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Master Thesis
Telemedicine and E-health

Twenty Years with Teledermatology in North Norway

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Abstract

'A picture is worth more than a thousand words' - (Mann & Colven, University of Washington Medical School), that simply can justify the necessity of teledermatology. In this paper, five information technology (IT) efforts in the field of teledermatology that based on skin image transmission procedure and their historical transformations in context of the notions of information infrastructures and actor-network theory have been discussed. The main purpose of these efforts was to decentralize specialist's services to the GP, nurses or district levels. Among the five efforts, only in one effort namely DMS Nord Troms, added telemedicine tool of the UNN creates virtual hospital, decentralized regional healthcare services.

This thesis paper tries to figure out the contents of dermatologic e-health services in North Norway from the mid 1980s onwards; the problems involved in previously non-sustainable and related some dermatological heath care services. Some of these services have been quite successful, such as Videoconferencing among UNN and Kirkenes, Hammerfest, Nordeisa etc. The paper applies some notions of theoretical approach whether they may be helpful to address the challenges in establishing sustainable telemedicine services in case of dermatology. Furthermore, the paper points out the actual strategy for establishing teledermatological services from the perspectives of different historical transformation. In this interpretive study based thesis, fifteen interviews have been conducted to illustrate the five teledermatological efforts.

Five teledermatological efforts were started with high motivation to reach their final goals. But four of them had not been sustainable due to finishing of funding or lacking control for the integrated nature of technology. The thesis concludes that e-health services of teledermatology should be very much linked into practice. The efforts should be evaluated through the lens of practice oriented processes or approaches such as information infrastructure or actor-network theory.

Keywords: Teledermatology, North Norway, information infrastructure, actor-network theory

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1. INTRODUCTION

In this Information Age, health care is being shifted, from hospital-based acute care to prevention, promotion of wellness, and maintenance of function in community and home-based facilities. Telemedicine, a method of health care which is carried out at a distance, can facilitate this shift (Jones, 1997). Telemedicine can provide second opinion medical e-consultation from renowned consultants or physicians of top hospitals or medical centers located around the world. Broadly it may be defined as the use of telecommunications technologies to provide medical information and services. The mentionable aspect of telemedicine is the use of electronic signals to transfer information from one site to another (Perednia et al., 1995). Another definition of telemedicine is given by Preston et al. (1992) as: 'Telecommunication that connects a patient and a healthcare provider through live two-way audio, two way video transmission across distances and that permits effective diagnosis, treatment and other healthcare activities'. According to Thrall et al. (1998) the recent developments and improvements in technology and telecommunications have resulted in renewed and earnest interest in telemedicine.

The concept of telemedicine is reserved, in many contexts, for applications where the subject is to render health services dependent on application of telecommunication. In this classical sense, forms of remote consultations and remote diagnoses within various medical specializations can be included in the field of telemedicine. Also transmission of knowledge in the form of distances education is included in the concept of telemedicine (Nymo, 1993). To cover all of the senses, there is a reliable definition of telemedicine given by AIM (1990) - 'The investigation, monitoring and management of patients and the education of patients and staff using systems which allow ready access to expert advice and patient information no matter where the patient or relevant information is located.' From efficient use of telecommunications or telemedicine, the public health service has a lot to do. Telecommunications can contribute to a more effective utilization of resources through tying the resources of the health sectors resources together in a large number of telemedical services (Nymo, 1993).

As evidence suggests, the upcoming challenge for the public health services will be - the population during the next ten years will be changed with regard to the composition of age

groups, more specifically in a developed country. According to Nymo (1993), older people, who are the foremost users of health services, will significantly increase in number. In Norway, the number of persons over the age of 80 has doubled since 1970. Towards the year 2020 this number will raise further. The part of the population over the age of 90 will increase greatly. In general, there will be more heavy users of the health services at the same time as there will be fewer persons in the age group which can create health services and supply to the economic resources needed by the health services. Moreover, an increased number of handicapped and chronically sick persons can be expected (St. meld, 1987-88). As an addressing answer to the increasing cost of running the institutions of the health care services (hospitals, nursing homes), Norway or other developed country should have a change towards greater emphasis on primary health care services. In light of these challenges telemedicine can be evaluated as a tool for more efficient utilization of available resources. Telecommunication will never replace the physician or other health workers concerned in a patient relation. Alternatively, it provides an opportunity of increasing the combination between various health care services and in this way contributes to better care directed towards the patients. So telemedicine or eHealth service can be an important medium for economical benefit of health sectors of a country.

However, many telemedicine or eHealth systems have proven problematic situations to implement in the organization. Therefore, it is necessary that the views, purposes and experiences of the users and providers of health care services are sought to enable problems to be resolved and issues addressed before telemedicine is fully implemented (Collins et al., 2000). The framework of information infrastructure and negotiations of actor network, according to actor-network theory (ANT), therefore, are needed to set up or implement a telemedicine tool. Information infrastructures (IIs) are a set of interconnected structural components which can make a framework supporting a whole structure through exchange of information. It requires more than the combination of traditional approaches and strategies for development of telecommunications solutions and information systems to be succeeded (Hanseth et al., 1998).

All researchers concerning information technology (IT) and health sciences have admitted that information technology plays a very important role in health care services. Now, patients need not to see physicians directly at first to take care of their physical or mental illness. E-mediated

communication with their physicians can help them to get treatment by sitting their own homes. This is the information technology – plays a vital role to get the patient admitted in a hospital, treatment by the technology during staying in hospital, again treatment information can be provided to the given patients, if patient stays at their home after taking emergency treatment from hospital. But developing or implementing an IT application in health care practices can never be process of simply using a new technology. According to Collen (1995), 'Developing a comprehensive medical information system is a more complex task than putting a man on the moon had been.'

In case of Norway, IT in health care services that means telemedicine tool has been added to the previous mode of information systems of University Hospital of North Norway (UNN) to make a well-defined information infrastructure. In Norway, the actual journey of telemedicine has been started out two decades ago with its high degree of competence; by 2006, a variety range of telecommunication and information technologies have been implemented in the health care sector in Norway. Since the late 1980's the University Hospital of North Norway has experience with the following areas: teleradiology, telepathology, teledermatology, remote transmission of ECGs (Hartvigsen et al., 2006).

In this thesis paper, I will discuss five IT efforts in the field of teledermatology and their historical transformation in context of the notions of information infrastructures and actor-network theory. The main purpose of these efforts was to decentralize specialist's services. Among the mentionable five efforts, only in one effort namely DMS Nord Troms, added telemedicine tool of the UNN creates virtual hospital, decentralized healthcare services. Here in this effort, University Hospital of North Norway (UNN), Tromsø, has, therefore, made cooperation with Kåfjord, Kvænangen, Skjervøy and Nordreisa for the development of district medical centre in Nord-Troms.

This research is aimed to find out answers relevant to the following research questions such as:

- What is the content of teledermatological services from the mid 1980s onwards in North Norway?

- How can sustainable teledermatological services be established?

- How can we find out the actual strategy for establishing teledermatological services from the perspectives of different historical transformation?

According to the above research questions, the first part of the thesis will try to discuss the important notions of information infrastructure and terminologies or concepts of actor-network theory, and secondly the interpretive study method followed by the case study – historical transformation of teledermatology. Then a discussion will also try to set up these notions of IIs and ANT into historical transformation of e-health services in dermatology including DMS case. In this discussion chapter the potential complexities of five efforts will also be discussed. Finally the last chapter provides conclusion of this research. The overall aim of this paper is to provide some important suggestions for improvement of some problematic issues involved in some previous teledermatoloical projects.

2. THEORY

This phase of this thesis paper motivates for detailed illustrations of information infrastructures (IIs) and actor-network theory. Here I will go into, at first, a brief discussion on telemedicine and e-health followed by teledermatology, and then the relationship between information systems and information infrastructure; information systems with telemedicine; aspects of IIs and finally actor-network theory.

2.1. Telemedicine and e-Health

The prefix 'tele' derives from the Greek word meaning 'far' or 'at a distance' or 'remote'. Therefore the word telemedicine signifies: medicine delivered at a distance. Here is a 1995 definition that gives more detail in a few more words: "Telemedicine is the use of telecommunication to provide medical information and services" (Norrish, 2002). Telemedicine was fundamentally born during the 'space race' between the USA and the former USSR. The National Aeronautics and Space Administration (NASA), the USA military and USA Government funded many telemedicine projects. NASA was keen to build up a distant monitoring system to manage the health of American astronauts in space (Sullivan, 2001). Generally

> *"Telemedicine involves the use of modern information technology, especially two-way interactive audio/video communications, computers, and telemetry, to deliver health services to remote patients and to facilitate information exchange between primary care physicians and specialists at some distances from each other" (Bashshur, 1997).*

In this Information Age, telemedicine and computer driven treatment methods are being used in the field of treatment of disease including cancer in different ways. In 2003, Cancer Research UK scientists have developed a sophisticated web-based system called LISA (Leukaemia Intervention Scheduling and Advice) to support doctors' decision-making in the treatment of childhood leukaemia (Cancer Research UK, 2003). Magnetic resonance imaging uses radio waves and computers to create images of the brain and spine in case of childhood or paediatric brain and spinal cord tumor (University of Chicago Comer Children's Hospital, 2007). However, Whitten *et. al.*, (2002) suggest that there is no mentionable and good evidence that telemedicine

is a cost- effective way for delivering health care. Additionally, they also argue that comparative cost-effectiveness of telemedicine systems depends on the unique local aspects of the individual service.

According to Norrish (2002), telemedicine term can be distinctly separated from the terms 'telehealth' and 'telecare'. Telemedicine uses information and communications technology to transfer medical information for diagnosis, therapy and education. Telehealth involves information and telecommunication technologies to transfer healthcare information for the delivery of clinical, administrative and educational services. Whereas 'telecare' is used to describe the application of telemedicine to deliver medical services to patients in their own homes or supervised institutions.

The categorization and scope of telemedicine (and telecare) practice have changed as the technology has developed and improved a lot. At present, we can identify four different types: Teleconsultation, tele-education, telemonitoring and telesurgey (Norrish, 2002). We can classify telemedicine in context of their services such as teledermatology, teleophthalmology, teledialysis, teleradiology, tele-otorhinolaryngology etc. In case of telemedicine services, Electronic Health Record (EHR) provides an integrated solution, to automate a clinical practice for the increasing efficiency, quality and safety. This EHR system should be capable of performing in order to promote greater safety, quality and efficiency in health care delivery or telemedicine services. The three players have main role in the system; they are patients, EHR system and hospitals. The main functions of the system are health information and data, electronic communication and connectivity, patients support, decision support, administrative processes and report, entry management and report management. EHR system in between hospital and patients, it provide gateway to receive data, store data and access data. We can say, it is the main heart and functioning part of the telemedicine system.

In fact, there are some special benefits of telemedicine services such as, better access to health care, access to better health care, easy access to information, justified communication between care-givers, easy to continue education regarding disease for patients and professionals, treatment procedure may have reduced cost etc (Norris, 2002). Extending health care services

access to rural communities and disadvantaged populations, is still one the major drivers of telemedicine.

