

Broadband Infrastructure and Rural Regional Development in Norway

Judith Molka-Danielsen, Ottar Ohren, and Bjørn Jæger

Abstract—*This paper reports on findings of two surveys conducted in April 2001 and November 2002 on broadband infrastructure deployment and utilization of ICT services in 38 local governments of one county in Norway. Services include internal administrative services for the employees and services to the residents of the communities. We examine how well actual adoption of services had met with expectations. Findings show adoption and use was not as pervasive as expected. Our study is compared to several other regional area studies carried out in Spain. We conclude this can be an inhibitor to this area's regional economic development.*

Index Terms— *Internet and society, infrastructure deployment, public sector, business, and education.*

1. INTRODUCTION

The target of information technology strategies by regional policy makers, such as the EU Information Society, has been to provide access to infrastructures for public services such as e-government, e-learning, e-health services, and even to provide for a more dynamic e-business environment [5],[6]. Access to broadband (BB) networks is often seen as the enabler of such services [3],[7],[8]. The service infrastructures are also seen as playing an important role in maintaining a level playing field for regional economic development between rural and urban areas. One reason is that it is presumed that Information Communication Technology (ICT) can help

businesses to operate more decentralized, although urban areas have an advantage in attracting specialized knowledge workers and in becoming centers for development of new services and products. Another reason is that by utilizing ICT a social cohesion can be created among the participants, which reduce the effect of limited regional social networks of partners, suppliers, and customers. It is believed that regional governments can play an important role in promoting the use of ICT to create such social networks. OECD studies have shown that investments in knowledge resources such as education, R&D, in addition to capital investments in infrastructure are related to the development of innovative capabilities [15]. Local government's actions can help support innovation and demand in BB markets.

The Norwegian government's strategy for development of BB networks is demand driven. It is believed that demand for BB services will raise a competition among telecommunication providers to build BB networks and that this will give BB network access to virtually everyone [7]. In order to increase the demand, particularly in rural areas, the government has supported regional and local governments with partial funding for buying BB services. Public investments therefore play a vital role in creating demand for BB services in Norway. However, as economic resources from the government cover only a fraction of the total cost for the communities, local governments are also encouraged to co-operate with the private sector to strengthen the demand side.

All authors are faculty with: Molde University College, Department of Informatics, P.O. 2110, N6402 Molde, Norway. Email: {J.Molka-Danielsen, Ottar.Ohren, Bjorn.Jager}@himolde.no. J. Molka-Danielsen is the contact author.

2. THE COUNTY OF MORE & ROMSDAL IN NORWAY

Møre & Romsdal (M&R) regional industries include fishing, fish farming, ship building, furniture manufacturing, mechanical industry and engineering and services related to the oil industry. 84.3% of 8000 registered businesses in M&R have less than 10 employees [18]. These industries operate within international competitive markets, where ICT is an enabler of operations. In 2001 the county was the second largest export county in Norway, with an annual export value of 2.8 billion € [18]. M&R has a total population of 244 000 in 15 000 sq. km. giving an average of 16 persons per sq. km. The county has three urban centers: Ålesund, Molde and Kristiansund with 39000, 24000 and 17000 inhabitants respectively. The geography of the county is mountainous with many fjords. Ferries are therefore an important part of the transport infrastructure, which is a challenge for transport and travel.

The County Department of Industry and Environment (IE) in M& R have considered how it can help to create a better economic development in its region. IE conducted a study to inventory assets and to consider the implication of investment elements. The OECD reports that Norway has lagged behind in knowledge based innovation [18]. Recent national policy has redirected funding in R&D to create centers of excellence to act as clusters of knowledge in specialized fields and to attract knowledge workers to Norway [16]. However, none of these centers are located in M&R, further pressing IE to support BB infrastructure development in the region. The national government supports the establishment and operation of incubators to strengthen innovation and research based commercialization in the country. While M&R County will benefit from recent national policies, it is also necessary to consider how local policies and investment decisions in ICT impact regional business development.

