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Rural Development Through Diffusion of Information Technology

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Abstract

This paper discusses different policy options for the diffusion of information technology (IT) in rural areas. An IT programme for the northern part of Norway is assessed, and the effects of the programme are compared with the consequences of the ongoing diffusion of IT in the region. The analysis shows that the programme initiated some successful projects, but that it as a whole had minor effect on the diffusion and use of IT in the region. The conclusions are that technology diffusion programs should be integrated into general development strategies, and that one should put emphasis on stimulating innovations and learning processes locally. While technology push strategies are likely to be influenced by outside controlled forces, market pull efforts can more easily be adapted to local conditions and needs. This is not at least important when taking seriously to provide new jobs for women, which is particular important in rural areas.

Keywords: *Technology diffusion policies, organisational learning, indigenous development, rural areas*

1. Introduction

In Norway, considerable emphasis has been put on mining a decentralized society, and to make the living conditions satisfactory in all parts of Norway. The development of microcomputers and extensive telecommunication networks has caused promising scenarios for rural areas. Norwegian regional politics have therefore become increasingly interested in how telematics can contribute to the development of rural areas. Various policies and measures have been initiated by the government to stimulate the regional diffusion of IT.[1]

The northern part of Norway has been defined as a target area for such policies. Due to its long distances and scattered population, the region was regarded as "an ideal laboratory for developing new telecommunication services" (NoU 83:32). Accordingly, the Norwegian Telecom started a number of projects, both aimed at general infrastructure build up, and more specific directed towards service development.[2] At the same time, Finnmark County Administration initiated a separate IT programme, in order to stimulate economic development in the region.

This paper reports from a study[3] of these different effort. This work also includes a minor survey of the actual use of IT in the region. The study shows that very few efforts have lead to successful innovations locally. The general effects of the IT programme have been small. In the same period, we have seen a strong increase in the application of IT in the various sectors of the economy. This has had substantial influence on work organisation and on the division of labour between rural and urban areas.

This paper is organised as follows. The next section provides the theoretical background, followed by a description of the research framework. Section 4 and 5 contains an analysis of the different policy efforts, along with a discription of the effects caused by the ongoing user-driven diffusion of IT in the region. The last section discusses alternative IT strategies for development of rural areas.

2. Theoretical Background

We are now experiencing a change in the use of information technology that causes the most pervasive changes in our economy, and which are affecting the structure and management of the enterprises and the relationship between them. This implies new forms of information flow and transfer of knowledge, the basis for the *network economy.* Networks allow for different types of integration: *vertical integration*, by closer links in the design, productions and distribution systems, and between producers and consumers, as just-in-time production and flexible specialization, and *horizontal integration*, which means alliances between individual companies, both within and across different business sectors.

The infrastructure[4] aspects of IT are essential, in that infrastructure is considered as a stabilizing factor in economic development, in particular for regional economies. These aspects can be viewed from two different perspectives:

- Computer and telecommunication networks that support the information handling activities taking place

across an organisation, and serving the users within it.

- Network structures connecting local and regional economies to national and international networks, including the support organisations that are required for utilising such services.

Some claim that this development is challenging the traditional taylorist ("fordist") pattern of hierarchical control (Boyer 1988), others maintain that we only see a new, more advanced form of control (Schulz-Wild 1991).

2.1. Technology and rural development

There is an ongoing scientific discussion concerning the theoretical concept of rural development. It is important to differentiate development *in a* rural area from development *of a* rural area. The first defines a rural area as a place of development, i.e. of markets, businesses, etc. The latter implies "defining it as a specific rural community that has a political and cultural identity, and that is more than an arena of trends that is ubiquitous" (Storgaard *et al.* 1993).

A key question is whether diffusion of technology into rural areas will imply increased dependence of the national economy. Or will it lead to more local based, *indigenous* developments, and by that creating more sustainable local economies? Indigenous development is related to self-reliance, which can be associated to three basic ideas (Johannisson & Spilling 1983):

- to work for development of people, and not things
- to develop a region through autonomy, by increasing the utilisation of own physical resources, knowledge and creativeness, etc.
- to aim at breaking down outside controlled structures, and define own goals for development.

There are, however, a number of problems related to this strategy. It may imply reduced trade and a slowdown of industrialisation and other modernisation processes. Such consequences require countermeasures that can stimulate trade and industrial development such that local economies can increase their internal coherence, e.g. through cooperation and mutual assistance, and not accept 'split and rule' tactics from outside (Galtung *et al.* 1980).

Some research findings suggest that the positive visions of progress in rural areas through new technologies have proven difficult to realize, as new and enduring economic crisis has falsified visions in face of reality and facts. Gillespie and Goddard (1990) argue that telecommunications is a necessary, but far from sufficient mechanism for regional development. They suggest that "…telecommunication strategies cannot be deployed without reference to the form of development one obtains in a particular region. For example, the dominant form of development in less favoured regions is that of the branch plant economy, associated as it is with high level of external control, low local multipliers and a narrow range of technical skills. This form, described as fordist, the internal economic structure of the region is highly fragmented and incoherent in terms of indigenous linkages."