Greater convenience to patients by decreasing travel and disruption is also a benefit claimed by the majority of telemedicine projects. Time savings for both patient and carer and faster access to care are similarly easy. Probably a mentionable benefit of telemedicine is the remote access that a patient and her or her general physician have to specialist advice when that is not avaible locally. Better monitoring of progress are additional advantages of telemedicine links involving a primary care doctor, a hospital specialist, a community care nurse etc. Digitised data such as patient's previous history, X-rays, test results are readily transmitted electronically using standard protocols and technologies such as email technology (Norris, 2002).

Digital communication gives healthcare info that is more accurate, more complete and more timely- gives of quality that lead to better access and affordable health care. Discharge letters are similarly available without delay. Different countries are promoting a subsidised scheme for low-income families to help them gain home access to the Internet. The Internet could be used for health promotion with web sites targeting both children and parents. Good access to the information is concerned more with the individual endeavouring to *pull* information from the Internet or other sources to answer specific questions. Again, better access to health care is one side of the access coin and better or proper resource utilization is the other side of the same coin. A preferred approach is therefore to set up a smaller number of resource sites and make this available for users through telemedical links. In case of teleradiology, clear cost savings have been identified, which has been around long enough for practitioners to creat a marketable services and optimize the operation procedures. Therefore, for strengthening the system of health care, any health care institution can adapt the new approaches of health care technologies (Norris, 2002). If we want to look at the limitations of telemedicine services, the following limitations (some of them have been discussed below) may be included (Norris, 2002).

The interference of technology between the patient and the carer is a potential source of argument, particularly if the electronic devices require constant adjustment or they breakdown. On the other hand, it can be pointed out that the enhancement of the patient-carer relationship

when a second healthcare worker is involved. Therefore, poorer relationships are by no means automatic and are often confined to the start-up stage of a link. Norris (2002) also argues that telemedicine can characterize a threat to status and preferred practices. The likelihood of such threats is increased if one of more of the clinical participants is over-enthusiastic and tries to coerce unconvinced colleagues into using the link without due discussion or preparation.

The beginning of new technologies and methods of working always lead to some disruption and concern about the short- and long-term consequences. The US Western Governors' Association Telemedicine Action Report lists several reasons for resisting change, including: fear that telemedicine will augment the workload; fear that telemedicine is market- rather than user-driven: lack of skills and the need to obtain them; be short of agreed standards. Additional sometimes impersonal technology may be created. The problems are most likely to occur with technophobic patients (or healthcare workers). Their occurrence is therefore greatest with elderly patients whose lack of self-reliance fuels their confusion. Careful preparation and equipment maintenance will diminish most difficulties (Adapted from Norris, 2002).

According to Norris (2002), education and training are key elements but considerable overheads in a flourishing telemedicine application. Both start-up and ongoing requirements must be considered as the system develops and new staff are taken on board. The training requirement covers the setting up and use of the equipment, the teleconsultation process, and the production of appropriate documentation for these tasks and for recording the consultation procedures and outcomes. Sometimes low quality or uncertain quality of health information can be appeared at web pages that are highly detrimental to the patients. Moreover, Protocol or pathway development is one of the most important and most time-consuming aspects of the introduction of a telemedicine application.

E-health* and *major trends of e-health services: The use of emerging information and communication technology, especially the Internet, for improving or enabling health and health care can be defined as ehealth and this 'ehealth' term bridges both the clinical and nonclinical sectors and includes both individual and population health-oriented tools (Eng, 2001). The nature and functions of e-health services are expanding rapidly, so it is difficult to define ehealth

accurately. Internet-based technologies will soon converge with satellite and cable television for full interactive broadcast capabilities delivered through seamless technology (Maheu, 2000). For the hospital care setting, e-health refers to electronic patient administration systems; laboratory and radiology information systems; electronic messaging systems; and, telemedicine -- teleconsultations, telepathology, teledermatology etc. In case of the home care setting, examples include teleconsultations and remote vital signs monitoring systems used for diabetes medicine, asthma monitoring and home dialysis systems. For the primary care setting, e-Health can refer to the use of computer systems by general practitioners and pharmacists for patient management, medical records and electronic prescribing (Adapted from: http://www.hc-sc.gc.ca/hcs-sss/ehealth-esante/index_e.html). Electronic Health Record can act as a fundamental building block of all these applications. It allows the sharing of necessary information between care providers across medical institutions.

The major trends of e-health services are given below: (Andreassen, 2007; Neuhauser et al., 2003):

- *Pure access to health information on the internet:* Internet can be act as a huge resource of health related information for patients, public as well as health professionals.
- *Decision support:* Online communication or information can help patients or public or health professionals for decision making task.
- *Support for lifestyle changes:* Tailored web sites can support for lifestyle changes such as, exercise, diet control, tobacco cessation etc.
- *Open public sites (such as, Mental health, Social support):* Here Internet plays a crucial role for mental health prevention and social support.
- *Self-help groups /psycho-educational services (individual or group*): It is going to be an integral part of treatment for emotional issues, behavior problems and mental health problems. It also deals with stressful situations. Some people believe that self-help groups are an important source for recovery and for empowerment (Focus Adolescent Services, 2007).
- *Question-answer services:* Individual patient or groups can do it via the Internet.

- *Online ask-the-doctor services for direct communication with health professionals:* Internet is an excellent communication medium for this type of services such as, e-mail contact between doctor and patient.
- *E-therapy*: The delivery of mental health services through Internet or online services may be called e-therapy. At present, online services are being typically delivered in the form of email communications, discussion lists, live chat rooms, or live audio or audiovisual conferencing (Gingerich, 2007).
- *Web-based discussion forums:* The emergence of web-based discussion forums has empowerment, peer support and experiential knowledge effects (Madara, 1997).
- *Electronic mailing lists*: At present some organizations are maintaining an electronic mailing list for their patients and organizational staffs.

Some e-health activities - consequences and benefits: Today's understanding about health is total well-being – not only to be a matter of the absence of disease (Raeburn *et al.,* 1998). The modern e-health era wants patients to be cooperative and participant in their treatment process. A dominant idea in the western health care system anno 2007 (Andreassen, 2007) is that the role of patient is shifting towards a more participating patient. It is being converted from 'passive receiver of help' to 'active participant'. People are doing a lots of health related activities via e-health services such as ordering of medicines, self-help activities, communication with family doctors or known health professionals, communication with web-doctors or health professionals, information collection before or after visit of doctors, taking decision if the person needs doctor, reading health related information. Young generations, women, patient having long-term illness are mentionable Internet health consumers. In addition, Internet's democratic nature can encourage people to participate more in society as well as in their own health care by interacting with peer patients, interacting with health professionals (Andreassen, 2007). Alternatively, e-health services or ICT-based services can be means to redistribute power and control providing individual citizens access to information. Information will lead to empowerment which, in turn, will lead to changes in the doctor-patient relationship (Hardey, 2001).

Legal and ethical issues – challenges for the Internet or e-health services: E-health technology in the medical profession, according to Maheu (2000) argument, has been developing for over 35

years. The incorporation of classic telemedicine and telehealth technologies with the Internet was the next logical step. At present, that technology is ready for the merger, its sudden growth is surprising. A number of specialty sites already exist for billing, marketing, medical records processing, communications, medical supplies etc. This e-health potential for immediate and international Internet dissemination of patient information and direct service delivery has many legal and ethical repercussions for psychologists. For example, traditional telehealth has relied upon telephone-based technologies for interactive videoconferencing, which has an established history of legal and ethical standards through telephone company regulation. The Internet is challenging these precedents (Adapted from Maheu, 2000).

There are lots of providers who provide information and services to patients and the public over the Internet, such as: health interested people in general, non-conventional medics, commercial units, interested groups, patient organizations in general, health personnel, health care sectors, quacks, fraudsters as well (Christiansen, 2007). Due to the legitimate concerns such as security and effectiveness, clinical uses of e-mediated communication are not growing up to the expected level. Patients and care providers are thinking that messages can be intercepted by unauthorized persons and it will breach the trust and legality that are necessary for the patient-doctor relationship (Car et al., 2004). Still there is no specific health legislation for health related web sites and e-health or telemedicine services nowhere (Christiansen, 2007). But each country has its general legislation for health care.

Yet, the World Medical Association (WMA), the global representative body for physicians, has presented some responsibilities and ethical guidelines for e-health and telemedicine practices. The followings are some legal and ethical guidelines (WMA, 1999) that should be considered when offering information and services to patients and the public over the Internet.

- It is essential that the physician and the patient be able to reliably identify each other when telemedicine or e-health services (for example, e-mail communication) is employed.
- Patients or publics' data and other information may be sent to a physician or other health professional, only on the request, or with the informed consent, of the patient, and to the extent approved by given patient or public. The data transmitted should be pertinent to the

problem in question (WMA, 1999). As for example, an ‘Act on patients' rights’ already has been passed in Norway (Christiansen, 2007).

- Because of the risks of information leakage due to some types of electronic communication, the physician must have an active commitment to ensure that all established standards of security measures have been followed to protect the patient's confidentiality.
- A physician practicing telemedicine or e-health services is responsible for the quality of care the patient receives
- Calibration procedures as well as routine controls can be used to monitor the accuracy and quality of data gathered and transmitted.
- Physicians practicing e-health services or telemedicine services must be authorized to practice medicine in the country or locality in which they are located, and should be competent in their field. When practicing telemedicine or e-health services via internet (e.g., email communication, prescription over the Internet) directly with a patient located in another country or state, the physician must be authorized to practice in that state or country, or it should be an internationally approved service (Adapted from WMA, 1999).

Christiansen (2007) argues that to evaluate an internet health service provided by authorized health personnel, we must at any rate find out what professional training the provider of the service has. The person in question must establish own identity properly and gives the answer whether the person is only responsible and accountable to the web site on the Internet. Some web health sites offer services that require us to provide health data about ourselves. In this case the operating health web site in principle, must obtain a license from the Data Inspectorate. Before providing health data about ourselves it might be wise to check whether the web site has obtained a license and whether it meets the Data Inspectorate's requirements for processing the data (Christiansen, 2007).

In this Information Age, e-mediated communication is very useful in case of health care purposes. Bergmo et al. (2005) argues that e-mediated patient-care provider communication can promise for improving efficiency and effectiveness of clinical care and a secure web-based messaging system is an effective way for providing patient care in general physician’s practices.

In this ground, we can say, e-mediated communication is increasingly used as a way of communication between patients and the physicians (Moyer et al., 2002).

Research studies show mixed arguments for (benefits) and against (pitfalls) e-mediated communication and doctor-patient, or peer support relationships. Some researcher such as Andreassen et al. (2006) have proved that e-mediated communication is affecting the context of doctor-patient interaction and in this case the element of trust in the patient-doctor relationship exerts influences each other. The above authors argue that communication technology gives better access and promotes a personal language that provides the lower threshold for contacting the physicians. The above authors also add that technology creates the potential for the patients to share with the physicians to deal with reflexivity of modern society. Moreover e-mediated communication offers 24 hours availability, anonymity option, reduced risk of stigma and negative social reactions, tailoring to individual needs, low stress situation and so on.

