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Fishing for Fun and Profit? National Domestication of Multimedia: The Case of Norway[1]

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INTRODUCING A NEW TECHNOLOGY: EMBEDDING AND LEARNING

During the past 20–25 years, a lot of effort has been put into the formulation of information technology policies. Repeatedly, we have met the warning that the "information society" is coming: Beware or meet the consequences! However, the significance of the slogan has never been clear, and its meaning has changed over the years. The concern has shifted from automation of work and unemployment to communication and play. The development of the field of multimedia is both an outgrowth and a potential transcendence of concerns of previous decades.[2]

The uptake of new technologies has traditionally been described as a process of diffusion, following an S-curve distribution over time. A period of introduction with slow growth, where users are pioneers, is supposed to be followed by a stage of relatively fast expansion, and finally a leveling off period as the potential market becomes saturated. The actual percentage of the population that buys the artifact varies a lot and has proven to be difficult to predict.[3]

However, the introduction and uptake of a new technology are much more than just a question of market penetration. In general terms, what is taking place is a process where the technology and the social system under scrutiny coevolve in a process of reciprocal shaping. If the introduction is successful, the artifact becomes situated, practically and symbolically, while the social system develops routines and institutions to support and regulate it. Users will construct practices as well as meanings around the artifact that will be transformed from an alien into a recognizable element. This process may be called *domestication*.[4]

Domestication has mainly been studied at the level of the household or the individual.[5] Here, it may be observed that it involves practical, symbolic, and cognitive aspects of the literal taming of a new and unknown artifact.[6] However, efforts to appropriate a new technology also have to be performed at the level of the nation state. In this context, it has to become embedded. Thus, issues like infrastructure, institution building, and regulation come forward.[7] However, appropriation implies more than social integration in an institutional sense. Even at the national level, one has to perform symbolic and cognitive work to make technologies work. This is why the concept of domestication is used in this article to analyze the adoption of multimedia in a specific country. We find that the concept of domestication is more sensitive to the symbolic and cognitive aspects of multimedia adoption at the national level than the more generic terms of appropriation or social integration.

From our point of view, the case of multimedia penetration in Norway represents an interesting opportunity to study domestication and to refine the concepts needed to analyze and understand the processes involved. In particular, we study *social learning* in relation to the multimedia scene in Norway. We regard social learning as a generic term of the processes of using, producing, and making sense of the new technology, emphasizing spatial as well as temporal aspects. In spatial terms, we face the challenge to understand how technologies are made to work when they are "displaced" into new locations through movements from laboratories to consumption, or from one country to another. The focus on the temporal dimension invites us to rectify an obvious and far-reaching weakness in most efforts to theorize the relationship between technology and culture. These efforts tend to neglect the

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"microhistory" of artifacts through their emphasis on the synchronous features of this relationship.[8]

We carry out the analysis by looking at three domains:

- The learning economy of networks of producers and users, in particular strategies among different providers of services.
- The appropriating constituency of users.
- The constituencies of regulation, both public and private, that try to stabilize and control the domestication of multimedia in Norway.

By analyzing the process as multilocal domestication, we observe the interaction between technological and social change as a reciprocal configuration. The work performed by the various actors that are engaged in this configuration is in some sense a process of searching in the dark, because too little is known about the sociocultural potential of multimedia. The actors may do careful planning, like you usually do when you go fishing, but the outcome is no less uncertain. There will be experiments with new sociocultural practices, there will be efforts to build new institutions and constellations, and there will be work done to regulate both technology (standards) and social relations. Thus, actors are into learning, and the role of the social analyst is to analyze what is learned.[9]

Even if the concept of multimedia has an international meaning, part of the analysis of the domestication of multimedia technology is to provide a local understanding. Thus, we continue our account by surveying how the concept of multimedia is understood in a Norwegian context and how this understanding can be used to provide some classification tools as well as a preliminary map of actors.

While our analysis involves a concrete description of the Norwegian multimedia scene, we also believe that it highlights more general features of such introduction processes. Even if national uptakes of new technologies follow a great variety of patterns, challenges of building infrastructure and regulatory institutions, providing cultural meaning and practical abilities, are usually present. These issues are the underlying concern of this article.

A RAPID APPROPRIATION: THE LIMITATION OF CONTEXT

Arguably, Norway is a perfect country for the diffusion of information technology. Its population is small, 4.37 million inhabitants, but the population density is just 14.2 persons per square kilometer. Situated at the northern periphery of Europe, its extension in a north–south direction is comparable to that of continental Europe from Denmark to the southern tip of Italy. To overcome the topographical challenges, the need for modern telecommunications is considerable.

However, historically, Norway was no forerunner in the field of telecommunications. In a relatively poor and semi-industrialised country, the demographic and topographic characteristics mentioned earlier constituted a problem rather than a fruitful challenge. In the last two decades, considerable changes have taken place. For example, the penetration level of mobile telephones is among the highest in the world. Also, more or less overnight, the World Wide Web has become an integral part of the life of most Norwegians. In November 1996, various access providers had sold a total of 114,900 private user connections. A Gallup survey at about the same time showed that over half a million Norwegians (about 11% of the population) would access the Net at least once a month.

Subsequent Gallup surveys have documented that the household market is growing rapidly (see Figure 1). In October 1998, an estimated 477,000 connected households means that about 25% of the population has Internet access at home. Also, 33% of the population above the age of 13 years use the Internet on a regular basis.[10] The potential for future growth is probably larger still, since more than half of Norwegian households have at least one PC.

Thus, in many ways, the Norwegian appropriation of the Internet and multimedia technology reads like a rapid success story. *Business Week* has described the Scandinavian countries as leading the field in Europe, neck and neck with the United States.[11] This allegation is born out by figures presented by the *Internet Industry Almanac*, which ranks Norway as one of the top countries in this respect. The United States has traditionally been the leader in computer rankings, but in 1997 Finland, Norway, and Iceland had a higher number of Internet users per 1000 people than the United States (see Table 1).[12]

One could of course try to explain this development by reference to structural features of Norway. We have already mentioned some topographic and demographic facts that could account for a strong motivation to use information and communication technologies (ICT) as a communication tool. A high per-capita income clearly facilitates this. In 1994 the gross national product per capita was 212,452 kroner (about $33,600).[13] Also, other favorable characteristics are worth mentioning. Compared to most other European countries, Norway has less unemployment (around 4%), there is a trade surplus, and the public finances are very solid. Some other characteristics are hardly that favorable. A wide range of very small companies dominates the industrial structure in Norway, and the electronics industry is highly specialized and niche oriented, with marine applications as a stronghold. Thus, the industrial basis for multimedia technology is weak.