3. RESEARCH OBJECTIVE AND METHOD

One objective of this project was to find out whether the BB strategy put forward by the national government works well in rural regions. The eNorway plan states the national governments goal is that all community administrations, schools and community libraries shall have offers for BB connectivity at competitive prices within 2005 [7]. Several reports say that the community administration role shall be central as a natural information channel to the citizens and that they are responsible for effective interaction with the citizens [3,7]. Another objective was to find if local government expectations were fulfilled.

In mid 2001 a survey was sent to 38 local government administrations [13]. The objective was to assess these organizations need for BB networks, current satisfaction with network capacity, future plans for access and proposed use. A response rate of 45% (17 of 38) of municipal governments was realized. A follow up survey was sent in November 2002 to the 38 municipalities to see how far adoption and use of BB networks had come. We pursued and received a 92% response rate on the second survey [14]³.

4. FINDINGS AND COMPARISONS

Although many factors contribute to the integration of ICT in regions, in terms of regional development and use of ICT in innovation, we concentrated on the following factors: i) availability of infrastructure, ii) the types of public service units with BB access, and iii) the applications of ICT in use by the communities. These factors have also been examined by other studies and in particular the Andalucía region of Spain [1] and the Madrid region of Spain [9]. Our study points out some important similarities and differences between these regions and ours. Comparative case studies often have difficulties in establishing general findings. We argue the value of our study is to point out our areas unique perspective and its

³ A follow up telephone survey was made in September 2004 to check on the current status. 94.7% (36) communities now have BB access. But only 79% (30) of them have access rates over 2Mbps.

special set of circumstances. In essence, one generalized model would not provide a good basis for the effective development of BB in all rural areas.

A. Infrastructures

Developing high bandwidth infrastructures are high cost undertakings. Population density and business density in a region are important factors to consider when investment decisions in BB infrastructure are taken. We remind, the population of M&R is 244000 with 33% living in the 3 towns and 84.3% of businesses in M&R have less than 10 employees. In our 2002 study, 60% of the communities in M&R claimed BB access. But, some had multiple access types. These percentages are in Table 1. Percentages for 2001 are from [13], (p.45). The selection of access technology was evenly distributed over the technologies types of wireless radio, xDSL technologies and fiber. In many communities there was a combination of adopted technologies. Fiber cable, with access speed of 2Mbps or greater was the most used. The evidence indicates that ADSL is the most dominant of the DSL technologies.

We compare our region with two regions in Spain. One study compares ADSL deployment to cable deployment in the Spanish region, the Community of Madrid, made up of 179 municipalities [9]. They found prior to April 2001 that ADSL and cable were available coincidentally in the same regions. But, since that time the expansion of ADSL had extended to 111 of the 179 municipalities, while the cable coverage was available in almost the same municipalities as before. They found not one municipality of 19 with less than 250 inhabitants/km² had ADSL, while all of the 82 municipalities with over 2500 inh/km² had coverage⁴ [9]. All of these regions have a higher population density than M&R.

In the southern Andalucía region of Spain they have 3,064 businesses in just the ICT sector, with 96.1% with less than 10 workers. They have a regional population of 7.2 million with 43% of the population living

⁴ Ratio of %Penetration -to- #inhabitants/km² was .00:<250; .06:>250; .26:>500; .30:>1000; .50:>1500; 1.0:>2500. [Source:9]

in cities and 32% concentrated in the provincial capital. The Andalucía noted a large difference between urban and rural access to high bandwidth infrastructures. In particular, they estimated that only 3% of the regional population had access to cable networks and 14% of the households have access to ADSL [2].

B. Institutional units with broadband access

We next examined which institutional units within our communities in M&R had BB access. We note that another study done by ECON Analysis [4] examined institutional access by technology type for Norway in general. If we sum the technology access types from their report (DSL, fiber, radio, and other) we see Norway in July 2003 reported national percentages: central administrations (49%), libraries (43%) and ground schools (34%) in ECON Analysis, page 32 [4]. It was anticipated in a February 2003 study that penetration would be 74%⁵, 63% and 45% respectively by 2004 [17]. In our study, in M&R, we find that central administration, primary schools and health care organizations are more likely to have

TABLE 1
M&R NETWORK ACCESS TECHNOLOGY

Technology municipalities with ->	% in 4/2001	% in 11/2002
Wireless radio	12	31
ADSL /SDSL / VDSL	6	31
Fiber	24	40
Coaxial cable network (i.e. cable TV network)	6	6

BB access than other institutional units. We claim that the M&R communities may see education and health care as representing a major proportion of community services as they were in November 2002 at the 2003 access level. Last, ICT operation and management functions in these units are often managed by the central administrations. So, it is natural for central administration to lead in connectivity.