E-mediated communication creates new constructions of trust between doctor and patients. Based on the data from a qualitative study performed among Norwegian patients who used information and communication technology to communicate with their doctors, 'trust' was constructed in the doctor-patient relationship. This study was conducted as part of of a big project namely 'PasientLink'. In the project 6 GPs and 200 patients were recruited (Andreassen et al. 2006). Research on e-mediated communication regarding peer support relationships has positive outcomes. In a mental health discussion forum (N=492), a majority (75%) found it easier to discuss personal health problems via online than do face-to-face; therefore online interaction may have some unique benefits for the population suffering from mental disorders (Kummervold et al., 2002). So e-mediated communication increases the personal interaction thus resulting in increased peer support relationships. Many researchers think that although face-to-face communication has vocal intonation, touch, positioning or movements of head, face or trunk, it provides insignificant impact on doctor-patient relationship. E-mediated communication is a good mediator or medium to build doctor-patient relationship.

E-health services and behavior changes of population: From the socio-technical literature it has been evident that "technology is society made durable" (Latour, 1991) and "to design socio-

technical systems, we must understand how people and technologies interact" (Coiera, 2004). Now it is partially proven that e-health communication can improve behavioral outcomes which is really important in case of health promotion efforts. Neuhauser et al. (2003) argue for the mass customization, interactivity and convenience of technology mediated health promotion or communication that may have leading role in behavioral change of population. E-health media can minimize many of the limitations of traditional health communications through its tailored, interactivity and mixed media functionalities. Neuhauser et al. (2003) are very much influenced to mention some expected benefits of e-health systems such as, more participation of the users, customized information for users, '24/7' services, information related to social and life contexts (Adapted from Caplan, 2001). E-health communication plays a mentionable role in influencing psychological factors of self-efficacy of people (Rubin & Rubin, 2001), increasing empathy for online groups (Preece & Ghozati, 2001), promoting interactivity and participation, providing customized and contexualized information, spreading the mix of media channels out.

To prevent diseases and reduce increased demand of modern health care services (Health Care Financing Administration, 2000), the betterment of health communication or services has a very important role. Health communication will be more effective when it will reach people on an emotional as well as a rational perspective, including when it relates to people's social or life circumstances. For changing people's behavior, it is necessary to combine interpersonal and mass media communications in effective way. Interpersonal approaches may be more effective in changing individual behavior but it is costly; on the other hand mass media communication have broader reach with its less expensive property, but includes limited capability to change population behavior. Of course, the communication must be tailored or customized according to the needs of recipients, and interactive than do generic messages or one-way communication (Neuhauser et al., 2003). If we want to see e-health communication to be completely successful, it must get networked with peoples' social work and their behavior. In case of supporting the e-health services or communication and behavioral change, some sorts of e-health tools have been designed to support a specific behavior change such as stopping smoking, starting regular exercise, or getting a mammogram (U.S. Department of Health and Human Services, 2006). Kummervold et al. (2002) believes that online interaction can have specific benefits, such as easier to discuss personal problems, for mental disorder patients. Another positive argument is

that technology has allowed tailored health communication to meet the specific needs of individuals (Bensley et al., 2004). Effective health communication, for individuals, helps to raise awareness of health risks and solutions, help them find support from other people, and attitude may be reinforced (National Cancer Institute, 1989).

Health Promotion and e-Health Services: "Health promotion is the process of enabling people to increase control over, and to improve, their health" (WHO, 1986). At present Internet intervention or e-health service is playing an important role for promotion of public health. In this age, Internet is the latest in a series of technological breakthroughs in interpersonal communication as well as it combines very innovative characteristics such as bridging great distances and reaching a mass audience (Bargh *et al.,* 2004). Study regarding Internet shows that both cognitive behavior therapy and psycho-education delivered through Internet are effective to reduce symptoms of depression (Christensen et al., 2004). But to design internet interventions for promotion of public health involves some important issues. These issues are briefly described below.

- *Tailoring of the programmes / interventions:* Tailoring is a strategy of evolving computer and web-based technologies and it is combined with health communication and behavior change research (Suggs et al., 2006). Behavioral researcher emphasizes the importance of 'tailoring' or 'customizing' information, because it closely meets the needs of the recipients (Neuhauser et al., 2003).
- *The reach of mass media for information:* An amalgamation of the effectiveness of interpersonal communication and the reach of mass media communication is needed to consider for designing Internet interventions. Because it changes population behaviour (Neuhauser et al., 2003). Mass media approaches are having broad reach for lower cost (Backer *et al.,* 1992).
- *Promoting interactivity and participation:* Neuhauser et al. (2003) argue that the interactivity of Internet communication or intervention can enhance its ability to be responsive as well as participatory.
- *Cost-effectiveness:* It is one of the considerations for designing interventions for promotion of public health.

- *Behavioral outcomes:* Now it is partially proven that e-health communication or intervention can improve behavioral outcomes which is really important in case of health promotion efforts (Neuhauser et al., 2003). So designers of Internet interventions or e-health services must consider it prior to developing the interventions.
- *Quality criteria of e-health services:* Quality criteria such as transparency and honesty, authority, privacy and data protection, updating of information, accessibility are other important issues to be considered in case of Internet intervention or e-health services.
- *Users Interface design*: It is a very important issue for designing Internet intervention. But to develop or design of user Interface is a creative process and difficult. Evidence suggests the it is important to have relationship delineated between self-presentation, ICT and health; these traits should be included in the design of health-services; also controlled (strategic) self presentation can be facilitated by an interface that may allow reprocessing of content (Adapted from Johnsen, 2007).
- *Users gender, age and cultural factors:* Most of our internet services are being inappropriately generalized across some factors such as gender, age and culture (Baum, 2000). These factors also should be considered when designing Internet interventions to promote public health.

2.2. Teledermatology

Telemedicine and e-health services that are involved dermatology sector are collectively called teledermatology. Teledermatology is used with the help of videoconferencing or still image transmission. Teledermatology is a solution where the patient and their general physician (GP) consult a specialist and this type of consultation provides an immediate result, and the treatment can begin at once. In addition, in case of still image solutions, the GP sends images and written referral and the images and the text can be evaluated at various times. Most of the GPs experience that this solution is very much effective for selecting patients that need to go to hospitals. In addition, general practitioners could enhance their expertise in dermatology. It is also realized that it inspires the confidence of GPs and they are able to obtain a second opinion in skin treatment diseases (Johnsen et al., 2006).

According to Johnsen et al. (2006), telemedicine services in dermatology are anticipated to have considerable potential for treatment benefits for patients groups with chronic skin diseases, for instance, placement of equipment in nursing homes and home care for sore treatment cases. Eedy et al. (2001) argues that teledermatology holds a great prospective for revolutionizing the delivery of dermatology services, providing equitable service to remote areas and allowing primary care physicians to refer patients to dermatology centres of excellence at a distance. However, before its routine application as a service tool, its reliability, cost-effectiveness needs to be justified by thorough evaluation. Teledermatology can be applied in one of two ways: it may be conducted in real-time, utilizing videoconferencing equipment, or by store-and-forward methods, when transmitted digital images or photographs are submitted with a clinical history.

At present while there is a considerable range of reported accuracy and reliability, evidence suggests that teledermatology will become increasingly utilized and incorporated into more usual dermatology service delivery systems. Studies to date have generally found that real-time dermatology is likely to allow greater clinical information to be obtained from the patient. This may result in fewer patients requiring usual consultations, but it is generally more time-consuming and costly to the health service provider. It is often favored by the patient because of the instantaneous nature of the diagnosis and management regimen for the condition, and it has educational value to the primary care physician. Store-and-forward systems of teledermatology often give high levels of diagnostic accuracy, and are cheaper, more convenient, more useful for the health care provider, but lack the immediacy of patient contact with the dermatologist, and involve a delay in obtaining the diagnosis and advice on management. It is increasingly likely that teledermatology will prove to be a significant tool in the provision of dermatology services in the future. These services will probably be provided by store-and-forward digital image systems, with real-time videoconferencing being used for case conferences and education. Accordingly, much more research is needed into the outcomes and limitations of such a service and its effect on waiting lists, as well as probable cost benefits for patients, primary health care professionals and dermatology departments (Eedy et al., 2001).

In case of teledermatology, videoconferencing was found, for example, in Norway, to be an effective way to deliver teledermatological services at a distance, but many physicians stated that

for most of the consultations, interactive video would be unnecessary and inconvenient, to some extent, to schedule. Later on, due to avoid this type of inconveniences, e-mail technology had been created for transmitting the information or still images (Breivik et al., 2006, p.7). In case of videoconferencing, the patient and the physician on one end and the dermatologist on the other, communicate via videoconferencing system (Figure 1).

Fig. 1: Videoconferencing system / equipments (Source: Ferguson, 2006)

A video camera is used to express images of diseased skin areas of the patients to the dermatologist. It helps dermatologist to make diagnosis and advice on treatments. Videoconferencing equipment can be selected for quality of image and ease of use. Simple, intuitive controls may be ideal. The majority parts of teleconsultations require only a few functions. Unfortunately, each new generation of videoconferencing equipment appears to be more and more complex, which tends to discourage practitioners who are not fully conversant with operating it. One of the solutions is to preset the majority of functions and leave visible only those controls important to carry out a simple teleconsultation. The equipment should be compatible with the remote site (Ferguson, 2006). As international standards have been improved and developed, most commercial equipment will interconnect irrespective of the manufacturer. Some remote sites will have older equipment and it is always worth performing test calls before connecting for clinical purposes. The capability to remotely control the remote site's camera is important, especially if the far site has a low volume of use. This helps the base

practitioner to adjust the camera view to suit his or her own requirements and support inexperienced remote users. Storing preset views on the remote site unit may simplify supervised examination. Technical support should be easily accessible, especially during normal operational hours. This support should include line/network assistance, as well as troubleshooting for videoconferencing equipment. The equipment and its settings should be checked regularly and repeatedly (Ferguson, 2006).

In case of teledermatology, patient satisfaction is high, although 10% are dissatisfied. Having a physician in the studio makes patients feel safer, and they understand the specialist better. Comparisons between videoconference and face-to-face consultations have shown up to 90% diagnostic agreement. A pilot study using still image referrals showed similar results. Videoconferences are nicely suited in everyday dermatology, when follow-up by specialist is necessary, and for patients in regular treatment at local clinics for skin disease. Still image referral seems promising and encouraging. The studio physician's diagnostic abilities are enhanced. Many patients are not suited for teleconsultation, but telemedical solutions will have a role in the years to come (Moseng, 2000). Mann et al. (2002) also agree that in recent years, digital photography has enhanced the electronic transfer of clinical images over distances.

A case study involving 59 patients has been carried out. The main conclusion was that the most common skin problems safely could be handled using telemedicine (Moseng, 2000). A limited survey of patients' satisfaction has also been carried out. This survey concluded that the patients found still image consultations to be a good supplement to videoconferencing or visits by specialists to rural areas. The GP and the specialists agreed that the system was useful and suitable for diagnostic work (Arild et al., 1999; Ekeland et al., 1999).

Teledermatology with still image may be an economic feasible option for some rural clinics. This however, will depend on the annual patient workload and the remoteness to the specialist. An economic evaluation carried out in 2000 showed that investment in still image dermatology would provide potential savings in 18 out of 44 municipalities (one clinic in each) in the two northernmost counties in Norway (Bergmo, 2000).