The political attitudes toward multimedia are ambiguous. The political culture has been dominated by a Social Democratic party concerned with balancing the

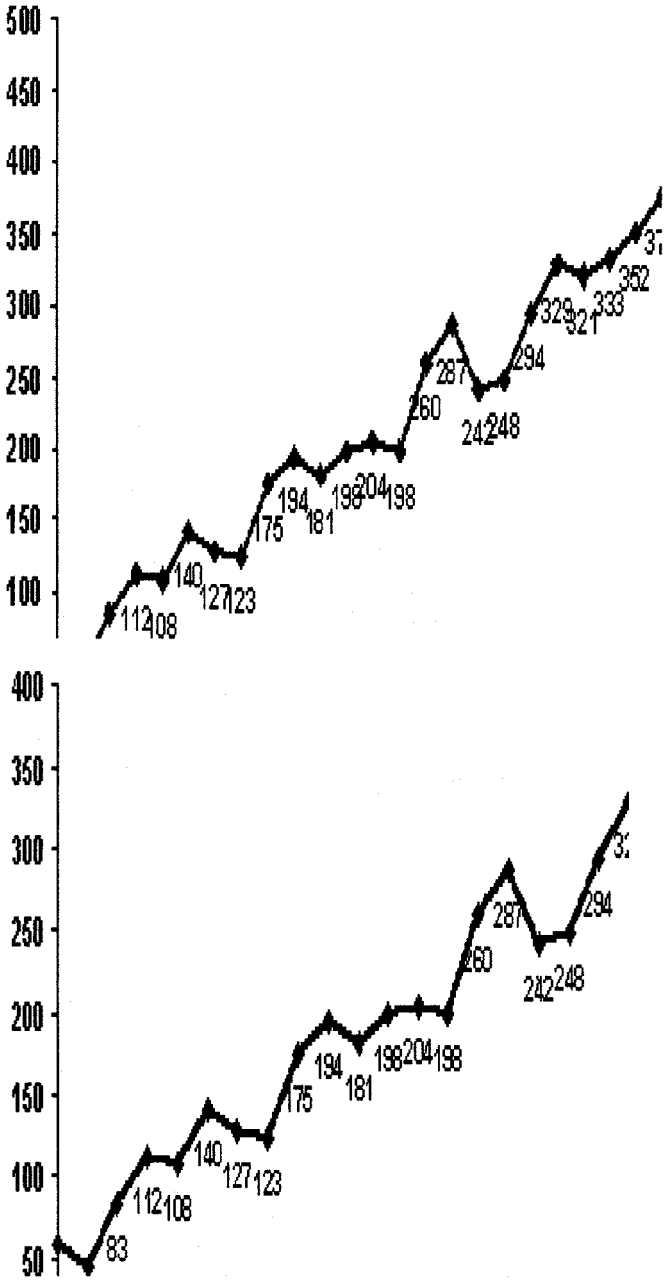

FIG. 1. Private households with internet access, November 1995–October 1998 (1000s).

TABLE 1
Top 15 countries in Internet users 1997

Rank	Country	Internet users per 1000 people
1	Finland	244.5
2	Norway	231.1
3	Iceland	227.3
4	United States	203.4
5	Australia	178.0
6	New Zealand	155.9
7	Canada	148.9
8	Sweden	147.3
9	Singapore	141.2
10	Denmark	125.6
11	Switzerland	107.1
12	United Kingdom	99.5
13	Netherlands	88.9
14	Hong Kong	64.9
15	Japan	63.1

perpetuation of the welfare state against economic liberalism. Although there is a tradition of industrial policy, the government has never seriously pushed a domestic high-tech industry. Nor have we seen concerted efforts to make the public sector technologically advanced. The present policy has a noticeable liberalist flavor, spiced with serious efforts at deregulation, although the trend is less apparent than in several other European countries. The main components of technology policy in Norway can be classified under headings such as general education, public support for R&D, and large investments in public infrastructure. The level of state ownership of industry is low and on the decline.

On the other hand, the level of general education is high. Also, Norway has for decades kept close cultural ties with the United States and Great Britain. This means that there is a considerable sale of English-language computer programs and CD-ROMs.

Due to considerable public subsidies, the cultural industry is fairly large. Norway still has 152 newspapers with a total circulation of 2.9 million copies. Typically, 84% of the adult population read at least one newspaper daily.[14] TV penetration is fairly high, but cable TV is less common than in many other countries due to difficult topography and low population density, and is partly replaced by satellite reception equipment.

Given the fact that Norway seems to be a front-runner in the uptake of multimedia technologies, the Norwegian context appears to be paradoxical. Along some dimensions, indicators seem favorable to the development of multimedia. In particular, the general economic conditions (gross national product [GNP] per capita), a high level of general education, and a relatively large cultural industry could be seen as supportive features. On the other hand, demography produces barriers, the industrial structure is not helpful, and technology policy is not particularly conducive.

Thus, it is difficult to explain the shaping of the multimedia situation in Norway just by making inferences from the general features of Norwegian society. Instead, it is

necessary to study the modus operandi of large and small Norwegian actors in relation to multimedia. This change of research strategy is reinforced by our motivation to focus on the way this new technology is transformed into social practice. What is interesting about the Norwegian situation is not technological development in a narrow sense, since most of the technology in question is imported. What happens in Norway (and in most other countries as well) is the discovery of how multimedia may be put into use, and how this process of discovery is related to a configuration and reconfiguration of social actors, their relationships, and their institutional embeddedness.

SYMBOLIC WORK: DEFINING MULTIMEDIA

In a Norwegian context, there is no established definition of what characterizes a multimedia application. However, an influential claim is that the field of multimedia can be defined through the knowledge base that it draws on rather than through its technical components. Still, multimedia is usually described in predominantly technical terms, although some bits of law and management sciences have been added for good measure. While academic communities have challenged this technicist bias only to a small extent, the notion of cultural multimedia aspects has emerged several times in the media already. When the Norwegian Broadcasting Company (NRK) launched its weekly Internet radio program *Radionettet*, the aim was stated as describing "how technology influences our culture—in short our way of living and working." In particular, the program would try to investigate questions such as: "How do the Internet, CD-ROM and the new information technology affect us? What kinds of cultural impulses and ideals are conveyed? How does it influence the society, the culture, the aesthetics as well as the image that we hold of ourselves?"

It should be noted that this cultural slant also includes a nondeterminist view on how technology can be influenced or appropriated: "Some people will object that all of it is just an American, technified, games-centered boy's culture. Others will say that information technology offers opportunities for us to put technology to good use the way we want in order to provide support for Norwegian language, culture, equality between men and women, and equal opportunities for everyone in our society of the future." In the journalists' own words, this aim was singled out as being the focal point of discussion in *Radionettet*.[15]

Thus, if signs coming from the media are anything to go by, it appears that the multimedia scene in Norway will concentrate more on the cultural shaping of technology and less on the technicalities in years to come. Multimedia will be defined by its locally produced contents rather than by its imported technical components. We can see this shift taking place as the press, the publishers, and radio and TV companies adopt the new technology. As a spokesperson of *Nettavisen* said when confronted with some technical glitches experienced on the electronic newspaper's opening day: "I don't want to comment on Java applets and other technicalities that might not function. The contents are our concern."[16]

Even if, strictly speaking, the concept of multimedia implies applications involving a combination of several media components, it is also used when only one component or a simple form of presentation is involved, such as the peruse of text-based systems. Also, communication need not be in dialogue form. Many present-day activities thought of as being multimedia applications are basically some kind of "simple retrieval," such as the lookup of entries in a textual database or in a graphics archive. This is so regardless of whether the lookup takes place against a server on the Net or locally from a CD-ROM or diskette.