Table 2 shows the percentage of the municipalities that has one or more of its service units assigned to a BB network. For example 48% have a central administration

⁵ See footnote 1.

with BB access, and 51% have at least one primary school with BB access⁶. In addition to the local institutions mentioned above, the county has 26 junior high schools and 4 hospitals which all have BB access. We find a significant difference between the 3 urban municipalities and the remaining 35 rural municipalities. As noted earlier, our urban areas are considered low population areas by EU standards. Table 2 shows that all departments in the urban communities are connected to BB, whereas the rural communities have less thorough coverage. About 40% of the rural municipalities “primary services” (health care, schools, and central administration) are connected to BB. The difference between rural and urban areas is even greater for schools. All primary schools in all urban municipalities have BB access, whereas some schools (at least one) in 45% of the rural municipalities have BB access. The fact that urban communities have come longer in the penetration of BB networks is a general tendency in BB deployment. Higher density areas represent bigger demand and are developed first.

In the Andalusian report they characterize the type of users in the region to demonstrate that this is a factor in the usage and adoption of ICT. In particular they state, “The lower level of education in general, and knowledge of languages in particular, of the Andalusian population, and the traditionally lower level of income per capita limit the capacity of citizens to access these (ICT) technologies.” [2] This is not however the case for M&R. The population across Norway is rather homogeneous in educational opportunities and households have small deviations in average income. While persons in rural areas have on average, fewer years of education than urban areas, the knowledge of foreign languages is reasonably good. Norwegians receive formal education in English from an early age. Along with the other Scandinavian countries Norway has a very high penetration of PC’s and availability of internet access. 74% of persons over 13 year have access to internet [10]. The

national average in Spain is 23.4% of persons over 14 years have internet access and the average in the Andalucía region is below that at 18.2% as measured in 2001 [2]. The Andalucía region also has the largest percentage of young people in Spain. Those younger than 15 years represent 23% of the regions population, as compared to the national average of 19.4%.

TABLE 2
ORGANIZATIONAL UNITS WITH BROADBAND ACCESS

BROADBAND USERS	% OF MUNICIPALITIES		
	ALL	URBAN	RURAL
CENTRAL ADMIN.	48	100	41
PRIMARY SCHOOLS	51	100	45
HEALTHCARE INST.	45	100	39
PRESCHOOLS	20	100	16
CULTURAL INST. (LIBRARY, MOVIE)	31	100	26
OTHER INSTITUTIONS	8	33	7

This region therefore looks forward to larger growth of internet users in the next 10 years.

Other demographic conditions, such as geography of the M&R region, M&R regional distance from central Europe and the high cost of transportation internally and externally, are likely to be more significant factors in encouraging M&R users to adopt the use of ICT than they are in Andalucía. At the same time, we recognize that adoption and use of ICT by community administrations require education and training.

As an inhibitor to this, rural communities may have access to less resourceful “knowledge networks.” The regions businesses and the experiences of their knowledge workers are contributors to the richness of these networks.

⁶ Most communities have all schools connected to one internal network. We did not have information on the number of schools per community that had access.