All citizens are entitled access to the proper care and treatment from the health care system. In a country, where people live in long distances way, ease of access varies depending on where the patient lives. In that case, travelling to see a specialist is often time consuming and exhausting. Here, telemedicine services can offer easier access to specialist advice. An ongoing evaluation of still images in dermatology in the Net has shown in more than 95% of all still image referrals, the dermatologist could take a decision on the basis of the information forwarded. This saved patient travels for face-to-face consultations (Johannessen *et al.*, 2004). In teledermatology, patients with several skin diseases and conditions such as atopic eczema, skin rash, lumps and bumps (Sullivan, 2001), psoriasis, wounds can be diagnosed and treated effectively.

Now I will try to co-relate the services of telemedicine and e-health with information systems and information infrastructure followed by actor-network theory.

2.3. Information Systems, IIs & Telemedicine

At present telemedicine is being considered as one of the emerging new service delivery vehicles that run on the information superhighway (Berek & Canna, 1994). And, this telemedicine, one of the tools of telecommunication technologies, is being added to the traditional systems of a health care institute. Telemedicine currently accounts for only small segment but it is spreading out very rapidly. In this telemedical information society, the visualization as well as manipulation of hyper-graphical 3D body or organ templates and patient specific 3D or Virtual Reality models is a crucial attempt to define an information infrastructure (Marsh, 1998). In a country with low population density and long traveling distances to nearest hospital or medical expert, telemedicine can play an important role in health care systems. Telemedicine has lots of ambitious visions in the health care sectors such as: better access to health care, access to better health care, improved communication between carers, easier and better continuing education, better access to information, better resource utilization, reduced treatment costs etc. (Norris, 2002).

However, the escalation and sustainability of these services have been shown below expectations and problems have been shown when we put it into daily use (May, et al., 2001) due to, perhaps,

too much technical experimentals and RCT evaluations. An alternative solution of it may be through the lenses of information infrastructure. Information infrastructures (IIs) differ from information systems in context of organization developed whether it is closed or open; self-contained or global. IIs provide more specialized solutions for communications within specific business sectors. Accordingly information infrastructure is an alternative strategy for developing and implementing telemedicine and e-health systems (Hanseth et al., 1998).

If we want to develop the information infrastructure, it requires dynamics, non-technical elements (of information system); ultimately these two requirements must be added to the standards required for the integration. So we can safely say, information infrastructure is more than information system (Hanseth et al., 1998). As information infrastructures are large integrated systems, so unlike information systems, they might have lack of complete control (Bowker et al., 1999) over the time. But the development of standardized design strategy can make them economically viable and long lasting (Hanseth et al., 1998).

2.4. The content of information infrastructures

Information infrastructures may be considered a reasonable practical match among routines of work practice, technology, large scale of organizational as well as technical resources having transparency to communities of users. It is arranged for a wide variety of users and user groups, and made to work in concerted way with a negotiated order involved in it (Bowker & Star, 1999). These all features are really pertinent to telemedicine arrangement, where telemedicine is being used for large number of users or user groups.

Information Infrastructures has the properties of embeddedness which is linked with social arrangements and technologies. IIs can reach beyond a single event or one-site practice either spatially or temporally. Here in information infrastructure, all new participants gather a normal familiarity with its objects as they become members of that infrastructure. It is important that information infrastructures should be shaped by the conventions of a community practice. Obviously IIs should include embodiment of standards. IIs has the invisible quality of working structure. It becomes visible when it breaks up (Bowker & Star, 1999). The information

infrastructure may be conceptualized in Figure 2 (concept adapted from Hanseth & Monteiro, 1998).

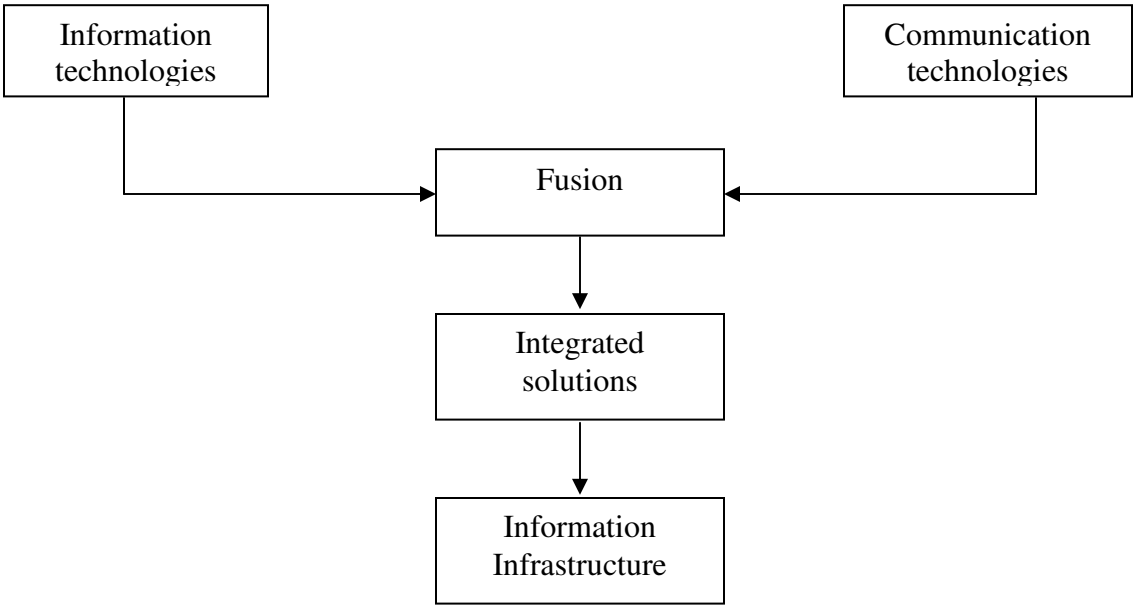

Fig. 2 : Ongoing understanding of information infrastructure.

In case of health care information infrastructures, the several types of information are interconnected as well as overlapping. The same information may be transmitted in different ways, for example, a digital X-ray image can be transmitted through multi-media conferencing system (a distinct tool of telemedicine) or attaching through an email (a distinct tool of e-health). Moreover, one organizational unit may communicate with several units of that organization or outside of that organization in different purposes, for instance, a lab can communicate many general practitioners, other labs, other wards of the hospital. This interconnecting properties make the systems having multi-level applications and turn the systems into infrastructure (Hanseth & Monteiro, 1998).

The future of information infrastructures will be just as dynamic as the information systems have been so far of its status. They will be the combined consequence of vertical and horizontal

integration of information systems. Actually they will be very much heterogeneous. In future, as of many researchers' ideas, the standardization of information infrastructures will be the key issue. It is obvious that the new infrastructures necessitate lots of standards. There are a number of studies within the field of Science and Technology Studies that deals with standards and that are necessary for developing information infrastructures. IT infrastructure has become a popular topic within individual business organizations (Broadbent, Weill XX).

2.5. Types of Infrastructures

Information infrastructures are coming out partly through the development of Internet, infrastructures for specific business sectors and corporate infrastructures.

Global infrastructures- The Internet: Internet itself is both a telecommunication and information system. It is a shared resource for billion of users all over the world. It is now used technological foundation for many classical telecommunication services such as TV broadcasting, mobile phones services etc. At present, the core of many technological developments is Internet (Hanseth et al., 1998)

Business sector infrastructures: The idea of exchange of information across organizational boundaries has been spread out into different solutions shared by organizations within some kind of business sectors. It includes solutions for e-commerce, extranets and telemedicine networks.

Corporate infrastructures: At present, telecommunications is being used to support users distributed across large geographical areas access to the same kind of information and services. The integration of telecommunication and information technologies has performed the amalgamation of information systems across any organizational and geographical borders. To improve their competitiveness, organizations are trying to integrate their various systems with those of their customers, suppliers and partners all over the world (Hanseth et al., 1998).

2.6. Information Infrastructure as actor

A large information infrastructure may be a powerful actor influencing its own future life (its extension, size, forms etc). To change a large information infrastructure is very difficult. The conception of standards of IIs and their self-reinforcing character as the installed base grows, can be described under 'self-reinforcing mechanisms' and 'network externalities'. When the value of a particular technology for individual adopters increases as the number of adopters augments, then self-reinforcing mechanisms appear. The 'network externalities' phenomenon comes into view when the value of a technology relies also on features being external to the technology itself (Hanseth et al., 1998).

2.7. Dilemmas with infrastructure

The challenges are involved everywhere in case of design and development for something. It is very distinctly true in case of the design and development of information infrastructure. The challenges regarding infrastructure design may be seen as different view. Firstly, it is true that many proposed infrastructures never take off. The reason is that infrastructures obtain their values and their development and are grown up by the size of their user community. They are initially having of no value. In view of that, no users find it profitable to adopt it at all, and, consequently, an installed base never starts growing out. Meanwhile, infrastructures are turning into self-reinforcing, as they grow. They are also getting momentum during their growing phase. In reality, to succeed in building an infrastructure, we have to get such a self-reinforcing process started out. For infrastructure developers, this phase of infrastructure is the most important dilemma to be managed (Moor, 1993).

Again, when an infrastructure starts growing, there is a risk that different users adopt different standards and ultimately incompatible infrastructures may get established. In such a situation, it may be considered beneficial if all users are in same agreement and adopt one shared standard. Otherwise it will make chaos among different users and user groups (Moor, 1993).

2.8. Characteristics of Information Infrastructures

Hanseth et al. (1998) argue that the term 'infrastructure' is being used, in relation to information technology, to indicate basic support systems such as operating systems, communication protocols, file servers etc. The IIs can be viewed as an evolution of computer networks, distributed information systems and Inter-organizational systems.

If we want to identify different characteristics of IIs, we must mention six important aspects of information infrastructures. They can be briefly described as below:

Aspect 1- Enabling function of infrastructure: Enabling function supports a large range of activities that may open up another field of new activities. The enabling function of infrastructures plays some important roles in policy documents (Hanseth et al., 1998).

Aspect 2- Infrastructure is shared by a larger community: In case of IIs, all the members of the community share this infrastructure. In this means, infrastructures may not be split into separate parts being used by different groups independently. But for analytical or design purposes, an infrastructure may be taken apart into various units. Of course, the dissimilar elements of an infrastructure should be integrated through common, consistent interfaces to all users or an infrastructure must have a standardized interfaces (Hanseth et al. 1998). Again standards are of three kinds: reference, minimum quality and compatibility standards. IIs belong to the compatibility standards which ensure that one component can be incorporated into a big system given a common interface specification of the standard (David & Greenstein, 1990, p. 4).

Aspect 3- Infrastructures are evolving, open and heterogeneous: The information infrastructure evolves continuously. For example, telecommunication infrastructure is continuously evolving from the first communication links. More users are adopting to this technology. The continuous growth and evolution of IIs creates openness of infrastructure (Hanseth, 2002). In infrastructure, the number of users, stakeholders, application areas or network operators have no boundaries thus creating open-mode structure. For example, in hospital infrastructure, information is being exchanged with other medical institutions, social insurance offices, even in other countries. Even in case of infrastructure, it consists of no border

regarding the number of elements that are included to it. Finally there is no beginning or ending of IIs, so is open for its development time (Hanseth, 2002).