TABLE 1. Technology policy options

Supply-side	*Bridges*	*Demand side*
Research, often collaboration	Infrastructure, e.g., telecommunications	Technology capability incentives
Innovation policy, mission oriented	Standardization, to strengthen supply side	Demonstration projects Adoption/innovation incentives
Industrial policy	Policies for coupling supply and demand	Public Procurement

2.2. A framework for regional technology policies

In most industrialised countries, technological development has been regarded so vital to the economy that it cannot be ruled by the market forces alone, and several technology policies and strategies have been defined (Edquist 1992). According to an OECD report, different technology policy options may be assigned to different categories (OECD 1989), see Table 1.

We find that supply side initiatives tend to be *pushing* for the introduction new technology, emphasising technical innovations. The *demand-side* activities, on the other hand, focus on the user side and organisational innovations and they have usually one or both of the purposes:

- To improve the efficiency of the economy by *promoting the use* of new technology
- To stimulate the *demand* for *locally made* new technical products or competence.

The OECD-paper points to that for regions that are technologically lagging, these two goals may be conflicting. Insistence on local supply means that the users not always will get 'state of the art technology', as it may not be available locally. But subsidising the access to more advanced technology makes it still more difficult for local suppliers to catch up.

2.3. Innovation and organisational learning

It is evident that innovation and diffusion activities are closely linked to learning processes (Lundvall 1992, Argyris 1992). Lundvall argues that learning is predominantly an interactive process, which is socially embedded and cannot be understood without taking into account the institutional and cultural context. The internal flow of information and structure of learning processes in organisations are important aspects of innovations, as well as the inter-organisational relationship. He furthermore claims that learning mainly takes place inside organisations, and in connection with routine activities as production, distribution and consumption, which all produces information as input to the innovation processes.

Argyris claims that learning in organisations or *organisational learning* is occurring under two conditions. Firstly, learning takes place when an organisation achieves what is intended (*single-loop learning)*. Secondly, learning oc-

TABLE 2. State of Computing Management[a]

	Locus of managerial control		
Type of interest	*IS management*	*Departmental management*	*Top management*
Technical	SKILL	Service/skill mix	Strategic/skill mix
Operational	Skill/service mix	SERVICE	Strategic/service mix
Managerial	Skill/strategic mix	Service/strategic mix	STRATEGIC

a. They use the term *computing change* and *computing management*, which corresponds to *changes in IT usage* and *IT management* that is used in the rest of the paper.

curs when a mismatch between intentions and outcome is identified and is corrected: that is when mismatch is turned into match (*double loop learning*). Argyris emphasises that both types of learning are essential, but "that many organisations, often without realising it, create systems of learning that suppress double-loop inquiry and make it very difficult for even a well-designed information system to be effective" (Argyris, p 122-123). The consequences are that such organisations have difficulty in learning to correct those factors that inhibit double-loop learning, e.g. organisations with a pyramidal structure, having specialisation of work, unity of command and centralization of power, and with information flow following the structure of power.

Jönsson and Grönlund argue that single-loop learning is based on a causal relationship between processes, and is often experimental and associational, without questioning the assumption under which the processes operate. In double-loop learning, the organisation will question the governing variables for these processes when there is found a mismatch between wanted and observed consequences. This type of learning is often structural and conceptual, and is usually found at higher levels in the organisation (Jönsson & Grönlund 1988).

An interesting question is whether these arguments can be applied at a regional level. Can we claim that double-loop learning is a necessary condition for indigenous development in a region, as single-loop learning will just enhance the skill to perform according to outside defined goals, and not develop capabilities for defining own goals or strategies? This issue is discussed in Section 6.

2.4. Measure learning effects in diffusion processes.

Kraemer *et al.* (1989) have carried out extensive analysis of different models for managing information systems in organisations. They have identified three loci of control over computing: *IS management, user department management and top management*. They also identified three main orientations toward computer use that corresponds to these loci: *technical advancement, operational applications and managerial applications*. By combining locus of control and interest served, we get this array of different

states (Kraemer *et al.* 1989, p. 30), see Table 2.

In three of these combinations, Kraemer *et al.* say that the level of managerial control and the orientation toward use are congruent and coherent. The *technical state* occurs when IS management controls computing and computing is applied to serve technical interest. Technical innovation is seen as a primary benefit to the organisation. In the *service state*, departmental management controls computing and applies it in serving operational interests in the various departments. In the *strategic state*, top management controls computing and applies it to serve managerial interests, directed toward applications that increase organisational efficiency and management control over financial and human resources.

One of Kraemer *et al.*'s. main conclusion is that managerial actions are the dominant factor affecting outcome for computing use, and that it is becoming increasingly important. They furthermore detected a trend toward the strategic state, the control of information systems by and for top managers and their strategic functions. Changes in computing imply both types of learning processes, but the mix of single and double loop learning will vary over time. They also state that "learning was usually incremental and cumulative," but they also observed "that learning processes were interrupted and the organisation's computing trajectory was even reversed" (op cit., p 266).