C. Applications and services

The electronic network applications or services that dominate are i) general information searching, ii) presentation of

TABLE 3

Applications	% of municipalities	
	Use at all (2-5)	Much use (4-5)
Information searching on the Internet	91	47
Presentation of community information on the web	100	26
Communication with external contacts by e-mail	85	56
Education of employees	29	3
Network meetings as a substitute for travel	0	0
Purchasing via public electronic marketplaces	50	9
Electronic invoicing, either sending or receiving	6	6

community information on web sites and iii) the use of e-mail for both internal and external communications. These services do not require BB capacity. However, the ECON analysis [4] has classified BB services requiring the following minimal upstream and downstream bandwidths: Internet web browsing (64kbs, 64kbs), E-mail (64kbs, 64kbs), File transfers (128kbs, 128kbs), Video conferencing (256kbs, 256kbs), Video-on-demand with MPEG-4 (64kbs, 500kbs). However, these bandwidths are for minimal functionality. These services do not fully represent the full range of usage. For example, health workers may need to connect to central databases from mobile technologies such laptops or telephones while on calls to patients. Institutions with greater demand for existing services and with the creation of new services will have a greater need for BB access.

As another example of the nature and complexity of services is the central administrations access to its citizens. Today all M&R communities have a web site that contain, or provide links to, relevant information about the community. At present there is a large variation in the quality of community web sites and many

communities have a considerable potential to improve their sites. Nevertheless, the website has become an important communication channel for the municipalities. For example, these community web sites often act as portals into private services of the region, such as helping people find health services, jobs, places to live, travel information, deadlines for applications, and much more.

In this study, we asked the M&R respondents to grade the usage of the services from 1 to 5, where 1 means not at all and 5 means very much. In Table 3 the results are grouped into communities with some use at all (answer is different from 1), and communities with much use (answer is 4 or 5). In Table 4 we again see a substantial difference in the use of applications between urban and rural communities. Urban communities have come further in usage of services such as purchasing, invoicing and to some degree in education, such as training employees through e-learning. Much of this difference

TABLE 4
ELECTRONIC NETWORK APPLICATIONS, RURAL AND URBAN MUNICIPALITIES

Applications	% rural municipalities		% urban municipalities	
	Use at all (2-5)	Much use (4-5)	Use at all (2-5)	Much use (4-5)
Information searching	90	42	100	100
Presentation of information	100	23	100	67
Communication by e-mail	84	55	100	67
Education of employees	22	3	100	0
Network meetings	0	0	0	0
Purchasing emarket place	45	3	100	67
Electronic invoicing	0	0	67	67

may be explained by the fact that the urban communities are the early adopters and are supposed to have achieved a higher competence and expertise to make use of

more advanced network services. In addition, since urban communities have larger administrations and larger volumes of information transactions (such as invoices, etc.) they can achieve higher savings by utilizing the services listed in Table 4, than those in rural communities. One service that has not been stated to be used in the M&R region at present is video-conferencing for network meetings. Despite that nearly 35% of the respondents from the 2001 investigation said that this was an application they would use, it has not yet been adopted by the municipalities. This is surprising in that the urban communities are using networks for education, it can be expected that two-way video conferencing would supplement this process. Part of the reason may be that end-user equipment for video-conferencing still is rather costly and requires some user competence. It may also be that the current bandwidth is not sufficient to achieve the desired interaction quality. Finally, much implicit information can be lost in the use of video conferencing.

TABLE 5
EXPECTED USE VERSUS ACTUAL USE FOR SOME BROADBAND APPLICATIONS

Applications	% of municipalities	
	Expected use	Actual use
Presentation of community information	100	100
Purchasing via electronic marketplaces	70	50
Education of employees	58	29
Network meetings	35	0

These systems are found to work best when an initial, in person, meeting is first established. On the other hand, if the need of communities is for a one time meeting with different participants every time, it may be that video technology is not a good substitute for the personal meeting [11].

The Andalusian observations of use of applications were similar to ours but they included businesses and used other measures. They stated that most companies did not go beyond searching and exchange of information. But, larger companies were more inclined to integrate ICT in B2B activities. They used an indicator to measure

the degree of implementation of electronic administration to be the number of terminals per 100 workers. In public administrations this was higher (52%) than for companies (42%). They noted several regional public programs that support the development of on-line public services, digital literacy and the development of digital content, have helped public administrations in their rural regions to adopt new technologies [1]. In our 2001 investigation which included businesses in the region, we did not make the same measure, but we noted a similar trend as public institutions were leading the adoption of BB access over private businesses.