The kind of multimedia applications that most people think of today as being typical is based on two-way or multiway communication using numerous techniques for representing text, pictures, sound, animation, etc., singly or in various combinations. Many such applications are edutainment, or games in which the user is instructed or controlled by the program in order to attain a predefined goal. Often the combination of techniques is based on pedagogical principles instead of being left to the user. These applications are often described as having "full interactivity."

Multimedia also comes in variations other than "simple retrieval" and "full interactivity." "Dialogue" is a less advanced two-way or multiway communication involving a limited or straightforward kind of presentation, such as the communication of text. Typical examples are the activities of talk groups or IRC (Internet Relay Chat) groups. Videoconferences are another example based on simple real-time transmission of picture and sound.

Furthermore, there is one-way communication based on various kinds of representation, which we have termed "presentation" in Table 2. This type of application has proliferated recently as various kinds of encyclopedias have been made available on CD-ROM.

Gradually, some applications classified as "presentation" will be developed into applications to be classified as "dialogue." Today shopping is one of the most prominent examples of this type of development. Automated bank services also fall into this category, and so do services permitting the search of databases using criteria chosen by the user, who is presented with the results of the search in real time.

Probably most multimedia actors will have a strategy of pursuing more than one of the categories in Table 2, depending on what kind of services they want to develop. Even the most hardware-oriented network providers are likely to offer some kind of application, although their

TABLE 2
Types of user interaction versus communication types

Communication type	Single-media interaction	Multimedia interaction
One-way	Simple retrieval, e.g., lookup in CD-ROMs or databases, access to WWW links	Presentation, e.g., most current WWW applications, CD-ROM encyclopedias
Two-way/multiway	Dialogue, e.g., making orders on the Net, talk groups on the Net	Full interactivity, e.g., educational applications and edutainment, games, video-on-demand

strategies will in some cases be hardly more ambitious than providing services classified as "simple retrieval." The most basic form of "simple retrieval" is the gateway service based on the establishment of links, that is, the provision of a catalogue of addresses allowing users to access the services of various other providers.

We feel that in the initial phase of the multimedia development, the evolving patterns are still much too rudimentary to warrant an unambiguous four-part classification such as the one illustrated in Table 2. The multimedia actors are putting in a lot of effort, and much still has to be done to develop "simple retrieval" applications into "presentation" applications or even into more advanced "dialogue" or "full interactivity" applications. Thus, the current strategies of most multimedia actors are concentrated more or less intently on following this path of development without deciding what type of communication they want to arrive at in the end.

This state of flux seems to demand that we adopt a simpler classification, at least as a temporary measure. Instead of concentrating on the degree of user interaction, it seems plausible to adopt the dichotomy of online and offline systems. This dichotomy seems to be more clear-cut than the categories in Table 2, at least for the purpose of analyzing contemporary actor strategies.

Obviously, the emphasis today is on developing online systems. Offline applications, as implemented on CD-ROMs and similar media, have not met with equal success. Nevertheless, there are still some differences in the focus of online and offline strategies. Offline systems are used mainly for games, encyclopedias, literature (both fact and fiction), and edutainment. Such applications are by and large absent from online systems, which are dominated by search engines, daily news as found in newspapers, purchase offers, and information on more topics than you would ever want to read about. These types of typical multimedia applications are summarized in Table 3.

Since offline applications are no longer the driving force of the multimedia field, this article concentrates on describing the development of online services. It must be said that a few Norwegian CD-ROM titles are still being issued every year, but investment in this technology is quite small and the quality of the productions has met with criticism. Some CD-ROMs are translations and adaptations of questionable quality, and some have been accused of being much too text-based or lacking in interactivity.[17] Even if most new PCs are sold with a CD-ROM unit, the sale of CD-ROMs has remained low. Also, some publishers have announced that they are dropping or reducing plans for future CD-ROM productions.[18]

On the other hand, as already indicated, online services have enjoyed a rapid success. A projected 500,000 households will be on the net before the end of 1998. Also, the value of the shares of the most successful innovators has risen noticeably on the stock exchange. Another indicator of success is the extent to which mergers are taking place and the entry onto the Norwegian scene of major international companies.

Already, there are too many actors, small and big, actual and soon-to-be-expected, to defy enumeration. Some are private and some are governmental actors, although there is a tendency for what used to be governmental activities in this field tend to be privatized and rapidly become commercial at short notice. Another distinction that no longer seems to be of much use is that of access providers and content providers. The trend is for access providers to expand their activities in the direction of content provision. Also, some content providers have been operating servers and networks of their own. Consequently, the time

TABLE 3
Typical multimedia categories

Online	Offline
Seek engines	Games
Daily news	Encyclopaedias
Purchase offers	Literature
Various kinds of information	Edutainment

has come for a more detailed classification of multimedia actors.

Among the content providers, it seems useful to differentiate between "goods providers" and "information providers." The traditional information providers are newspapers and government agencies, who still do not believe in getting much revenue from their services. Government funds or income from advertising applets accompanying the information contents often finances the cost of operating these services. The "goods providers," on the other hand, depend on revenue from sales and will often maintain an automated mail-order catalogue from which users can place their orders online.

What used to be thought of as access providers can now best be split into three categories: network providers, access providers, and agent providers. Several new network providers will emerge, as the monopoly of the Norwegian telecom, Telenor, as the owner of physical telecommunication networks, was abolished at the end of 1997. As a result, access providers will have a choice of competing network providers when setting up servers to which users are connected. There will also be agent providers, who select for the users the kind of information they want and digest it, that is, classify, summarize, and reduce it to a systematic or convenient form. We call them agent providers because they operate advanced search engines, so-called "intelligent agents," to process the information. Relationships between these three types of providers forming the infrastructure of the multimedia world will often appear as a hierarchy, as illustrated in Figure 2.

PRIVATE-SECTOR ACTORS AND THEIR STRATEGIES

The Norwegian multimedia scene is in flux. Even as late as in the summer of 1996, it would have been difficult to foresee the pattern emerging in 1997. This is so because of the simultaneous rearrangement of major groups of actors during the last months of 1996.