From this we can conclude that a transition from one state to another will require double loop learning, as it requires an assessment of the goals and premises for computing management. Accordingly, identifying changes in computing states may give insight in learning processes in organisations. Kraemer *et al.*'s. taxonomy seems to offer an interesting framework for analysing how IT is used and managed, also in a regional perspective. We must then take into account that their empirical data are collected from large governmental organisations in urban areas, and that their conclusions cannot be applied without assessing the premises.

3. Research Issues

The aim of this study is to examine the impact of the diffusion and use of IT in rural areas in Norway. These specific issues are discussed:

1. What are the important factors for successful diffusion and use of IT in rural areas?
2. How can diffusion of IT contribute to indigenous or locally controlled development?
3. What role can regional (and national) technology policies play in such development processes?

This research approach implies both theoretical and methodological challenges, as it involves different levels and perspectives. Firstly, we have the innovation and diffusion processes in the individual organisations, including changes in work processes, organisational structures and management. Secondly, we have the institutional, social and cultural structures of a region, that influence the diffusion of IT into the local and regional economy, and functioning of the economic activities in general. Such factors do greatly influence the interaction between the

local and national economies, as changes in the internal social and cultural patterns.

Thirdly, we have to consider the national level, which comprises the technological and economic structures as well as the goals and strategies that define the national technology policies. These systems and the interactions between them provide a framework for technological change, often denoted as *the national system of innovations,* in which the regional institutions and organisations have to adapt themselves (Lundvall 1992).

Even if we cannot overlook factors at all levels, this paper will mainly focus at the regional level, in analysing how different initiatives and efforts have caused effects on the local economies and on the region as such.

A preliminary analysis of the IT programme indicates that only few projects have succeeded to accomplish the innovations that were planned (Jansen 1993). Other studies of regional technology programmes report similar difficulties in carrying out successful innovations in rural economies (e.g. Hetland 1991, Qvortrup 1994). We accordingly would like to study the following assumptions:

1. The IT programme did not manage to stimulate innovative activities in the organisations, due to that the information flow and knowledge exchange were not organised in an appropriate way.
2. The IT programme had little effect on the region, due to lack of strategic orientation of IT innovations in the companies.
3. The regional IT-policy did not account for the specific characteristics of the region and in the various local communities.

3.1. Research methodology

The approach applied here is based on qualitative analysis of a number of the projects that have been initiated by the IT programme. The empirical part of this study consists of two parts:

a. An analysis of the effects of an IT programme in Finnmark running from 1989-93. The effects have been assessed according to the results achieved in the organisations involved. The regional impacts are estimated through aggregating the effects of the individual projects on the local economy.

These data have been collected through studying available documents and reports from the different projects. A number interviews with informants have been carried out, either by personal visits or through telephone. In addition, a questionnaire has been sent to the remaining organisations involved.

b. The second part consists of a minor study of present use of IT in different sectors of the regional economy.

These data have collected through student projects, where we have selected a number of branches in the economy, mainly in the service sector. The students have carried out semistructured interviews in about 80 enterprises, which are documented in student reports.

In a report to the Finnmark County administration, this research approach and the empirical findings are discussed in more details (Jansen 1995).

TABLE 3. Employment and gross product in Finnmark and Norway, excl. oil. 1992 in percentages.

	Employment		*Gross product*	
	Finnmark	*Norway*	*Finnmark*	*Norway*
Agriculture and fishing	8	6	13	5
Manufacturing industries	14	16	20	24
Energy, construction & transport	18	17	27	28
Trade, hotels, businessserv.	19	26	13	17
Public & private services	41	35	27	26

4. A Case Study: Policy-Initiated Diffusion of IT in Finnmark

Finnmark, the northernmost region in Norway, has a very scattered population and great distances. Characteristic features of the region's economy are:

- small local markets and long distance to national and international markets
- small labour markets, low competence and difficulty in recruiting skilled workers
- easy access to rich natural resources, in particular fish. But the economic structures and trade regulations have favoured export of raw material.

These factors have created a one-sided and a vulnerable industrial structure, dominated by the fishing industry and some mining companies. Many small communities along the coast are completely dependent of one or two fish-producing plants, and in addition on private and public service organisations. The economy may be illustrated by some figures, see Table 3.

The share of the population having higher education in this region is lower than in the rest of Norway, and there are fewer opportunities for educated women (St.mld 32:89-90). Studies carried out have shown that the use of new technology in Finnmark has been lagging behind other parts of Norway (Buflod 1987, Fredeng 1989). The number of IT-companies is still small (ITF 1993).

4.1. An IT programme in Finnmark

Various efforts have been introduced by the government to stimulate economic and technological development of the region.[5] A large project was initiated by the Norwegian Telecom in 1987. Another effort was the IT programme, running from 1989 to 93 and managed by Finnmark County administration.[6] Below follows a brief description of the main parts of these efforts, see (Jansen 1995).