D. *Expected versus actual use*

What services did the communities in M&R expect to use in 2001 and what services were actually used in November 2002? We make a comparison of the studies. As shown in Table 5, the expectations were higher than the realized usage.

In 2001 we did not ask the municipalities if they planned to use ICT for electronic invoicing, use of email, or searching for information on the web. So, we cannot compare expectations in these areas, however, we see that use in electronic invoicing was low. As shown in Table 5 use of advanced services like education of employees and network meetings was below expectations. Comparing with Table 3, only 9% (purchasing) and 3% (education) of the municipalities have reported to have made "much use" of these applications. Again, given the geography of M&R, some of these responses are surprising.

We find in M&R that for many communities a short term value of high bandwidth investments is overestimated and a long term value is underestimated. Policies in Spain reflect an attitude that high bandwidth content applications are not ready so middle bandwidth access is acceptable. While in M&R many municipalities had formal plans for BB access in 2001 and had achieved this 1.5 years later, as stated in Table 1, M&R municipal administrations have so far not fully utilized their ICT. Applications expected

to be used in 2001 have had low adoption and especially the advanced network applications receive little use. In particular this is the case for education (e-learning) and network meetings (video-conferences). But, it is wise for the municipalities of M&R to be patient and keep a long term view. In the Andalucía study they state that more than 73% of their public organizations have simple web page presentations on the Internet. Community needs like supporting tourism and access to community events are becoming more important to the economy of the communities. These needs from community participants will spur community administrations to make more use of their networks and increase their need for high bandwidth access.

5. CONCLUSION

We conclude that a lapse of 1.5 years is too short of a period to observe great rates of change in the adoption and usage of BB in the M&R region. However since the count of national BB providers have increased, and penetration has increased, it is an indication that the national demand driven policy is working⁷ [12].

One conclusion we make by comparing our region with the Andalucía region and the Madrid region is that our social-demographic barriers in M&R are much less and should manage the expansion of services with greater ease. Although the two Spanish regions are different in character that is Madrid is more urban and Andalucía is more rural, they are both under one national policy. The national support systems in Spain have seemed to make it easier for the adoption of ADSL technology. But, these regions have relatively large differences in population density between urban and rural areas in their regions. The urban areas are very concentrated and the rural areas are quite dispersed. To make the most of funds, they must concentrate resources on the urban areas leaving less for the rural area. In Norway, even the "urban" areas are considered "rural" by European standards. Also, in Norway, and in M&R in particular,

the differences in population densities are not so great between town and country. So, the dispersion of resources, and even the dispersion of demand for service is much more evenly distributed. This means that Norway should have a policy to more evenly support the same level of bandwidth access in both urban and rural regions.

While it has been our clear observation that most rural areas have eventually gained BB access, they did not gain access before the urban areas and there still are differences between rural and urban areas in M&R. What rural areas have achieved are somewhat hidden in the details. That is, it seems clear that many municipalities in rural regions are not able support their inhabitants electronically in the same way as urban municipalities can. For example, "24 hours" availability of some information services cannot be made available, or personnel attendance may still be required for certain services. As such, rural communities do not utilize the saving potential from effective use of ICT and cannot upgrade as quickly. The lesser demand of users in rural communities is often not great enough to justify the initial investments and improvements. National programs are still needed to support the lowest demand areas. This is supported by another national trend. That is since 2002 many institutions that had high bandwidth access already, have since upgraded to higher speeds. While those that have lower speed access have not sought upgrades [8]. Yet, as we have pointed out the value of present day applications cannot be fully realized at low bandwidths. Also, considering that many of tomorrow's BB services are not yet developed, it makes it difficult to estimate the impact on the rural communities' economies. The findings of this study indicate that the demand driven strategy for BB infrastructure development has some limitations, especially for rural areas. These limitations can be an inhibitor to regional economic development. be an inhibitor to regional economic development.

REFERENCES

- [1] Castaño, C. and C. Y Román (Dir. Coord.) (2002) "Andalucía ante la Sociedad de la Información." Consejo Económico y Social de Andalucía (CES), Junta de Andalucía.

⁷ The Department of Business and Trade (NHD) reports the number of BB providers in Norway increased from the fall of 2001 to March 2004 from 50 to 150.