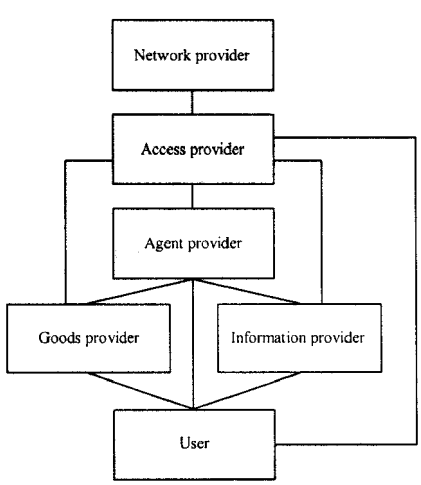

FIG. 2. The multimedia provider hierarchy.

One of the interesting qualities of new technologies is their ability to act as catalysts of social change. New technologies may be used to redefine the situation in terms of what is doable, who may do what, what is challenging, and so on. They may be domesticated into old structures, but there may also be room for radical change. This means that established macro actors may be cut down in size and influence, while small organizations may grow into new strongholds.

The early history of data communications took place in the public sector.[19] In 1973, Norway and Great Britain were the first countries outside the United States to be linked to Arpanet. Slowly, there emerged an academic net with extensions to academic communities in other industrialised countries. In Norway, Uninett was set up as a company with public funding to be responsible for net services to universities, colleges, and research institutions. As the biggest telecommunications project of its kind, Uninett had at the time exclusive access to Arpanet and its successor, the Internet. Uninett had no commercial aspects, so companies wanting to communicate via the Internet had to document a strong relationship with academic R&D institutions at home or abroad. Access was denied to private users.

The situation changed in 1991 when computer scientists at the University of Oslo and the Norwegian Computing Center established a new company, Oslonett, that would offer easy Internet access to companies and private users. In 1992 they got their first customer, the National Association of Mechanical Industries, which wanted an Intranet solution for its members. According to Gisle Hannemyr, one of the founders of Oslonett, they were able early on to persuade Telenor to invest in the establishment of a commercial Internet service in Norway.[20]

In 1993, Oslonett started selling Internet access to private users and had about 1000 customers by the end of the year. The Lillehammer Winter Olympic Games in 1994 proved to be a major breakthrough. The Web server set up was one of the first internationally to offer highly useful information. As a result, the transatlantic bandwidth was filled to capacity and Sun had to set up a mirror site in the United States. Gradually, new customers joined, and by the end of 1994 Oslonett had 4000 users. However, its fastest growth period occurred during 1995, when its customer base expanded to about 10,000.

Being acutely in need of more capital in order to invest in its own infrastructure, Oslonett started looking for a major telecom partner such as Swedish Telia or France Telecom. A merger with EUnet was also considered. Eventually, the Schibsted publishing group—a major media group in Norway—got interested. In September

1995 Schibsted acquired the firm, which was renamed Schibsted Nett.

From the autumn of 1995 until the autumn of 1996 there were only two major contenders in the Norwegian multimedia market: Telenor and Schibsted. Interestingly, Telenor expanded into content provision and Schibsted took on being an access provider. However, while Telenor made a profit from their expanding activities, Schibsted suffered a large loss. In part, this was due to the decentralized nature of the infrastructure required on the part of the access providers. First, to provide cheap access, each of the contenders would have to install servers and modems in as many of Norway's 435 municipalities as they could afford, and also as fast as they could afford. Second, the influx of new users, partly as a consequence of campaigns offering cheap Internet connections, completely swamped the systems and necessitated frequent updating or replacement of the servers. Its technically competent staff and broad geographical coverage were a great asset to Telenor as a well-established telecom firm, whereas Schibsted suffered greatly from having to establish everything from scratch.

Schibsted realized that in a short time it would lose out in the contest with Telenor and other soon-to-come telecom actors. Being an access provider was not central to its core activities, so Schibsted acted quickly. Hardly more than 1 year after buying Oslonett, alias Schibsted Nett, it sold the enterprise to its major competitor, Telenor, in November 1996. Generally, this was regarded as a very good deal for Schibsted, so why did Telenor make such a generous offer?

Part of the answer will be found in the following account by one the Telenor managing directors: "This area has been like a toy shop where one has bought a couple of modems and started up as an access provider. . . . The market has greater demands, and now we can concentrate on the potential for expansion inherent in the Internet as well as sharpen our innovators' skills towards this goal."[21]

After the deal between Schibsted and Telenor, both sides allegedly went "back to basics," which meant contents provision in the case of Schibsted and access provision in the case of Telenor. This was only partly true, as Schibsted's content provider, Schibsted Nett, was to continue as a joint company with Telenor under the name Scandinavia Online. First, as indicated by the change of name, the services would be expanded beyond the national borders. Second, as part of the merger, Scandinavia Online ended up with 50,000 Telenor Internet customers as well as 40,000 previously served by Schibsted Nett. This meant a market share of about 80% and triggered an investigation by the Competition Surveillance Board (Konkurransetilsynet), a government body set up to prevent the formation of monopolies and cartels. In view of the competition expected when deregulation of the telecom market happened in the beginning of 1998, particularly the entry onto the Norwegian scene of multinationals, the board did not impose any sanctions on Scandinavia Online.[22]

If one should try to summarize developments from 1996 to 1998, the first thing to be noted is the voracious appetite shown by Telenor in acquiring smaller competitors. With government approval it spent about 6 billion kroner (approximately $800 million) in 1996 buying other firms, expanding its own networks and investing in infrastructure abroad. Also, sales had risen from 13 billion kroner in 1988 to 23 billion kroner and were projected to increase to 30 billion kroner by 2001. In spite of the deregulation of all telecom services, some politicians, mostly from the Conservative Party, were concerned that Telenor would still have a monopoly. Thus, competition would not be real. They cited these huge investments and the strong backing by the Social Democratic government as a major cause of concern.[23]

At the same time that Telenor and Schibsted established Scandinavia Online, Swedish telecom Telia decided that the time had come to start moving into the Norwegian market. At short notice, Telia acquired a small content provider, RiksNett, which had been owned in part by the union of Social Democratic newspapers. Telia paid 23.6 million kroner for this enterprise, which may seem a lot, because it had a customer base of only 10% of the Internet users.[24] Obviously this fact did not matter much, because the strategy of Telia, as far as Norway is concerned, is to develop services for companies.

Of greater importance were the size and potential outreach of the network of servers and modems that RiksNett had established in 70 communities throughout the country. None of the remaining access and contents providers were equally well equipped. Also, Telia must have felt a strong urge to buy RiksNett before other multinational companies moved in.

The events since 1996 led to the interesting fact that multimedia came to be very much dominated by telecom companies, in particular the national company Telenor, but also its Swedish competitor Telia. Clearly, these services were too demanding in terms of infrastructure and financial needs for smaller companies. Also, potential competitors such as the cable TV companies seemed to lack access to a sufficient number of users to be able to compete (though it should be noted that Telenor also owns a large part of the Norwegian cable TV network).

It is probably no accident that two large publishing groups, Schibsted and the Social Democratic newspapers, tried to enter the Internet provider market early on. This indicates that they interpreted multimedia as part of the media market, suitable for media know-how and services. But by the end of 1996, both groups had sold out. Both had been intimidated by the challenges of being access as well as content providers.