Infrastructure and telematic[7] service development

One of the basic ideas in the programme has been to use telecommunications as a basic element in a diffusion strategy. This strategy consisted of three main parts:

a. Establishment of *computer network*

between regional research centers in Finnmark and the rest of the country (FUNN). The goals were to improve communication and cooperation between research communities, to strengthen the local competence, and to create a basis for commercial business operations, as part of a general policy for regional development. These goals proved to be partly conflicting within the short time horizon that was given for the plan to prove successful. Very few centers were able to provide profitable information services (Hetland 1989). One important reason has been the lack of support from local authorities, and that there was little demand locally for the services being offered.

b. Supporting the development of 10 *telematic centers*, which provide to-way video communication services. These services have been important for the implementation of other parts of the programme. However, many of the centers have experienced economic problems, in particular due to changes in charging policy of the Norwegian Telecom.

c. Development of user applications, as *telemedicine, videoconferencing and distance teaching*. Telemedicine means the application of IT in the provision of health service activities, such that resources outside a local organisation can be used in service provision. This implies that e.g. citizens in small communities are provided better medical services without having to travel to central hospitals. This development has implied challenges at both technical, functional and organisational levels, requiring competence buildup and cooperation between different user group. This project has included both supply-side activities as development of new services, infrastructure buildup and demand-side efforts in stimulating the use of such services. Telemedicine is an example of a social experiment that has gained international attention (Qvortrup 1994).

Support to telecottages and other IT-service providers

The goal was to establish 5 Community Teleservice Centers (CTCs) in Finnmark. A CTC is a multipurpose centre aimed at providing computer and telecommunication facilities for local communities in remote, rural regions, offering some computer training classes and support for low-skill service provision (Qvortrup 1993).[8] To day, only one of the CTCs in Finnmark is in operation, located in Guovdageaidnu, a major Lappish settlement. The main activity is related to the development of a Lappish IT dictionary, and to provide translation services. This idea should have potential for commercial success, but so far, the CTC has not become profitable.

The programme has also supported other firms offering distance work based on the use of PC and telecommunications, but none of them has survived. The policy has primarily been to support the creation of new businesses and services, and little efforts have been done for integrating these firms into the local economy.

These experiences illustrate a typical problem for small, service-providing firms in rural areas. They are facing small, low-competent local market, they

TABLE 4. Overview of the effort, relate to different policy options

	Policy options		
Efforts	*Supply-side*	*Bridges*	*Demand side*
Data- & telecom.	Service development	Communication facilities	
Telecenters/IS service providers	Service innovations, experiments	Telecommunication services	Demonstrations
IT-investments			Support to procurement and IS implementation
Telemedicine	Development of methods and tools	Communication facilities Cooperation effort	Knowledge build-up, support to users

have long distances to larger markets, and they do often lack experiences in economic planning and business operations. Hetland (1991) explains the difficulties in gaining entry into the remote work market in this way: "the more standardized a service is, the more important it is that the transaction cost is low, whereas the more unique a service being provided is, the less effect such cost exerts on its profitability". The telecottage experience shows that when a rural community tries to establish an enterprise based on local competent personnel, it demands an extensive degree of networking over a long period to get accepted in an outside market.

IT-investments and development of user competence

The last element of the programme was to support IT investments and implementation of specific application systems in a number of export-oriented companies, mainly fishing industries and hotels. The objectives have been to increase the quality and efficiency in information handling and administrative routines, and to improve service provision and sales operation. Some of these projects are still running, and it may be too early to evaluate them, as the full effects have not been realised yet. In a preliminary report from the programme committee, it is stated that there have been few examples of organisational changes caused by these efforts, and that many companies lacked competence to realise the potentials created by the investments. The report claims that the real needs related to investments in IT were not analysed systematically in many companies. Moreover, IT has not been used to develop or strengthen their strategic alliances (Christensen *et al.* 1993).

4.2. The impact of the programme on the development in the region

A more systematic way of describing the different elements is obtained by applying the schema presented in Table 1, as follows in Table 4.

The table shows that most efforts were oriented toward the supply-side

and the infrastructure building. The programme lacked in general initiatives that would stimulate the demand for the services being developed. Only the telemedicine project has virtually been both supply- and demand-oriented, as this project included the introduction of new applications, and also supported the use of the corresponding services. This has not been the case for the videoconference facilities. The demand for such services has been low, and to day only those telematic centers supporting telemedicine are in daily operation.