In infrastructure, unlimited numbers of users, stakeholders, developers, use areas – all these create heterogeneity of IIs. Infrastructures are heterogeneous considering that they are layered on each other as in OSI (open systems interconnection) model. Heterogeneity is determined by several factors such as: equipment used, information, applications of infrastructure, standards of network, different implementation ways and people engaged (Hanseth et al., 1998). In addition, infrastructures are heterogeneous in this sense that they consist the elements of various kinds such as technological and non-technological like human, social or organizational. In this sense, IIs are, of course, heterogeneous (Hanseth, 2002).

Aspect 4- Infrastructures are socio-technical networks: II is not pure technology. They are more than pure technology in context of the qualities of their constituents. Infrastructure, of course, should have socio-technical networking aspect as well because people will use it. They will not work without supporting people (Hanseth et al., 1998). This aspect of information infrastructures can be explicitly explained by actor network theory (ANT). To mention the relationship between technology and society, here, we can quote the Coiera's four rules for the reinvention of health care: "Technical systems have social consequences; Social systems have technical consequences; We don't design technology, we design sociotechnical systems; To design sociotechnical systems, we must understand how people and technologies interact" (Coiera, 2004). Again an infrastructure is fundamentally a rational concept, becoming a real infrastructure in relation to organized practices (Star, 1999).

Aspect 5- Infrastructures are connected and interrelated (ecologies of networks): Interconnection and interrelation between sub-infrastrcutures are some important parameters of infrastructure. The different technologies are connected to make ecologies of infrastructure. Infrastructure presents a common interface to all users in a standard way making it as a standardized II. They are layered, links logical related networks and integrates independent components. The components become interdependent, when all independent components are

connected together into a larger system (Hanseth et al., 1998). Also the infrastructure resource should have capability to add any number of users or uses (McGarty, 1992, p. 235-236).

Aspect 6- Infrastructures develops through extending the installed base: Another aspect of infrastructure is that it proceeds with the inertia of installed base and gets strengths from this base inheritably; so it may be considered as always already existing. The whole infrastructure can not be changed abruptly; the new one must be connected to the old infrastructure. The old one is called installed base. The new or improved components have to be fitted into the old one. The existing infrastructure, therefore, influences how the new elements can be designed and developed (Hanseth et al., 1998) and the continuous growth of IIs become self-reinforcing (Hanseth, 2002).

Actually IIs are complex systems considering all of the processes including extending and improving of installed base and engage huge numbers of independent actors whether they are developers or users (Hanseth et al., 1998). Of course, considering the history importance, installed base is not a unique feature of IIs. As the installed base breeds its further development, to manage its direction is also important. The management strategies for development of IIs may be considered as cultivation of installed base over time (Hanseth, 2002).

2.9. Actor-Network Theory

It is argued that Actor-Network Theory (ANT) has been evolved from the work of Michel Callon in 1991 and Bruno Latour in 1992 at the Ecole des Mines in Paris (Bardini, 2007). Before illustrating actor-network theory, here we can know the term ‘actor-network’. Actor-network may be defined as the act linked together with all of its influencing factors (which again are linked), producing a network. An actor-network links together both technical and non-technical elements (Monteiro, 2000). Actor-network theory has become widely known in recent years, and a substantial number of researchers are making explicit use of the theory in their research work (Walsham, 1997). According to Walsham (1997):

"Actor-network is a heterogeneous network of aligned interests, including people, organizations and standards." (Walsham, 1997).

Monteiro (2000) argues that if information infrastructure is a socio-technical process of negotiation, then ANT is sensitizing vehicle and ANT gives the flexible level of analysis of information infrastructure. ANT may offer vocabulary which opens up the concept of alignment. According to ANT, alignment is not the result of any top-down plan or decision.

Actor-network theory can be positioned within the wider backdrop of conceptualizations of society and technology. Actually, ANT is nothing but a vocabulary that provides a language to describe how, where and to what extent technology influences human behavior. ANT provides a different handle on how information systems and business strategies get aligned. ANT is located within a broader strand of critical thinking rounding information systems and information technology (Monteiro, 2000). In fact,

"Our technologies mirror our societies." (Bijker and Law 1992)

Also they are continuously shaped and reshaped by the interplay of a range of heterogeneous forces within the networks (Stanforth, 2006).

Monteiro (2000) argues that actor-network theory is specifically pertinent to developing information infrastructure. According to Monteiro (2000), it has been said that information technology has two types of implications such as restricting and enabling. ANT represents one framework within this restricting/enabling regime. Actually, ANT has neither has been employed extensively within information system research. But ANT is born out as an interdisciplinary field of science and technology studies (STS) (Monteiro, 2000). The general label of STS has four types of approaches (Bijker et al. 1987), such as: historical development of technological infrastructure by emphasizing of inertia and heterogeneity, social construction of technology, actor-network theory and the sociology of scientific knowledge. So actor-network theory is one of the approaches of four labels of STS.

An actor-network ties both technical and non-technical elements. Also ANT talks about the heterogeneous nature of actor-networks. Actually an actor-network is the network of heterogeneous materials producing the context. In the convincing process of actor-network, actor, who has interests, tries to convince other actors in such a way to create an alignment of the other actors' interests with their own interests. When this convincing process becomes effective, it creates an actor-network. The idea of an actor-network, instructs us to map out the set of elements that actually determine action. But in turn, each of these elements is part of another actor-network and so forth (Monteiro, 2000).

Although there are a lot of key concepts in actor-network theory (Walsham, 1997), here only two key concepts are described elaborately, as these two are equally necessary for analyzing the all five efforts in teledermatology.

2.9.1. Translation

In actor-network theory, translation is a very important concept. In ANT terms, users and others interests may be translated into specific needs. Monteiro (2000) argues that in a translation, or design, the designer creates a scenario for how this system will be used. Translation is the process which generates ordering effects such as devices, agents, institutions or organizations (Law 1992, p. 366). Enrolment is creating a body of allies, human and non-human, through a process of translating their interests to be aligned with the actor-network. In ANT terms, design is translation: ‘users’ and others’ may, according to typical ideal models, be translated into specific “needs,” the specific needs are further translated into more general and unified needs so that these needs might translated into one and the same solution. Callon et al. (1983) depicts translation in this way:

> *“Translation involves all the strategies through which an actor identifies other actors and arranges them in relation to each other.”* (Callon et al., 1983).

In addition, Callon (1986) suggests four "moments" of translation:

Problematisation – In this phase of problematisation, the actor defines the problem in a way that makes this actor indispensable for other actors in this network. During this phase some *"obligatory passage points"* and actors are distinct.

Interessement – This is the group of actions by which some actor is attempting to impose and stabilize the identity of the other actors that were defined through problematisation phase.

Enrolment – The given successful interessement phase continues with enrolment, a set of interrelated roles is defined and ascribed to actors who acknowledge them.

Mobilisation – It it is often done by spokesman who is representing a particular network and its intentions (Callon, 1986).

In such a translation, or design, process, the designer works out a scenario for how the system will be used. This scenario is inscribed into the system.

2.9.2. Inscription

The inscription refers to the way that technical artifacts embody patterns of use (Akrich 1992). Inscription can include programmes of action for the users and it defines roles to be played by users and the system. Monteior (2000) argues that the inscription may be flexible or inflexible depending on the programmes of action. There are four aspects of inscription and translation such as: the identification of explicit scenarios of use held by the different actors during design; how these anticipations are translated and inscribed into standards; inscriber and the strengths of the inscriptions (Monteiro, 2000). Once the programmes of action is inscribed strongly, it does not turn back. This is irreversibility of actor-network. Finally stabilized networks become black box. A black box is any setting that is now so stable and certain that it can be treated as a fact where only the input and output counts (Monteiro, 2000).

The given inscribed patterns of use may not succeed because the actual use deviates from it (Monteiro, 2000). In that case, a user may follow an anti-programme. But through a succession of translations, interests may be inscribed into a strong network that can impose desired behavior on users (Latour, 1991).

In this thesis, actor-network theory will be used for the description of implementing process of five teledermatological efforts with their different actors and their interests.

3. METHOD

3.1. Research design

Method chapter plays a vital part in each type of researches. Research design is an important part of methods in any type of research. In qualitative approach, method chapter considers research design, research setting, data collection as well as reflections on method. A good research design for a case study is like a good design for a ship. It will help it to safely and efficiently reach its destination and a poor design will fail to achieve its goals (Maxwell, 1996). According to Robson (2002, p. 167), research question drives the research design whether the research will be qualitative or quantitative. According to him, researchers using flexible designs have to be concerned themselves with the reliability of their methods and research practices (p. 176). Regarding research design for qualitative research, it has a critical realist view, like this:

> *"Flexible or qualitative methods have traditionally included the researcher and the relationship with the researched within the boundary of what is examined. Because all any study can do is approximate knowledge of phenomena as they exist in the real world, the process of study itself must be an object of study." (Anastas et al., 1994, p. 60)*

Robson (2002) prefers to use the terms 'fixed' and 'flexible' design to depict quantitative and qualitative research methods respectively. According to him, fixed design contains pre-specification, quantitative data; alternatively, flexible design contains qualitative data of much less pre-specification. In flexible designs, the design evolves, extends as well as unfolds as the research proceeds whereas in fixed design studies emphasise the measurement and analysis of causal relationships between variables, but not processes (Robson, 2002). Of course, qualitative research means different things to different people (Tesch, 1990). According to him, probably, each discipline seems to have its favourite type of qualitative research. For an educator, for example, 'qualitative' may bring to mind 'ethnography', while sociologist may connect it with 'ethnomethodology and for a psychologist it may bond with phenomenology. The author also describes the qualitative data in this way- 'all data that can not be expressed in numbers'.

Because a large proportion of studies in the field of education are evaluative, qualitative (flexible) research has a vital importance in the way of evaluation.

Although quantitative research methods have been the methods of choice in evaluating information systems, qualitative methods are best in identifying and selecting research topics for investigation (Stoop *et al.*, 2003, p. 459-461). According to them, qualitative research is often a prerequisite for quantitative research and for interpreting the results from quantitative research requires qualitative methods. So in this sense, quantitative methods depend on qualitative method to some extent. Qualitative research can be seen, in geographical terms, as a movement when a researcher, primarily as a distance, is coming closer and closer the live realities of other people (Alvesson, 2003, p. 168).

According to Klein et al. (1999), in some cases there is no clear-cut difference between qualitative research and interpretive research. It defines the same meaning for some cases. But Myers (1997) argues that depending upon the philosophical assumption of the researchers, qualitative research may or may not be interpretive. Chua's (1986) classification of epistemologies clearly defines qualitative research can be done with a *positivist, interpretive or critical* stance.

Information systems research may be classified as positivist when there are evidences of quantifiable measures of variables, hypothesis testing from a representative sample to a stated population (Orlikowski et al., 1991). IS research can be designed as critical if the main task is seen as being one of social critiques (Klein et al., 1999). *So, when will qualitative IS research be interpretive?* There is an excellent interpretation of this *Interpretive Research* from Kaplan et al. (1994).

> "*IS research can be classified as interpretive if it is assumed that our knowledge of reality is gained only through social constructions such as language, consciousness, shared meanings, documents, tools, and other artifacts"*(Kaplan et al., 1994).

