarios. One is the final victory, over most of Europe, of American mass culture, by virtue of its low cost production, and the need to garner advertising revenue. The other scenario would be one of making constant virtue out of a whole series of language and cultural shocks, relying upon them to develop truly creative, and diverse, novelties. Perhaps the two scenarios may combine into just one, those novelties constantly challenging but also feeding the software of low cost commercialism.

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

TELDOK aims at documenting, as early as possible, working applications of new information systems and arranging study trips and seminars directly related to this task

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
- Arrange study trips and seminars directly related to the preparation and dissemination of information pertaining to practical applications of telecommunicating information systems at work

TELDOK activities are coordinated by an Editorial Board with wide representation from the user community, research, trade unions, government authorities, suppliers, and Swedish Telecom.

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