The various initiatives should be analysed along three different dimensions:

- The establishing *technical facilities*, made up by the basic infrastructure development and IT investment in individual enterprises. These efforts have, as a whole, been successful as technical solutions, as nearly all systems have been implemented according to the plans, except the telecottages (Fredeng 1991). The activities have involved development of skill and practical experience. It is assumed that innovations in these areas require mainly single-loop learning, as they mainly imply improving technical achievement, within well-defined goals. We find mainly that the *technical skill* has been improved, where the control is usually found among the IT staff in the organisations, corresponding to Kraemer et al's. IS management (see Table 2).
- The development of *functional and operational services*, which includes the build up of telematic centers and telecottages and development of the support functions and providing user services. Here we find greater differences in the degree of success. Some of these efforts have been carried out as planned, but the use of the services has not been as expected. In other cases, the quality of the services has not been satisfactory. Many of these cases seem to fit into the *skill/service mixed state*: user interest should be served, but the control of IS management resides in the technical departments. We find that mainly single-loop learning have taken place. This does not create the knowledge and competence needed for changing the control structures and management attitudes that make innovations difficult to accomplish (Jønsson&Grønlund, op cit.).
- The *organisational and management factors* that are necessary for integrating the infrastructure and services into the local production system. This includes development of knowledge and adapting the organisation for using the new services, too. The empirical data describe few cases of organisational changes or cases where the strategic usage of IT is reported. These findings indicate that IT has not served the interest of or have been controlled by the top management. It is evident that double-loop learning is required to accomplish this type of innovations, as they imply fundamental changes in management activities.

We can group the different efforts into five categories, and estimate their achievement along the three dimensions described above. The estimated values are given by the author, based on person-

TABLE 5. The effects of the IT programme

	Degree of achievement			
Type of effort	*Technical skill*	*Operational service*	*Strategic management*	*Regional impact*
Telecottages	poor	poor	lacking	negligible
New IT services	poor/fair	poor/fair	poor	negligible
Video-conference	good	fair/good	poor	small
IT-investments	good	fair/good	poor/fair	small
Telemedicine	good	good	good	significant

al interviews or on written reports from the projects. The values given are *average* scores for each group, which may vary considerably within each group. The values for the regional impact are based on estimated scores on a number of indicators.[9] See Table 5.

The table show that while the development of technical and operational services on average has been fairly successful, as it is reported improved effectiveness and quality of service provision in a number of the companies that have been supported. However, the strategic orientation of the efforts was in general lacking. These findings indicate that the capabilities for double-loop learning and to accomplish organisational changes have been lacking in many of the organisations. They furthermore indicate that the programme primarily has caused changes *within* the individual organisations, as we have found very few inter-organisational relations being created. The impact on the local and regional economy has been very limited. The main exception is the telemedicine project, which has stimulated collaboration and mutual competence build up between the involved parties, as general practising doctors, remote medical specialist, IT specialist and other physicians, and in this way caused organisational changes.

This effect has been intended, resulting from a deliberate strategy for the telemedicine project. In most other projects, such strategic links to the users have been lacking. This was particularly the case for the CTCs and information service providing enterprises, as well for the general buildup of the telematic centers. These findings seem to be in line with Kraemer *et al.*'s conclusion, that managerial actions are the dominant factor affecting outcomes of IT-usage.

4.3. Conclusions - the effects of the IT policy efforts

We have found that the programme did not succeed to initiate innovations in many of the organisations involved. One main reason seems to be poorly organised information and knowledge exchange that are necessary to stimulate learning processes. These findings seem to support, at least partly our first assumption. There are, however, important exceptions, in particular the telemedi-

cine project, and some IT-investments that have been successful.

It seems furthermore reasonable to conclude that the programs have had little effect on the development in the region, as postulated in assumption 2. The programme has not stimulated the demand for the services that have been created. One explanation may be that the programme was not able to establishing couplings between service providers and their customers, such that they could interact and influence innovations and learning processes. One find few cases of local or regional, horizontal networks resulting from these efforts. The programme has strengthened the ties to centrally controlled networks (vertical integration) in some of the businesses, which also have negative effects. Even such couplings may stimulate technology diffusion, they tend to prevent access to important information and do not allow for mutual exchange of knowledge, which is a to achieve double-loop learning.

Another important point is that very few women were involved in the various initiatives. The programme did not focus on the particular consequences of technology diffusion for women, even that one know that lack of work places for women are a serious and increasing problem for many small communities. Furthermore, we find that the IT programme in very few cases only did take into account the specific characteristics of the region. This is discussed in section 6.

5. User-Driven Technology Diffusion in a Rural Context

The other trajectory for diffusion of IT is closely linked to the economic development and changes in the production life in the region in general. Technology diffusion into rural areas takes often one of these three forms (Arbo & Gulowsen 1992, Storgaard 1993):

- *Consumer-driven* transfer of technology, mainly because most people can afford to buy advanced equipment, as TV/video, PC's and other advanced electronic facilities.
- Through *organisational transformations*, in that enterprises change work routines and through interregional collaboration, or have adapted themselves to higher technical standards, e.g. as (sub)providers.
- Technology transfer that is *mediated by larger corporations*, in particular in the utilisation of raw materials in fishing industry, in service provision, communication, etc.

Some small scale investigations of the actual IT usage in Finnmark has been carried out during 1992-1995 (Jansen 1995). These data, which are collected from a limited number of enterprises and branches, may not provide a complete picture of the current situation. We do, however, believe that they give an adequate description of IT usage in rural areas in Norway to day. Our findings are:

- In most branches of the service sector, the local technical solutions are comparable to elsewhere in Norway. But some sectors, in particular industrial production, are lagging.