If two-way communication is taken to mean full interactivity in every application, Norway still has a long way to go. Referring back to Table 2, we see that presentation is the most widespread multimedia category. There are very

few on-demand applications to be found. Such applications take a long time to develop. Also, the capacity of ordinary networks is still too restricted for true interactivity on a grand scale. In addition, most people still find satisfaction in using less advanced applications and do not demand full interactivity.

As far as multimedia institutions are concerned, it was expected that major international actors such as Global One and America Online would make their strategies in Norway known by the year 2000 and probably take some action. Also, Telenor continued to expand even after the telecom monopoly expired at the end of 1997. Its goal in the next 10 years or so is to secure a share of the Scandinavian telecommunications market of 40%. Also, Telenor will be fighting fiercely if there is a risk of losing more than 30–40% of the domestic market.[25] In the same period, Telia expects to take 30% of the Norwegian market, thus leaving very little to major multinational actors who might be moving in soon. It is expected that these big actors will be the future access providers, and that most of the smaller companies will vanish.[26]

It is expected that the access providers will also be major agent providers. Recently, Telenor and Telia have reshaped Scandinavia Online and RiksNett to get rid of most of the contents in order to concentrate on gateway functions. This is a strategy emphasizing services that have not yet caught on fully among users. Even so, the telecommunication companies obviously have a strong belief in their ability to select and digest the information that they perceive is required by the users.

Following the rearrangement of access and agent providers on the Norwegian scene, the area of content provision is left in a formative state. No clear strategies have emerged, although the Orkla combine, one of the biggest in Norway, with ownership interests in a number of industries, has announced a direct marketing approach targeted at private households. Its concept is to unite several content providers into an electronic shopping mall. The concept is an old one even in Norway, where smaller content providers already operate several malls with modest success. It remains to be seen how the concept can evolve when promoted by an industry giant such as Orkla.[27]

On the whole, the issue of payment is guiding the efforts of most news media. Newspapers not being sold by subscription tend to reserve the best stories for their paper-based versions. Also, the owners of the fully electronic *Nettavisen* have expressed doubts as to whether they are ever going to make money from Internet readers or be content with making money from advertisements.

Currently, the efforts to domesticate multimedia in Norway, in terms of setting up institutions and construct practices, have led to realignments and restructuring of many of the participating actors. The telecommunication companies, in particular Telenor, followed by Telia, have been able to get a solid hold on the market for access provision. Telenor's strategy, which is as much shaped by deregulation strategies as by multimedia developments, implies a dramatic change of the public service company into a diversified, high-tech combine (although still formally owned by the government). The resulting division of labor between access and content provision may not yet be stable, but it represents an interesting national configuration.

Developments related to the supply of content in multimedia services are more complex. This is an area where small companies may have a better chance of survival, but the most prominent services are still outgrowths of relatively large, well-established companies that try to extend their services through the Net. The efforts of many newspapers to provide electronic versions are a good example, but there are also other actors such as banks, which launch electronic payment and banking services on the Internet.

We should recognize current developments as sustained efforts to learn, with an acknowledgment that risks may be substantial and that profits are uncertain. In many ways most attempts at supplying multimedia content are social experiments, and will analyze them as such in a later section. The outcomes of these experiments are critical to the future of multimedia.

PLANNED FISHING? THE NETTED GOVERNMENT[28]

As previously mentioned, the government-supported Uninett for universities and colleges was a pioneering project of the late 1980s. This early initiative accounts for the fact that 26% of the respondents with Internet access confirmed in a Gallup poll in the autumn of 1996 that the access point was an educational institution (see Table 4).[29] Also, one of the more notable Web-related decisions made by the Norwegian parliament in 1994 was the pledge to provide every school with Internet access in a move called the "electronic classroom." However, this promise will take some time to fulfill, because most primary and secondary schools lack the funds necessary to acquire suitable PCs and to cover the costs of maintaining a permanent Internet connection. So far, only colleges and universities can offer their students satisfactory Internet connectivity.

TABLE 4
Location of personal Internet access points, autumn 1996

Location	Percent ($n = 840$)
At work (noneducational)	47 (395)
Educational institution	26 (221)
At home	25 (214)
Other places	12 (101)

Thus, it seems clear that the Norwegian government has championed the domestication of the Internet in two ways. First, it has provided a financial basis for the development of a national knowledge base to operate the technology. This is a rather traditional role, related to public investments in R&D. Second, due to the expansion in tertiary education, a large section of the younger cohorts have experienced the opportunity of using the Internet. In this way, the government has supported a rather large avant-garde group that may prove of great importance as sources of learning about multimedia.

Of course, even Norway has its information technology (IT) policy, which is more or less in step with the European Union and other OECD countries. While the early 1980s were spent fumbling, investments in IT projects in order to strengthen and broaden the scope of the domestic IT industry were supported by a major technology program of the Norwegian government during 1987–1990. In retrospect it can be concluded that the efforts did not lead to much new activity, even if considerable funds were spent in the process.[30]

Undaunted by the meager results of the first program, a second government program is being implemented.[31] The first program stressed the importance of higher education and hardware-oriented industry production. The new one seems to be more oriented toward the multimedia world, stressing the importance of Internet-based applications and the cultural aspect associated with the use of computer technology, although placing particular emphasis on regional issues. The title of the initial government report outlining the perspectives of the new program is "The Norwegian IT Highway" and indicates that the domestication of technology is becoming a major concern even for the politicians.[32]

Apart from the somewhat misguided efforts of the first government IT program to support a large-scale computer industry, many projects in the public sector have been rather piecemeal. This is particularly true of projects of a multimedia character. Generally, the bureaucratic "line principle" is applied, meaning that the individual ministries and their respective agencies are responsible for implementing solutions within their own fields. As a notable exception to this principle, there is a Central Information Service taking care of services to central government bodies in areas where considerations of quality, cost-benefit, or preparedness indicate that centralized solutions are to be preferred.[33]

All ministries have access to the Internet, a central government network is being developed, and a network service to regional bodies was launched in March 1996. Many of the networks serve internal purposes, such as the distribution of messages by electronic mail and the announcement of regulations by means of home pages. Priority has not been assigned to developing services for external communication. While serving external purposes, the ODIN service (Official Documentation and Information in Norway), announcing major actions and policy measures taken by the ministries, is at least as important internally as it is externally. Also, much effort has been spent on developing basic standards rather than developing services. Examples of recent standards are NOSIP (Norwegian OSI profile, the basic specifications for government computer systems), NORBAS (framework for utilizing open systems in public administration), EDI (Electronic Document Interchange, applied to health administration and customs work), and NISE (standardized gateway function for accessing electronic files).[34]

ODIN has been described as a "full-scale experiment." It is a simple retrieval application based on texts such as government press releases, speeches of ministers, and the occasional government report. The best thing about ODIN is that the documents are now more readily available than they used to be. A preliminary evaluation one year after the launch showed that 86.5% of those asked found ODIN to be a better service than traditional channels of information.[35]

Government plans for the next few years seem to emphasize multimedia applications that are simple retrieval and designed mainly for internal use. Several such projects are underway. One of the most important seems to be SRI Net for connecting central and regional state authorities, and KOSTRA for managing information interchange between the government and the municipalities. It should be noted that these two applications came fairly early in the development of public-sector use of multimedia techniques.