Again, Walsham (1993a) argues that the main aim of interpretive research is to produce an understanding of the context of the information systems. Interpretive field studies discuss the project's current political structure and overall objectives in terms of the principle of contexualization (Orlikowski, 1991). The information systems literature consists of reports and conclusions from a significant number of interpretive case studies that cover a range of topics and issues (Walsham, 1993b). Walsham (1993a) also classifies the types of generalizations of interpretive case studies such as, development of concepts, the generation of theory, the drawing of specific implications and the contribution of rich insight. Klein *et al.* clearly states that theory plays a crucial role in interpretive research. Interpretive research helps information systems researchers to comprehend human thought and action in social and organizational contexts (Klein et al., 1999). In addition, in another principle, they argue that interpretive field research requires critical reflection on how the research data are socially constructed through the interaction between the researcher and participants. Interpretive research has emerged as a well-founded and important approach in the area of information systems research. At present significant numbers of authors are working within the interpretive tradition (Klein et al., 1999). Most of the literature is concerned on the substantive case studies themselves and the conclusions which can be drawn from them (Walsham, 1995).

It is mentionable that ethnography field study is one type of interpretive field studies in information systems. According to Harper (2000), ethnography can specify the role of computer based systems in work practices. It involves individual researcher or research team in the everyday activities of an organization or society, usually for a prolonged period of time. Ethnography is simply one way of looking at how people do their work. The objectives of the paper are to discuss what ethnography involves as a structured, organised set of activities as well as to outline one particular fieldwork program. In computer supported work processes, field work programmes are important. There can be no doubt that to be successful in the field requires a systematic, organised approach. Systematic approach is particularly important when it comes to delivering materials for computer supported cooperative work. Field work programmes have three main components: a) Life cycle of information in an organization, b) Ritual inductions, and c) Undertaking interviews and observing work. To know the life cycle in an organization is important for various purposes such as to map out the key processes of the organization, to

understand the diversities of work within the organization, to understand how different sets of persons depend upon each other and to determine what were viewed as the salient junctures in the life cycle.

Harper (2000) also argues that ritual inductions are the initiation ceremony transforming outsider to an insider. It depends on how many individuals have been interviewed and the extent of the observation of the information life cycle. It ensures that the materials generated by the ethnography get taken seriously or put it another way, 'count'.The last component of the program is undertaking interviews and observing work. It relates to the motivations behinds interviews and observation of work. Ethnographic interviews are typically described as informal and open-ended. In ethnography, observations are important to see the actualities in an organization. Undertaking interviews and observing work practices in an organization provide raw materials for analysis. The last concern of this paper is to give a suggestion regarding ethnography and design of an organization.

There are at least four ways in which ethnography can connect to design. The first role involves undertaking an ethnography concurrent with design. The second process is one where the ethnography is undertaken quickly and roughly. The third process that ethnography can be a part of an evaluation system and finally the fourth process involves using ethnography to re-examine previous studies of the work places. Ethnography can be allied with computer systems and work practice design. It is certain that ethnography has some kind of systematic properties. In short, those who want to undertake ethnography for computer supported cooperative work, will find plenty of materials for the analytical concerns (Harper, 2000).

In this thesis, we follow an interpretive case study that belongs to Walsham et al. (1994). According to them, the IS strategy implementation process is a dynamic one, involving time-varying relationships, multilevel contexts and political aspects.

Qualitative or interpretive methods permit the evaluator to study selected issues in depth and detailed way. Alternatively, quantitative methods require the use of standardized measures so that the varying perspectives and experiences of people can be shaped into a limited number of

predetermined response categories to which numbers are assigned (Patton, 1990). According to Patton (1990) qualitative or interpretive methods produce a wealth of detailed information about a smaller number of people and cases. This highlights understanding of the cases and situations studied. Probably in this way qualitative research can take an expected position in case of case study research.

As stated earlier, qualitative or interpretive research is very much concerned with case study research. About case study research Yin (1994) argues that-

> *"Case study is a strategy for doing research which involves an empirical investigation of a particular contemporary phenomenon within its real life contexts using multiple sources of evidence." (Yin, 1994)*

Cook *et al.* (1979, p. 96) advised the case study researchers to be serious in case of experimental design. According to them, 'case study as normally practised should not be demeaned by identification with one-group post-test-only design'. Robson (2002) clarifies this statement in this way that case study is a fundamentally different strategy with its own design procedure and it is not an imperfect experimental design (p.180).

Interpretive research is also concerned with ethnography research. According to Walsham (1995), the ethnographic research in anthropology is a valuable starting point for a consideration of the philosophical basis of interpretive case studies. In the writing pattern of organizational ethnography, Maanen (1979) said the interviewee's construction as first-order concepts and the construction of researcher as second order concepts. Ethnography is a mean of studying human life. Ethnography is multi-modal, electic; ethnographic researchers use a variety of research techniques to amass their data (Goetz et al., 1984, pp. 3-4). Atkinson et al. (1994) defines ethnography as a study of an explorative nature, working with unstructured data, being case oriented and showing an interest in meanings. Again, Alvesson (2003) strongly has criticised the quantitative (fixed) approach in this way:

'Ethnography is looked upon as sophisticated – it involves first hand experiences – having "been there" – offer a deeper level of understanding and a greater authority-base than sending out questionnaires' (Alvesson, 2003, p.171)

In the area of interpretive studies, case study research has been accepted as a valid research within the information systems research community. When the criteria are useful in evaluating case study research conducted according to the natural science model of social science, the positivist criteria proposed are inappropriate for interpretive research (Klein et al., 1999). Again according to Myers (1994), most of the theories of IS implementation are very narrow; IS implementation can only be understood as part of the broader social and organizational context. In this sense, for the study of IS implementation, interpretive research strength out-weighs the strength of quantitative research and positivist criteria.

3.2. Data collection

In this study, the data collection has been based on qualitative approach such as interviews, documents collected and participatory observations and informal discussions, physical artifacts etc. In qualitative approach, the data from interviews consists of direct quotations or direct explanations from people about their opinions, experiences, knowledge and feelings. The data from observations contains detailed descriptions of people's activities, behaviors, actions and organization processes. Document analysis in qualitative inquiry yields excerpts, quotations; official publications and reports, archival records, personal diaries etc (Robson, 2002).

As case studies, I had chosen five mentionable teledermatological efforts in North Norway. My observations and interviews period were from February 2007 to May 2008.

In total, I have conducted 15 semi-structured interviews with the DMS project leader, dermatologist, project member of 'Show Window' project, two nurses of DMS Nord-Troms, project leader of Kroken project, project leader and involved dermatologist of 'Eczema counselling over the Internet' project, one GP of DMS Nord Troms, some other informants . I

got some pictures of Well Communicator from a project member of 'Show Window' via e-mail and a map of DMS area from project leader of DMS. I have also got some documents (in Norwegian) from project leader and orthopaedician of UNN. The duration of each interview was from 45 minutes to 1 hour and 15 minutes. In addition to these, I talked with DMS project manager on the phone in seven times. I communicated with project manager ten times via e-mail. We interviewed a dermatologist for two times, a project manager two times and a project member for two times.

My interviewed subjects are:

No.	Profession	Work place
1.	Project Manager, DMS Nord Troms	NST
2.	Physician 1	UNN
3.	Physician 2	UNN
4.	Physician 3	Sonjatun, Nordreisa
5.	Project member, Show Window	NST
6.	Nurse 1	UNN
7.	Nurse 2	Sonjatun, Nordreisa
8.	Nurse 3	Sonjatun, Nordreisa
9.	Project Manager, Kroken project	NST
10.	Project Manager, Eczema Counseling	NST
11.	Special consultant	NST
12.	Telemedicine consultant	NST

I started my data collection in February 2007, with the first introduction with project leader. At that introductory period, my supervisor was present there as well. At first day, I used some A4 sized pages to briefly write down the overall project description.

In March 2007, project leader introduced me with a dermatologist of UNN and I interviewed him 55 minutes regarding DMS and other teledermatological projects. At the same month, I also interviewed an orthopaedician of UNN who is also associated with DMS project. In the month of

April, I interviewed a project member of 'Show Window' project to know why their teledermatological services were non-sustainable and to know about 'Well Communicator'. I used voice recorder and research diary in most cases of interviews. In April 2008, I visited Sonjatun, Nordreisa. Sonjatun is the local hospital of DMS Nord Troms. In one interview, I used only my research diary to take note. From the above interviews, five interviews have been transcribed.

3.3. Reflections on method

According to the second principle *'Principle of Contextualization'* of interpretive filed research, the field research requires critical reflection of the social and historical background of the research settings (Klein et al., 1999). I have chosen the given efforts (projects) as past evidence, more specifically for DMS, at the middle phase of DMS project. So many of the parts including historical background of five projects, at first couple of months, were unknown to me. But I was on the way to follow the suggestions of Pettigrew (1987) that it is very important to study the content, context, and process of organization changes when researching business or organization work strategy and its implementation. Harper (2000, p.241) also argues that for 'uncovering the organization' it is very important to study the system design by an adequate field work programme, for instance, ethnographic research and the information life cycles of the given organization.

In case of getting access or involvement to this project, I was formally introduced with project manager in NST. When project manager discussed the running DMS project, it was interesting to me. My supervisor was also present at that introducing day. The project has been constructed in a new dimension in the field of teledermatology, as manager claimed. I was really thinking at that time that I should learn some important telemedicine projects, as I have future plan to be engaged in initially-started-telemedicine project in my country, Bangladesh.

After three interviews, I recognized myself that I should change my interviewing-pattern. I should be good listener with common sensitivity. Generally, I used a voice recorder for interview

recording all time. It is a very good device for re-listening the interview. As, audio voice recorder does not express the emotional expression and reflection clearly, so during interviewing, my observation-and-sensitivity eyes were open and enquiring (Robson, 2002, p.167).

In case of flexible research design, according to Robson (2002, p.166), the project starts with a single problem that the researcher seeks to understand. This statement completely relates to my research. If I get some clues or findings to solve the problems of previously non-sustainable teledermalogical approach, my research may be, then, helpful for future users, vendors and others.

Another reflection on methods is concerned with validity of my findings or research. Because validity of interpretation of any type of qualitative research is contingent upon the 'end product' (Mason, 1996). In relating to this, I had a presentation and discussion with my supervisor to validate the interpretation and ongoing methods so far done.

After then, within couple of months, I interviewed some of relevant persons to the five efforts. At first four or five interviews, I was just asking questions regarding the beginning events of individual projects. As Harper (2000) says that programme of research means setting out to understand the circumstances in which some set of activities occurs – the circumstances that will give those activities meaning. In addition, he also argues that description of the understanding should be rich and detailed enough to make some observed behaviour understandable. I think, according to Harper (2000), at this phase, my roles are to map out the main processes of DMS, understand the diversities of work within DMS project, to understand how different sets of actors depend upon one another. I really agree with Johnson's (1978) argument that, probably, all modes of scientific research involve participant observation. I do also believe that, according to Walsham (1995), it is important for the interpretive researchers to have a view of their own role in the complex human processes.