- [2] Asián Chaves, Rosario and Javier Rodríguez Alba (2003) "The Role of Knowledge Systems, and the Innovation of ICT in Regional Development: Analysis of the Andalucía Region.", Regional Studies Association, International Conference 2003, Pisa. <http://www.regional-studies-assoc.ac.uk/events/pisa03/asianchaves.pdf>
- [3] ECON Analysis AS (2002) "Bredband – kartlegging" Rapport 92/02, 3. December 2002, Project nr. 37620, ISBN 82-7645-568-9.
- [4] ECON Analyse AS (2003) "Oppdatering av status for bredbånds-dekning og – tilknytning i Norge" ECON-rapport nr. 2003-056, Prosjekt nr. 37621, 9.juli 2003.
- [5] eEurope (2000) "eEurope: An Information Society for All" accessed nov. 2002. http://europa.eu.int/information_society/eeurope/news_library/pdf_files/initiative_en.pdf
- [6] eEurope (2002) "eEurope: Benchmarking national and regional e-business policies for SME", http://www.europa.eu.int/information_society/topic_s/ebusiness/godigital/benchmarking/docs/de_2002_06_12_final_%20benchmarking_%20report.pdf (accessed November 2002).
- [7] eNorge (2002) "e-Norge 2005", K- 0635 B, NHD.
- [8] eNorge (2004) "e-Norge Tilstandrapport 2004", "Inspections report", K-0677 B, NHD.
- [9] Gomez Barroso, Jose Luis and Jorge Perez Martinez (2003) "Broadband Access in the Community of Madrid: Can the Market Bring on "An Information Society for All"?", pp. 165-172, in Building the Knowledge Economy: Issues, Applications, Case Studies, P. Cunningham et al. (Eds.), IOS Press.
- [10] Mellor, W. and V. Parr (2002) Government Online, An international perspective. Taylor Nelson Sofres.
- [11] Molka-Danielsen, Judith (2002) "Discovering Relevant Dimensions and Evaluation of ICT in Distant Education", Proceedings of NOKOBIT 2002, Nov. 25-27, Kongsberg, Norway.
- [12] Norsk Telecom AS (2004) "Norske Bredbåndsaktører" Rapport 2. Mars 2004 for NHD. <http://www.enorge.org/FileArchive/81/Akt%C3%B8rrapport%204%20final.pdf>
- [13] Ohren, Ottar and Bjørn Jæger and Judith Molka-Danielsen (2001) "BREDBÅND I MØRE OG ROMSDAL, Behovsundersøkelse og aktuelle utbyggingsmodeller ", Arbeidsrapport M0115, Møreforskning Molde.
- [14] Ohren, Ottar and Bjørn Jæger and Judith Molka-Danielsen (2003) "Bredbåndsundersøkelsen 2002: Status i kommunene i Møre og Romsdal, leverandørvalg, kostnader og erfaringer" August 2003, Møreforskning Molde.
- [15] Remø, Svend Otto (2000) "Norway in the Knowledge Economy: The significance of knowledge for innovation and growth", pp. 17-42, The New Economy – Drøm eller Virkelighet?, ed. Leif B. Methlie, SNF årbok 2000, Fagbokforlaget.
- [16] Smaglik, Paul ed. (2002) Naturejobs 417, "Norway Turning Oil into Science", 02 May 2002, 4 - 5; doi:10.1038/nj6884-04a; accessed feb. 24, 2003. http://www.nature.com/cgiataf/DynaPage.taf?file=nature/journal/v417/n6884/full/nj6884-04a_r.html
- [17] Teleplan (2003) "Bredbånd – Dekning og tilknytning" 20. februar 2003, NHD, online source: http://www.enorge.org/modules/module_111/news_item_view.asp?iNewsId=2369&iCategoryId=153
- [18] SSB (2002), Statistics of the Central Bureau of Norway, "Exports of traditional goods by country productions", original source: <http://www.ssb.no>, Møre og Romsdal fylkeskommune, reported in: <http://www.mr-fylke.org> (accessed Feb. 24, 2003).