Also, the government intends to support selected projects in the private sector, such as pilot projects related to tourist industry marketing and telecommuting. One of the efforts supported by the government is termed NIN (National Information Network) and aims to attain such vaguely defined goals as a higher quality of life, increased user participation, and sustainable growth in various industries. More to the point is the support for a range of 12 project areas (shown in Table 5).[36]

Norway changed government in the fall of 1997. Still, it continues a policy development process mainly concerned with the promotion of the use of multimedia technologies, including the Internet, as well as the development of productive and profitable services.[37] There is also a particular concern to avoid that the new technology being used in ways that reinforce, or even increase, social inequality. This means that there will be focus on the issue of obtaining access. It also points out gender, social status, and regional issues as important topics. Thus, the development of multimedia is, ideologically speaking, situated in a quite traditional form of Social Democratic discourse.

TABLE 5
National Information Network (NIN) project areas

Electronically based trade using EDI
National road traffic information network (VITN)
Electronic marine navigation
Information network for geodata in local authorities
Information network for the construction industry
Information network for the oil sector
Data-based network for smaller firms
Network for cooperation and marketing in the tourist trade
Telemedical network
National environment information network
Telecommuting/home office concept
Technology for national information networks (HUGIN)

However, in concrete terms, there are few new policy initiatives to be found. This fact may in part reflect the impact of the international wave of liberalism and deregulation, but probably it can also be looked upon as an indication that private-sector actors may sidestep the government. The greatest paradox here is the role of Telenor. Formally, the government owns and controls it, but in practice, the Ministry of Transport and Communications seems to find it difficult to intervene.

Still, several government initiatives will be important. The use of Internet and multimedia in public services represents a major effort to integrate the new technologies into everyday administrative practices. Clearly, this trend will have impacts on the private sector. Specialized applications in the health services (that mainly are public), like telemedicine, are putting multimedia technologies to use in ways that might influence other areas at a later date. Last, but not least, education will provide a very important ground for learning how to provide remote teaching through the Internet and other kinds of multimedia. In this area, there are currently public as well as private initiatives, and within the public education sector, there are both central and local activities.

SOCIAL EXPERIMENTS AND TRIALS

The fast development and proliferation of multimedia applications, particularly those using the Internet, seem to imply that social experiments and trials in the traditional manner are easily dispensed with. We have outlined the typical strategies of multimedia actors in Table 2 to show that transition from paper-based to electronically based communication can be effected gradually without following a pretested pattern. Also, the costs of adopting the most basic forms of one-way communication are negligible in most cases. For these reasons, experiments and trials will often be regarded as irrelevant when it comes to testing the technical, economic, and social feasibility of new multimedia applications.

This attitude is evident especially among the goods providers, many of whom have been eager to display their merchandise on the Net without waiting for recommendations based on trials. This is so even if goods providers could benefit greatly by waiting for various principles to reach a certain level of maturity through experiments. In particular, there are crucial factors to contend with, such as the techniques of multimedia presentations, easy-to-use software for constructing and maintaining Web pages, and new procedures using the SET (Secure Electronic Transaction) technology for effecting credit-card payments.

Even if many hastily set up electronic malls will act as a replacement for social trials, a few such endeavors seem more important than others. A few firms have started experimenting with online ordering systems combined with express delivery by the Post Office. In this way, even two of the biggest grocery chains, Rema and Rimi, have seen fit to undertake what amounts to an uncontrolled social experiment in order to investigate the potential of the Web in changing customer behavior. Home shopping on the Web combined with express delivery by the Post Office or by their own distribution service is believed to be a way of further reducing the network of retail grocery stores and increasing profits.[38]

As far as information providers are concerned, multimedia applications seem to be developing in a rather haphazard manner without consideration of the changes in style and structure that may be required for multimedia presentations. Again, the piecemeal strategy shown in Table 2 is in evidence. Many information providers seem to be content with converting their presentation brochures into a set of simple text files displayed as home pages without employing much in the way of multimedia techniques. Again, it is doubtful if much can be gained in the way of systematic knowledge and social learning from such unplanned trials.

A more adventurous experiment in the field of mass media is LAVA, a pilot project for the online distribution of TV programs in ATM (Asymmetric Transfer Mode) technology, initiated by the Norwegian Broadcasting Company (NRK) and the Norwegian Computing Centre. The transmission uses MPEG compression technology, which, when run on powerful client machines, meets the requirements of video publishing over the network. The project aims to build competence among researchers, to transfer competence to the industry and potential user organizations, as well as technology development in its own right. In addition, the project provides students with insights into technology under development. When the service was launched in December 1995, it was the first attempt ever to publish TV programs based on real-time video transmission on a regular basis.[39]

TABLE 6
Telenor research projects in multimedia and related fields

Distance education, e.g., prototype of an ATM-based electronic class room.
Virtual reality, e.g., virtual model of Oslo's new international airport, Gardermoen.
Interactive TV, e.g., field trial of video on demand for 35 homes and locations in Oslo.
Conference services, e.g., interconnectivity of equipment for multimedia conferences.
Teleworking, e.g., theoretical studies as well as trials in a number of companies.
Potential trade-offs between teleworking and commuting.
Home office, e.g., empirical studies of different user groups in domestic settings.
"Electronic school path," offering Internet access via ISDN to every school.
Virtual corporation, i.e., electronic flow and distribution of documents among firms.
Politicians channel, i.e., PC field trials enabling local politicians to send e-mail etc.

From a political point of view, education and reeducation are considered to be important factors in the society of the future. Concepts such as the "global classroom" and the "electronic school path" have emerged, mostly as concepts without much substance.[40] It is a sad fact that after some overambitious and disastrous telecommunication programs in the first part of the 1990s, which almost cost the Minister of Education his seat, information technology planning in the educational sector has progressed very cautiously. The main keyword is "normalization," which, in political-bureaucratic parlance, means no special ministerial task force and no extra IT resources.[41]

As one of the few concrete measures taken, the government in 1992 established the National Centre for Educational Resources (Norsk lære middelsenter, NLS) for the initiation of development and diffusion of new educational techniques. One of the first initiatives was the adaptation of educational software as part of the EPES project (European Pool for Educational Software), but today much of the activity is being concentrated on the potential of multimedia applications on the Internet, as well as on acquiring more of a research profile.