- Public and private services have been substantially improved during the last 10-15 years.
- Modern telecommunications have provided easy access to information and knowledge outside the region, and provides better tools for cooperation and knowledge exchange
- The skill development shows ambiguous trends. In e.g. banks and insurance companies, the qualification requirements have in general been enhanced. In retail trade, however, the job content for most lower-level employees has been reduced, which resembles a fordist pattern. This applies in particular for work places typical for women.
- Most enterprises are linked to computer networks operated from outside. This opens for external control and increased local vulnerability by depending on remote information systems (vertical integration). Telecommunication services have not stimulated cooperation through horizontal networks between local enterprises.
- Most computer systems in use are developed and maintained outside the region. This may create dependency of external expertise, and hamper competence build up locally.
- Many local offices (or branches) are mainly importing IT-services into the region through the networks, and few are buying these services locally.
- The use of networks has increased specialisation and division of labour in some sectors (e.g. in retail trade, manufacturing industry), which may imply that the region's share of the value-adding chains has been reduced.
- Rationalisation, partly caused by increased IT-usage has implied staff reduction, which have severe effects on small communities. We find that the diffusion of new technology has created few new IT-based jobs in the region.

We find, typically, all three forms of diffusion as described above. But the third form, mediated by larger corporation seems to be the most influential one. This is the case both in many branches in private sector, and even more typical in the public sector, where the local offices are equipped by IT-equipment according to central strategies.

These conclusions are in line with other findings. In a study of the developments in retail trade in European countries, it is claimed that "..the organisational changes lead to more interdependence within the trade sector. One consequence is an increased organisational flexibility, with the risk of deterioration of worker condition, and their jobs have become standardised" (Vendramin and Valenduc 1993). Furthermore, Gillespie and Goddard (1989) states "…improved communication and better trade relations with fewer barriers provide a better competitive climate for stronger rather than weaker economies. For the districts that have a weak economy, greater openness will only render their weakness more obvious. In this negative scenario, the main applications of communication services are as delivery mechanisms for externally-produced goods and services, so that the region concerned will have little roles to play in

shaping the infrastructure or the services run over it, because it is designed primarily to serve the interest of external organisations."

It may also be relevant to look at the diffusion of other technologies, e.g., in transportation and communication. We find that there have been radical changes in the use of advanced technology in the region during the last 15-20 years, illustrated by some other observations (Jansen 1993):

- The development of air traffic has been substantial, as Finnmark has three larger and eight smaller airports. This is impressive in a region with less than 80 000 inhabitants.
- The use of mobile telephone, TV and other communication systems, both at land and offshore can be compared to an average national level.

However, in spite of this substantial increase in the use of new technical artifacts in the region, we do not find corresponding development of local manufacturing industries or support services (Arbo & Gulowsen 1992). Accordingly, the economic, social and cultural integration of new technology at the consumer side has not implied a similar development at the producer side (except the development of maintenance services for cars and snowmobiles). It seems to be a mismatch between the changes in the customers demand and the innovation processes at the supply side in the local economy.

Our findings indicate that the learning effects of the technology diffusion have been small. One reason may be the structure of the local economy itself: the availability of capital, machinery and knowledge is insufficient to stimulate the type of innovations that is required. Can we find strategies that counteract such this type of development?

6. How Can Technology Diffusion Support Indigenous Development?

It seems to be a paradox that while the general development of the regional economy has implied a significant user-driven diffusion of technology, the IT programme, with some exceptions, has not succeeded in creating services that can meet local demand. This may indicate that the underlying technology policy did not rest on an adequate understanding of the real mechanisms in the local economies. It is necessary to look closer into the innovation and diffusion processes, to understand the factors that inhibit such developments.

6.1. The Producer - User relation

In a market economy, characterised by a highly developed division of labor, product innovation raises an information problem between the users and producers. If markets were pure, and characterised by an anonymous relationship between users and producers, this information problem is difficult to solve. Innovative activities aiming at new products would be very risky to initiate, and successful innovation would be very difficult to achieve. Williamson points to vertical integration as a solution to this information problem, but he has later revised his original analysis of markets and hierarchies, and accepted alternative forms of governance, e.g. the network (Williamson 1985). Lundvall presents an intermediate institutional setup that characterises the relationship between users

and producers of product innovations, called organised markets. The most fundamental aspect of the organised market is the ongoing process of exchange of information between users and producers, involving a process of change in knowledge and enhancing the innovative capability of the producer and the user competence. This user-producer approach implies an emphasis on innovation as an *interactive learning process* (Lundvall 1992).

Interactive learning involves, according to Lundvall, both *technical, communicative and social learning*. While the technical learning focuses on awareness, understanding and developing a know-how among the users, the communicative emphasise the mutual discourse between users and producers. The social learning implies understanding of social as well as economic needs for the other party and developing common rules restricting egoistic behavior.