During the time of interviewing, I should admit that I was getting difficulties with the conversation. Probably, if I would know Norwegian language, then the interviewee's emotional expression would be perfectly clear to me. I have also some reflections on being a student from

Bangladesh in a Norwegian setting. In Bangladesh, a student has to face a lot of problems in case of empirical data collection. In Bangladesh, sometimes interviewee does not give enough time to a student. But here in Norway, each and every interviewee is very cooperative and helpful to a student. When I visited Nordreisa municipalities, in a single word, I got a grand reception from the medical centre authority. I really surprised to see that a leaflet including my name had been distributed all personnel of the centre stating that 'A master student (citizen of Bangladesh) of Telemedicine of University of Trosmø is coming to our centre to see the real telemedicine practices.' They did a whole-day programme for me. I visited different departments with some people to have a look about their on-going activities.

During the assessment of previous related projects, in my observations, I found, several problems were involved in the previous related projects prior to starting DMS. According to Harper (2000), I do believe that ethnography can be a part of evaluating systems and may be involved to re-examine previous study of the workplace. In videoconferencing between UNN and Kirkenes or Hammerfest Hospital, the skin image could not be shown in videoconferencing system, as it is enclosed at email. In 'Show Window' project, there was no link between Well Communicator and EPR system of hospital. So the specialists could not see images in the records of the patients. Alternatively, DMS project involves skin image transmission in another way where the specialists could see the images during videoconferencing system simultaneously. In addition, Norwegian Government suggests to provide continuity of care for patients and clients through electronic services focusing on step-by-step advancement (Te@mwork 2007). For decentralizing the specialists health care services in four small municipalities, a body of allies, consisting of human and non-human (Walsham, 1997), has been created in this project. So, they have developed the information infrastructure in a new approach. Now, I have clear ideas, why so many transformations have been happened in teledermatological services in North Norway.

Of course, some issues strike me in the sense that in DMS, if an emergency case, the given X-ray department is busy with other task (rather than patients of DMS), then what will be fate of emergency image transmission. The videoconferencing unit is one in number. The same videoconferencing unit is being used in teledermatological and teleorthopedic purposes. If, in emergency cases of teledermatology, VC unit is busy with teleorthopedic purposes, then what

will be the fate of teledermatology consultation. Are the nurses involved in DMS properly trained to conduct patient and videoconference system handling? Who will deal the legal issues of this project? My feelings are that they should be considered in such type of project.

My another reflection is that in the case study research, researcher should become inside observer, if it is possible, because 'outside observer role preserves more distance from the personnel in the field organizations' (Walsham, 1995). However, Walsham (1995) again argues that inside observer sometimes may be debarred from the access of confidential data whereas personnel from organizations frankly express their views to the outsider that makes a relationship of trust. This concept also reflects the main theme of the third principle namely 'principle of interaction between the Researchers and the subjects' in case of interpretive field research.

From my methods work done, I could understand that I was working as an outside observer. But my visit to DMS area had made an interactive bridge between me and the users of current form of teledermatology. In conclusion, what I was getting the generalization from this interpretive research is that it would contribute the rich insight for me - realizing the difference between plans and practical actions of a project (Suchman, 1987).

4. THE CASE STUDY

4.1. Organizations involved

4.1.1. Norwegian Centre for Telemedicine (NST)

The Norwegian Centre for Telemedicine is a centre of research that congregates, produces and disseminates knowledge about telemedicine and e-health services, both in Norway and internationally. It is located in Tromsø, Norway. Tromsø city is situated at latitude of nearly 70 degrees north. Sometimes Tromsø is called 'Gateway to the Arctic and capital of Northern Norway'. The most important driving force for the pioneers who were involved in developing a telemedicine community in Tromsø was made up of two factors: the widely dispersed population and the shortage of medical specialists (adapted from: http://www.telemed.no/index.php?id=444 3190).

The main goal of NST is to ensure the integration of telemedicine services (www.telemed.no) in Norway including all over the world. Together with several partners, the Norwegian Centre for Telemedicine is building a scientific environment within the area of telemedicine and eHealth services. The vision of NST is to ensure high-quality health services for everyone, regardless of time and place. The brief history of establishment of NST can be described as follows:

The telemedicine operations in Norway, more specifically in Tromsø, started with Norwegian Telecom (Telenor) R&D's activities at the end of the 1980s (Breivik et al., 2006). In 1987, a telemedicine department was established at the research unit of the Norwegian telecommunications administration in Tromsø with the following collaborative partners: Tromsø Regional Hospital (now the University Hospital in Tromsø), the independent research institute Norut IT, Kirkenes Hospital and Troms Military Hospital. In 1993, The Norwegian Centre for Telemedicine was established as a department of the University Hospital of North Norway in Tromsø (www.telemed.no). The activities of Telenor were continued through the establishment of a telemedicine department, the Norwegian Centre for Telemedicine (NST), by UNN in 1993. Telemedicine case studies, probably in more experimental way, were initiated in dermatology, pathology, ENT, psychiatry, and cardiology using videoconferencing equipment with additional special equipment. At that time, most of the projects continued as routine services. Telenor

withdrew its research support but the activities were continued through the establishment of NST (Elford, 1997).

Norwegian authorities designated the Norwegian Centre for Telemedicine as a national centre of expertise in telemedicine in 1999. In 2002, The Norwegian Centre for Telemedicine was designated as the first Collaborating Centre in telemedicine by the World Health Organization (WHO). In 2003, The Norwegian Centre for Telemedicine established regional offices in the regional health authorities of Central Norway (Trondheim), Western Norway (Bergen), Southern Norway (Oslo) and Eastern Norway (Oslo). In September 2004, the Northern Norwegian Health Net Ltd. was established. With the advancement of the Norwegian Health Net and telemedicine service in Northern Norway, NST has emphasized on developing and implementing telemedicine services in the other health regions nationally and internationally. In 2006, The Norwegian Centre for Telemedicine was designated by the Research Council of Norway as a "Centre for Research-based Innovation" (SFI), and Tromsø Telemedicine Laboratory was established as a research project with the University Hospital of North Norway, through the NST, as its host institution (www.telemed.no; Elford, 1997).

At present, in NST, the educational backgrounds of the staff include: medicine, nursing, information and telecommunications technology, computer science, social science, economics, law etc. Most staff are involved in the design and accomplishment of new telemedicine projects. A few are responsible for helping maintain, monitor and evaluate telemedicine activities that were initiated by Norwegian Telecom Research (Elford, 1997).

With the advancement of technology and contribution of Norwegian Government, NST has become a huge organization for telemedicine services. The foundation of NST's knowledge source has been acquired through development projects, experience and scientific education. Being a project based organization, NST can provide huge project and research based knowledge that can be an important goldmine for those seeking info about telemedicine and e-health services. The Norwegian Centre for Telemedicine strives for user participation in all development work related to patients. NST defines users as an important resource in its research. NST, during the last ten years, has produced several companies and a lot of new healthcare

services as spin-offs from their research activities. The mentionable companies name for such type of example are: Well Diagnostics AS and Norwegian Healthnet (www.telemed.no).

An organizational chart for Norwegian Centre of Telemedicine is given below (Figure 1):

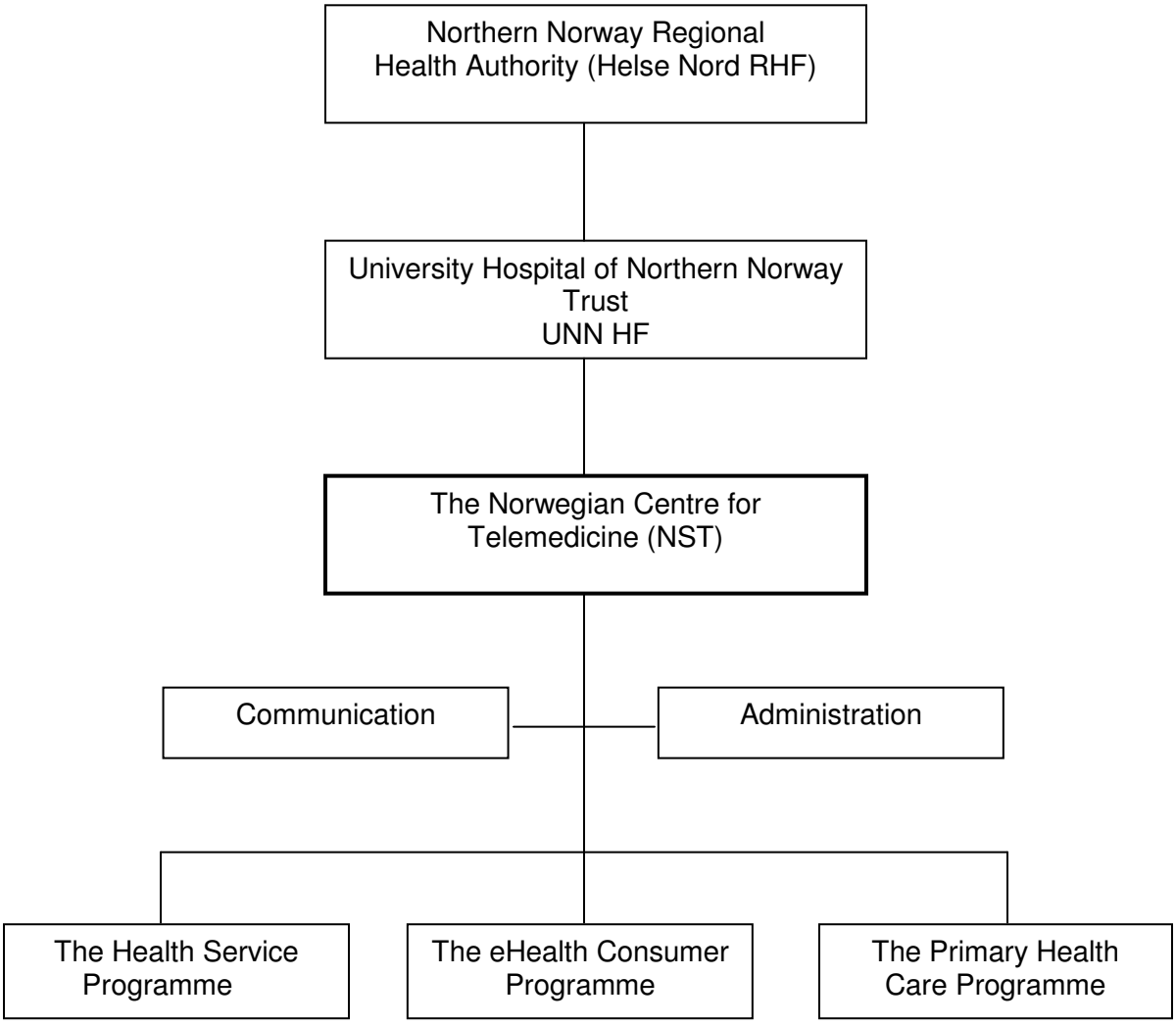

Fig. 3: Organizational chart for Norwegian Centre of Telemedicine (Source: Breivik et al., 2006)

4.1.2. University Hospital of North Norway (UNN)

The University hospital of North Norway (Norwegian: Universitetssykehuset Nord-Norge) or UNN located in Tromsø, Norway, is a hospital and health trust and part of the Northern Norway Regional Health Authority. UNN is the regional hospital of the northern health region. The University Hospital of North Norway plays a very important role in case of teledermatology services in North Norway. University Hospital of North Norway provides special health services that are needed for their patients. It is located in Tromsø municipality. There are 619 beds in the hospital and since 1st of January 2007, hospitals in Narvik and Harstad have become a part of UNN (www.unn.no).