A major event for NLS in 1996 was the opening of the School Network, aimed at pupils and teachers. The network, when fully developed, will offer various kinds of educational material and guidelines relevant to learning in primary schools as well as talk groups or IRC (Internet Relay Chats). The idea behind the School Network is to make the classroom a more interesting place for students and teachers alike by introducing a strong "virtual" or multimedia component.[42] Economics, computer science, consumer issues, mathematics, physics, English, and Norwegian were some of the topics for which supplementary course material was presented electronically during 1996.

Even if most access and content providers will be rethinking their strategies in the light of the moves of the big actors toward the end of 1996, Telenor as market leader does not seem to be much ruffled by the woes of its smaller competitors. The list of Telenor's most important research projects in multimedia and related fields is detailed in Table 6.[43] Between them, Telenor and the Norwegian Computing Centre share the most interesting projects with a social experiment character. However, Telenor R&D, with 700 employees located at 8 sites around the country, is the only institution with sufficient resources to carry out extensive field trials and engage in a wide range of research topics.

One of the adventurous projects of Telenor R&D was the construction of a virtual reality model of Oslo's new international airport, Gardermoen. The model allowed users to come in for a landing, to walk through the projected main terminal building, or to enter a virtual conference room with access to various existing and future telephone services. The intention was that the application should be used in the instruction of personnel at the new airport and made available for multimedia-conscious passengers to play with.[44]

Also, Telenor R&D has developed a futuristic virtual conference system. Users can connect to a host machine and enter into a virtual world shared with other users. Every user has a synthetic representation (an Avatar) that can be moved and through which the user can carry out tasks. Movements are updated for all participants simultaneously, and two-way communication is supported. The system, if developed beyond the prototype stage, can be used on various types of networks (ISDN, ATM) and used for purposes such as entertainment, distance education, teleconferencing or the remote control of various kinds of equipment.

Among projects having a more obvious social impact, Telenor has participated in a large-scale demonstration of teleworking in order to gain practical experience in trials involving a number of companies. Also, it has studied the potential trade-offs between teleworking and commuting in cooperation with the Institute for Transport Economics. Based on variables such as occupation and distance to work, the study developed a model that was tested in two

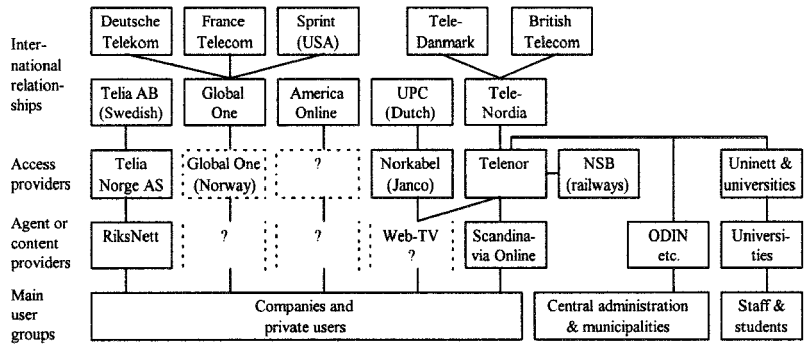

FIG. 3. Map of major Norwegian multimedia actors, 1998.

urban regions of Norway. The study proved that there is a potential for a 3 to 6% reduction in the number of commuters in the next 10 to 15 years if teleworking is sufficiently propagated.[45]

Even if social experiments with multimedia are part of the strategies of private and public actors, it is still difficult to see a distinctive pattern. Most of the experiments are performed on the basis of a firm, but vague, belief that multimedia technology will be of major importance in the future. Consequently, actors go on exploring the possibilities of making new products based on this technology, or exploiting the potential for making services better or more efficient by means of multimedia applications. In this sense, most actors are undertaking fishing trips.

It is also unclear if the experiences from various social experiments are made use of by actors other than those participating in the experiment. Put differently, it seems that learning across experiments may not be very widespread or efficient. However, this observation has to be examined more closely before conclusions are made with any degree of certainty.

CONCLUSIONS: FROM FISHING TO FARMING?

The Norwegian domestication of multimedia seems to be well on its way, but the outcome is still undefined. We may safely conclude that multimedia will be integrated into a host of different social practices, but how, to what extent, and with what consequences cannot yet be answered.

The map of actors shown in Figure 3 is designed to give some indication about the main ownership structure, as well as relationships with international actors. The overview contains many simplifications. First, there are too many agent providers and content providers—of goods as well as information—in the market to be presented in a single chart. Second, several smaller access providers have been omitted. Third, there are more international relationships than could be visualised. Taking these deficiencies into account, Figure 3 still provides a representative view of the present state of actors and their relationships on the Norwegian multimedia scene. The major access providers are Norwegian-based Telenor and Swedish-based Telia, both of them telecom firms owning dedicated content providers, which they claim will develop very soon into typical agent providers.[46] Major multinational actors such as Global One and America Online are still lurking in the wings. Also, Web TV exists only in prototype form both from Telenor and Janco Kabel-TV, which emerged as the cable TV market leader after the merger with Dutch-owned Norkabel at the beginning of 1997.

However, looking for specifics, it could be argued that multimedia is more of a tool or a means to providing or efficiently producing services or goods that are not multimedia in themselves. The emergence of this "catalyst strategy" could be attributed to the small population of the country. We note that there is no mass market for multimedia products compared to that of the United States, Great Britain, or Japan. This fact leaves the actors with two main options: either to cater for domestic needs where there is little or no international competition, or to develop specialized niche products. Our overview suggests that the first option is most prominent, at least at this stage, but this conclusion might well have been made on the basis of a certain bias or vagueness inherent in the available data.

With the possible exception of Telenor's highly aggressive acquisition strategy in 1996 and 1997, we have characterized Norwegian efforts in the multimedia field as fishing trips. This is due to the fact that most efforts are of an experimental nature showing an unclear profit potential. Of course, there will be economic arguments supporting the need for such experiments. After all, profits are expected in a not-too-distant future to those who find smart ways of developing or using multimedia applications. Still, one might suspect that quite a few developers and users would be having fun in the process.

Farming is often looked upon as being the opposite of fishing, at least metaphorically. Farming implies emphasis on planning and hard, steady work. Fishing, while

haphazard, is very hard work while it lasts, but efforts have great fluctuations. Until now, fishing-style multimedia is what we can see. Whether farming-style multimedia will be possible, and what this concept will imply in terms of practices and uptake, are still things of the future.

The "fishing strategy" is particularly interesting from the point of view of evolutionary economy. In particular, we think that relationships between companies may be perceived as a learning economy of forward and backward linkages of information exchange between producers and users (interactive learning).[47] Theoretically, the establishment of an efficient learning economy is of great importance to the successful exploitation of a new technology such as multimedia. The "fishing strategy," which emphasizes experimentation, produces a wide variety of experiences and insights that could be of great value if this strategy is put to use in the learning economy sense. However, the learning economy of the multimedia effort in Norway does not fulfill such promises, probably because the actors are not sufficiently aware of the benefits.