Lundvall furthermore defines four different dimensions of space in the user-producer relationship: *Economic space*, which relates to how different economic activities are located in a system of production where the vertical division of labor is highly developed. *Organisational space* refers to horizontal and vertical integration. The *geographical space* can be measured in terms of distance, when activities can be assigned to distinct locations. Lastly, the *cultural space* is a more loose and complex concept, but it relates to important characteristics in the real life, having great impact on e.g. learning and communication processes.

6.2. Winning back the control of information as a strategy for indigenous development?

Our study shows that the economy in Finnmark, as in most rural areas, can be characterised by outside controlled, vertical integration, and few cases of horizontal networks. The geographical distance to the outside markets is large. There are also significant cultural differences between the region and the markets, and between the local authorities and central, government agencies.

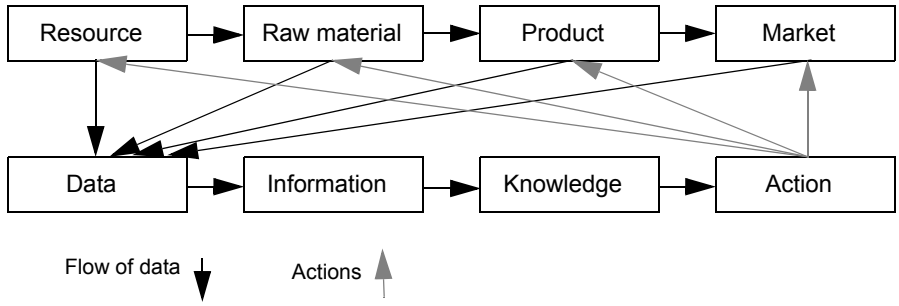
These factors clearly imply that communicative and social learning based on interaction between users and producers have been difficult to achieve in the region. Vertical, outside operated networks create barriers for information flow into the region, and by that inhibit knowledge buildup in the region. E.g. the interaction between local information services providers and the customers in a remote market is low. We need, accordingly, a strategy that can change the structures that control the information flow and by that the knowledge buildup.

Krogh (1993) has developed a model that may help to understand these processes. His basic assumption is that information is an input factor in all production processes, corresponding to physical resources. The main point is that information work is not a separate activity, but an integrated part of the value adding system. A figure may illustrate this, see Figure 1.

The information work in the production processes has, however, three important characteristics:

- Every step in the production processes creates data that can be converted to knowledge.

FIGURE 1. A model of value added chains in resource based production systems



- The information handling processes are directed toward all links in the value-adding activity, starting with the catching of natural resources, and ends up with marked and sales operations.
- These processes may take place at large distances from the physical processes.

The value adding chain in the fishing industry can illustrate this model. Data are collected in all processes: fishing, production, distribution, marketing and the negotiations with the customers. These data form basis for the development of new knowledge and competence. When a local fish factory belongs to a centrally located corporation, majors part of these operations is carried out outside the region, and important information as customer's requirement and changes at the marketplace, will not be available locally. This will prevent the local actors to develop knowledge and competence in these areas.

The challenge for the local economy is to get access to the data sources in all parts of the value chain. One way is to stimulate horizontal cooperation, such that more information flows internally in the region. We know, furthermore, that direct contacts with the different actors in the market are essential for local service providers. Hepworth emphasises that it is a major question for rural development policy to discover ways of helping small-scale operations to connect into the information economy. Rather than continuing a dependency form of development associated with branch-plant economies, there is a need for a strategy that would result in greater regional autonomy, based on creating a networking culture between small and medium-sized enterprises in remote areas, such that locally based service offerings can stimulate indigenous development (Hepworth 1989). This implies that both the local and the regional market have an important role to play in this development.

Katz (1988) has analysed IT as a force shaping society in three different phases: "The first stage of statebuilding, IT is mainly used by the apparatus. Thus the political variable has more weight than the economic variable in determining their diffusion. In the second phase, which we might call infrastructure building for economic development, communications development is driven by economic needs, mediated by the political

system. In the third phase - that of maturity - the manufacturing and service sectors become the main contributors to the expansion of information and communication systems. In this phase, the economic variable is the one that has more weight."

This is a unilinear model, taking IT as more or less independent variable. The model cannot be applied on Norwegian rural areas without modifications, as we are more likely to see the different phases developing in parallel. But it may provide an interesting perspective to the analysis of the diffusion processes. In our cases as described here, we might claim that the policy initiated efforts belongs to phase 2, while the user driven IT diffusion resembles what Katz denotes as phase 3 events. However, these two types of developments have actually taken place simultaneously. However, this perspective did not influence the planning and implementation of the policy efforts.

These findings indicate that the programme did not take into account the specific strengths and weaknesses in this region, other than those generally found in rural areas in Norway. The programme did not manage to stimulate innovation processes that could benefit from the strength of the regional economy, or actions that could counteract its weaknesses.This finding supports our third assumption.