The Norwegian case illustrates the open-ended nature of the national domestication process. We have shown how multimedia has to be defined and given meaning, how actors struggle over meaning as well as their positions in relation to the technology, and how the construction of institutions and practices remain in flux over a long period of time. Thus, the national uptake cannot be predicted in terms of the resulting sociotechnical constituency of producers, users, and artifacts. The strategies that are developed by national actors decisively influence the way the multimedia scene is shaped and reshaped. Probably the "consequences" that eventually emerge from the introduction of multimedia technologies in Norway, in our terms the domestication of and social learning related to multimedia, cannot be understood unless these features are taken into consideration.

NOTES

1. This article is part of a European study of Social Learning in Multimedia—an eight-country research project funded under the European Commission's Targeted Socio-Economic Research programme (TSER Proposal: 4141 PL 951003, May 1996–January 1999). The project examined the prospects and social significance of the range of multimedia products and services that are expected to result from continuing improvements by analyzing the *processes* whereby these technologies are developed, applied and used. The first phase of empirical research examined how generic capabilities in information and communications technologies are "domesticated"—selectively taken up and adapted to particular contexts and appropriated by users to meet existing and emergent social needs. This article is one of a set of national studies—encompassing Belgium, Denmark, France, Germany, Great Britain, Ireland, Japan, the Netherlands, Norway, Switzerland—examining how multimedia was appropriated differently in different national contexts and settings. The full set of national studies is published in Robin Williams and Roger S. Slack, ed., 1998. *National uptake of multimedia*, report 42/99. Trondheim: Center for Technology and Society.

2. See, for instance, Sherry Turkle. 1995. *Life on the Screen: Identity in the Age of the Internet.* New York: Simon & Schuster. Joan Greenbaum. 1995. *Window on the Workplace: Computers, Jobs, and the Organization at Office Work in the Late Twentieth Century.* New York: Monthly Review Press.

3. Everett M. Rogers. 1983. *Diffusion of Innovations*, 3rd ed. New York: Free Press.

4. Merete Lie and Knut H. Sørensen, eds. 1996. *Making Technology Our Own? Domesticating Technology Into Everyday Life.* Oslo: Scandinavian University Press.

5. Roger Silverstone, Eric Hirsch, and David Morley. 1991. Information and communication technologies and the moral economy of the household. In Knut H. Sørensen and Anne-Jorunn Berg, eds. *Technology and Everyday Life: Trajectories and Transformations.* Report No. 5. Oslo: Norwegian Research Council for Science and the Humanities. Merete Lie and Knut H. Sørensen, eds. 1996. *Making Technology Our Own? Domesticating Technology Into Everyday Life*. Oslo: Scandinavian University Press.

6. Knut H. Sørensen, Margrethe Aune, and Morten Hatling. 1996. *Against linearity: On the cultural appropriation of science and technology.* STS Working Paper 9/96. Trondheim: Center for Technology and Society.

7. Per Østby. 1993. *Escape from Detroit. The Norwegian conquest of an alien artifact.* STS Working Paper 2/93. Trondheim: Center for Technology and Society.

8. Knut H. Sørensen. 1996. *Learning technology, constructing culture. Socio-technical change as social learning.* STS Working Paper 18/96. Trondheim: Center for Technology and Society.

9. Interestingly, the development of Internet-based multimedia applications has created new methodological options for social scientists who study these phenomena. In fact, a lot of information about different actions and actors is available on the Net. This is so partly because news providers allow for easy electronic retrieval of analytically relevant information, and partly because actors leave electronic paths that the social scientist will be able to retrace.

We were able to gather much of the data needed for this article by downloading the latest news about the telecom, data, and multimedia world from Web pages as soon as the stories were presented. This manner of data collection is very convenient on the part of the researcher and gives rise to a very detailed account of the decisions and strategies of multimedia actors. The major drawback is the transient state of much of the material used. In the notes, we have included URLs as they appeared when the news stories were retrieved. However, it is a sad fact that after a couple of weeks, most URLs will have changed or become invalid, thus preventing readers from prying into many of the sources that we have used. However, they may be found in our archives.

10. Press release from Norsk Gallup, November 1998.

11. *Business Week*, August 26, 1996, pp. 18–19.

12. Egil Juliussen and Karen Petska-Juliussen. 1998. *Internet Industry Almanac.* Glenbrook, NV: Computer Industry Almanac.

13. NOS. 1996. *Statistical Yearbook 1996*, table 256.

14. NOS. 1995. *Statistical Yearbook 1995*, table 217. NOS. 1995. *Norwegian Media Barometer 1995*, table 1.

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26. Rune F. Olsen. 1996. Telia: 30% markedsandel i 2005. *Internett Kanal1 digi* 12.11.1996. ⟨http://web.sol.no/kanal1/digitele/ro11710232.htm⟩

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30. Trond Bruland. 1996. *Den store IT-planen: Norges satsing på informasjonsteknologi 1987–1990.* STS Report No. 27/96. Trondheim: Center for Technology and Society.

31. See *Stortingsmelding nr. 39 (1997–1998).* IT-kompetanse i et regionalt perspektiv IT competence in a regional perspective.

32. *Den norske IT-veien: Bit for bit.* Oslo: Ministry of Transport and Communications, 1996. ⟨http://odin.dep.no/html/nofovalt/offpub/utredninger/it/it-veien/⟩

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36. Anne-Lise Hilmen. 1995. *Regjeringen—en pådriver for en framtidsrettet teknologiutvikling og anvendelse.* Paper, 28.11.1995. ⟨http://odin.dep.no/ad/taler/hi951128/⟩

37. See, for example, former Minister of Planning, Bendik Rugaas. 1997. *IT-politisk redegjørelse.* Parliamentary speech, Stortinget 28.1 1997. ⟨http://odin.dep.no/psd/taler/97/970128.html⟩

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42. See http://www.nls.no/; http://skolenettet.nls.no/dok/sn/english.html

43. Compiled from *Multi-media development* ⟨http://www.fou.telenor.no/xtf/english/eres95/multimedia.html⟩. *Users, markets and competition* ⟨http://www.fou.telenor.no/xtf/english/eres95/usersmc.html⟩. *Network-based collaboration.* ⟨http://www.fou.telenor.no/xtf/english/eres95/ network.html⟩

44. See *Virtual reality*, under *Multi-media development.* ⟨http://www.fou.telenor.no/xtf/english/eres95/multimedia.html⟩

45. See *Teleworking* under *Users, markets and competition.* ⟨http://www.fou.telenor.no/xtf/english/eres95/usersmc.html⟩

46. Morten Øverbye. 1997. Strever med strategiene. *Internett Kanal1 digi* 16.1.1997. ⟨http://web.sol.no/kanal1/digimedia/mo17229458.htm⟩

47. See E. S. Andersen and B.-Å. Lundwall. 1988. A small national systems of innovation facing technological revolutions: An analytical framework. In C. Freeman and B.-Å. Lundwall, eds. *Small countries facing the technological revolution*, pp. 9–36. London: Pinter.