7. Conclusion

This study has revealed some fundamental problems in defining and implementing regional IT policies. We found that the IT programme carried out in Finnmark had some successful projects, which have initiated innovations and created new services. But the general conclusion is that the programme has not contributed significantly to the development of the region. It has not counteracted the general trajectory of change in the economy, dominated by vertical integration into centrally dominated networks and organisations. Small efforts have been done to stimulate the development of horizontal networks between small and medium-sized enterprises in the region. Thus the local synergy effects and knowledge development have been limited.

The programme had few resources, which were fragmented into many small projects. The time horizon for many projects was too short to give any substantial effect, and there were no plans for transfer of experience and knowledge gained from the different projects. It was little focus on the interaction between technology and organisational, social and cultural factors, as e.g. women's relation to technology was not an issue at all. The plan failed in stimulating the local market for new IT-services, and the public sector as customers were not integrated in the programme.

These conclusions do not necessarily imply that the programme has been wasted efforts. Many of the basic investments and the experiences gained can prove beneficial if one continues infrastructure buildup, and include to support users of these new services that are created.

However, a new IT-strategy is required, that is based on a more adequate understanding of the technology diffusion processes that are actually going on in this region. Furthermore, this strategy should be an integral part of a long term,

holistic development policy for the region, including elements as the following:

- To stimulate integration between the service providers and users locally, and even support cooperation among the users of new technology in the region. One should include local public institutions (e.g. municipalities) as part of local market for IT-services.
- To develop horizontal networks between the industry, educational and R&D-institutions from all parts of the region that can contribute to knowledge buildup and innovations. It should be allocated resources to the transfer of experience and knowledge between the various actors.
- To stimulate the development of information services that are based on the regions own industry or rooted in local competence and cultural traditions.

Is this a realistic strategy? A OECD report claims that there are some signs of a positive development: "A new, 'post-Fordist' or indigenous forms of development are emerging, and these appear to offer more scope for creating a greater degree of internal coherence in the regional economy. The indication for this form of development is a decline in the vertically-integrated corporate structures on one hand, and, on the other hand the development of spatially proximate networks of firms that may provide the basis for a renaissance of regionally-focused production systems" (OECD 1991)

In Norway too, we may find such examples, as e.g. in the furniture industry, which is a successful export-oriented business sector in Norway. A majority of the enterprises are found in a small, remote region at the west coast (Møre and Romsdal), and they have established horizontal networks and locally based cooperation patterns. These experiences should be studied carefully.

We now experience a significant optimism in the north related to an increase in the fish resources and a stronger local economy. The increased cooperation with Russia offers great challenges. Research should be allocated to follow these developments carefully, aiming at study how the exploiting of the resources in regions can be managed by the region itself, and not be dominated by outside interests. Much effort should be aimed at investigating the conditions for strengthening the horizontal cooperation and development of local innovative networks.

Notes

[1]Both the 1985 White paper on regional Policy (St. mld no 67:1984-85) and Long Term Programme for the Regional Development Fund St. mld 4:1984-85) stress competence enhancement through the increased use of IT. The National IT Programme, initiated in 1987 (St. mld 1:1987-88) included a separate part aimed at regional diffusion of IT.

[2]The plan for these efforts in Finnmark is described in Forut, (1986), as part of Norwegian Telecom's Strategy

[3]This study is part of "The Rural Development Programme", running from 1991-1994 and funded by Norwegian Research Council.

[4]Infrastructure may have (at least) two different meanings:

i Tele- and datacommunication facilities and support services, aiming at providing communication and infor-mation services spanning physical distances (analogous to road and railway systems), in a more restricted meaning.

ii Those parts of IT systems in organisations

that do not belong to any specific user groups or applications, but rather are providing a common set of facilities and services across the organisation, as basis for all IT systems and applications. (a broad definition, cf Gunton 1992)

[5]A short description of these efforts is given in the yearly reports from Telecom Research Center (TF 1988, TF 1989), to be retrieved from Norwegian Telecom Research Development, Kjeller, Norway.

[6]Its main goal was initialey defined as: *To establish profitable and sustainable IT applications within prioritised areas, which in 1992 was changed to be: ..contribute to increase the application of IT as a vehicle for the reorganisation and development of the business sector in Finnmark.* The programme initiated about 40 projects, adding up to total 5.7 NOK. The description given here includes also other centrally managed efforts that were aimed at this region, and should be seen as extensions of the regional programme, as e.g. infrastructure investments, the telemedicine and the FUNN projects.

[7]Telematics is being used as a common term for IT-based communication and information exchange, including multi-media communications

[8]The support to CTCs in Finnmark was part of a nationalwide programme for development of small, IT-based service providing centers in rural areas. These efforts have in general not been successfull, and to day only one or two of them are still in action. See Hetland (1989) for more detailed description.

[9]The indicators used here are 1)improved service provision to citizens, 2) creation of new jobs, 3) increased import or increase export of services 4) strengthening of veretical integration 5) development of horizontal network. These indicators correspond partly to 8 cohesion factors as defined in The EU ACCORDE project. A more detailed discussion is given Jansen (1995).

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