The University Hospital of North Norway (UNN) is one of the 5 trusts under the umbrella of the Northern Norway Regional Health Authority. The Health North HF was established on January 1, 2002 when the central government took over the responsibility for the hospital services from the county councils. Likewise, The Royal Norwegian Ministry of Health and Care Service owns the Northern Norway Regional Health Authority. According to Elford (1997), The UNN is the referral centre for the most northern region, Health Region 5. The region is composed of the three most northern counties Nordland, Troms and Finnmark and is the largest health region in the country (113,000 km^2) and the least populated (475,000). The UNN is located in the town of Tromsø (population 60,000), approximately 600 km north of the Arctic Circle, making it the world's northernmost university hospital. Most medical specialties are represented, but staff turnover is high. Because of the size of the region, mountainous zone, most patients have to travel long distances to the hospital and often air transport is the only communication option.

NST belongs to the umbrella of University Hospital of North Norway. UNN has taken part in lots of the past and running research and telemedical projects of Norwegian Centre for Telemedicine. The major referral centre in northern Norway, the University Hospital of North Norway, has been involved in a variety of telemedicine activities since the late 1980s. Many of the departments in the hospital regularly use videoconferencing to conduct remote medical consultations and for education and meetings. From June 1995 to June 1996, 334 videoconferencing sessions were conducted at UNN, with 2715 participants (Elford, 1997).

4.1.3. The local hospitals in the region

As local hospitals, Kirkenes Hospital and Hammerfest Hospital are involved in teledermatology project. The distance of Tromsø-Kirkenes is 900 km and Tromsø-Hammerfest is 550 km.

Kirkenes Hospital is one of the two hospitals in Finnmark, and is a local hospital for the eight municipalities of East-Finnmark. Patient basis is about 28000. The hospital covers the whole region with regard to rehabilitation, and has 86 sleeping accommodations. Kirkenes Hospital has a reception department with an acute medical communication centre (AMK) for East Finnmark (http://www.kirkenesgateway.no/english/services-publicserv.html). Hammerfest is a city and municipality in the county of Finnmark, Norway. The municipality encompasses parts of three islands such as Kvaløya, Sørøya and Seiland. Hammerfest hospital is one of the two hospitals in Finnmark.

4.2. Teledermatology in North Norway

In case of telemedicine or e-health services in dermatology, videoconferencing system plays an important role. Later on, still skin image transmission has been emphasized via email technology due to difficulty of strict consultation-schedule maintenance and image quality of VC system.

We can divide the teledermatology services of Norway into five periods (Table 1):

Categ-ories	Year (starting to onwards)	Name of Project	Characteristics	No. of transmissions	Finance
1	From 1988 (and from 1996) to onwards	VC-based teledermatology between UNN and Kirkenes Hospital (from 1988) and Hammerfest Hospital (from 1996) to onwards	- Videoconference between specialist and general practitioners - Experimental efforts	Nearly 800 patients were examined in 1999; 200-280 the last 6 years (Kirkenes), Hammerfest 160-200 (in total)	200,000 NOK; money provided by Telenor and Govt.
2	1999 Jan. – 2003 Dec.	'The Show Window' still image transmission project	- General physicians transmit still images to Specialists - Mobilizing GPs	Total 770 transmission including 291 transmission (2005 to mid 2007)	4 Mill NOK; funded by Ministry of Health
3	2003 Feb. – 2004 Feb.	Kroken project or 'Connecting a nursing home to GP and hospital by using Electronic Communication in a dedicated network' (Abelsen, 2003) followed by 'SES@m Tromsø' project .	- Nurses in nursing homes transmit still images to trained nurses in hospitals - Searching for new user groups	Almost no transmissions of wound pictures	Approx. 20 Mill. NOK; funded by Directorate for Health and Social affairs
4	2005 Jan. – 2007 Dec.	Eczema counseling over the Internet	Internet based counseling between Specialists, eczema patients.	115 emails, 56 images from patients upto August'06	3 Mill NOK for 3 yrs; funded by Helse Nord
5	2006 Jan. – 2007 May	'Telemedicine as an aid in district medical centre (DMS) Nord-Troms' project	- Patients and nurses directly communicate with specialists via Videoconference - An integrated approach; the hospital in control	4-8 per month, if 7 to 8 patients are present	1 Mill. NOK; funded by Helse Nord RHF

Table 1: Teledermatology in Northern-Norway from the late 1980s onwards

Here I will present the five efforts consequently:

4.2.1. VC-based teledermatology between UNN and Kirkenes & Hammerfest (1988 onwards)

The main motivation of this initiative was quite experimental. Telenor (mostly known as provider of mobile communications services worldwide) was contributing quite a lot with its R&D department to get this things established. Previously Telenor was known as Norwegian Telecom.

According to a project member,

> *"At that time (at the mid of 1980s) Telenor had a lot of money. And there was great freedom for the persons working there to choose what they wanted to do; The company set up a number of videoconferencing studios for distance education and meetings. And in 1986 they launched a large project for providing health care services in Kirkenes from UNN. At first phase, just they wanted to try it, if it could be done." (Project Member)*

The first use of videoconferencing for medical purposes was in 1986, for the Telematics in the Health Service of Finnmark Project. The sponsors included Norwegian Telecom, NORUT (The University of Tromsø Research Foundation) and the Finnmark county health authorities. A videoconferencing system was used to link the county hospital in Kirkenes to UHT (later the name became UNN), approximately 900 km apart, for medical education, professional meetings and remote consultations (Elford, 1997). And Telenor authority saw that they could spread their competence more and decrease the needs for traveling of the patients. Probably they were interested in telemedicine to spread their technological competence with the purpose to provide health care services.

Norwegian Telecom Research realized that the development and carrying out of telemedicine required cooperation between the fields of medical informatics, health services and telecommunications, and an interdisciplinary research group was established. A number of medical opinion leaders from UNN were identified and supported. Telemedicine pilot projects in various medical specialties were initiated (e.g. dermatology, pathology, radiology, ENT, microbiology, psychiatry, gastroenterology and cardiology). Often, particular equipment had to be added to the videoconferencing system or custom designed to capture the necessary pictures and video. Most of the pilot projects found that telemedicine could effectively deliver medical or health services at a distance and the majority continued as routine services (Elford, 1997).

In case of experimenting of teledermatology, this type of teleconsultation consists of UNN and the local user (here, general physicians of Kirkenes and Hammerfest). But at that period there were two types of technological challenges, such as, network and large camera.

> *"The network was of large number of ISDN lines; at the most 24 lines and packages transmitted. It was a lot of experimenting. And there was no small camera at that time. They could not connect them to the equipment, to the VC equipment; It is still image camera. But it has the possibility to transmit still image with VC between Kirkenes and Tromsø. It was a large camera. It was mounted on the wall. With the arm it can be taken around to take images of the patients. Technology was the great challenge getting the VC equipment to link together with camera. They got the camera from American Medical Department (AMD). It costs 50,000 NOK." (Project member)*

Moreover, all videoconferencing was conducted using codecs conforming to H.120 standards and transmitted over a special 2 Mbit/s network, 'Meganet', maintained by Norwegian Telecom. Video resolution was 256 x 288 pixels, in 24-bit colour, refreshed at 25 frames/s (Elford, 1997). According to a project leader:

> *"At that time (before 1994), in videoconferencing, the challenge was quality of image and expense of Meganet. Meganet was a special type of network designed for special purposes. But it was huge expensive." – (Project leader)*

Since 1994, all video codecs had been developed to conform to H.320 standards, and since mid-1995 all systems connect using dial-up lines over an Integrated Services Digital Network (ISDN). All remote telemedicine consultations were conducted using a 384 kbit/s link, with a video resolution of 352 x 288 pixels, in 24-bit color, refreshed at 25 frames/s. Some sites had the capability to confine still images with a resolution of 702 x 576 pixels, in 24-bit color. At most sites, 27-inch (69 cm) monitors are used to display the incoming and outgoing video (Adapted from Elford, 1997). ISDN was comparatively cheaper and had of higher accessibility. ISDN gives the necessary flexibility by using a collection of basic access and primary rate access. The primary health services need for communication both to local hospitals and in the home-based

care, basic access offering two 64 kbit/s channels (B-channels) in the majority of cases give sufficient competence for the applications we see today. For telemedical or e-health services between hospitals the flexibility will be secured by primary rate access (30 B-channels). In a complete "health network" it is also necessary to incorporate mobile communication, especially in cases of catastrophes (Nymo, 1993).

Teleconsultation within dermatology started in 1988 (someone stated, in 1989) between UNN and Kirkenes Hospital. In 1996, UNN established teleconsultations with Hammerfest Hospital. Both remote hospitals set up teleconsultations once a week, normally with 10-12 patients, with dermatology department of UNN. These consultations last for 2.5-3 hours all-together. Additionally, specialists travel from UNN to Vadsø six times a year. Both Kirkenes and Hammerfest hospitals have equipment for treating dermatological diseases and are able to offer their patients treatment locally. In 1999, nearly 800 patients were examined via videoconferencing between UNN and Kirkenes and Hammerfest (Hartvigsen, 2006). The purpose of the project was to demonstrate the feasibility of teledermatology and to determine whether the quality of consultation was sufficient to replace the existing visiting dermatologist service. Previously, a UHT (later on UNN) dermatologist would fly to Kirkenes once a month to conduct outpatient visits (Elford, 1997).

In case of VC consultations, patient and GP or other health personnel meet with the specialist through VC (Figure 4 and Figure 6). The GP and specialist would work together to take a decision at the diagnosis and then the dermatologist would suggest a treatment. According to Elford (1997), from 1989 until 1993, teledermatology consultations occurred monthly between Tromsø and Kirkenes, with five or six patients seen at each session. In 1993, the hospital in Kirkenes bought a phototherapy machine, permitting patients to receive phototherapy locally rather than travelling to Tromsø. Although phototherapy is relatively uncomplicated and lasts only a few minutes, it has to be done daily and also requires the patient to be seen a number of times by a physician, usually once a week for a few weeks. Previously, this required the patient to travel to Tromsø for 10–14 days at a time, and go to the hospital to receive phototherapy every day. Telemedicine allowed patients to stay in Kirkenes and continue their normal activities,

going to the local hospital only for daily light-treatment and for weekly videoconferences with the dermatologist.

> *"Now (2008) we have good facilities in Kirkenes, we have new equipments, close up cameras, but we are not so confident in new patients because they need diagnosis. But it is very good system for follow up the old patients." (Dermatologist)*

Since 1993, teledermatology clinics (consultation) have been conducted on one afternoon per week, with 12–15 patients seen during each session. Around half the patients are new referrals and the other half are on follow-up visits. Normally, a clinic lasts 2.5 hours. Four dermatologists take turns to conduct the teledermatology clinics, and the same GP is involved in all consultations. A teledermatology consultation is now usually possible within a few weeks, compared with four to five months for an in-person referral. Patients who have skin conditions that are particularly difficult to diagnose or treat or that need an inpatient procedure (e.g. a special biopsy) travel to UNN (Adapted from Elford, 1997).

The following figures show videoconferencing unit in use and the images of skin wounds via videoconferencing unit:

Fig. 4: Videoconferencing unit in use. A small digital camera, seen mounted on the top of the unit. (Source: Eedy et al. 2001)

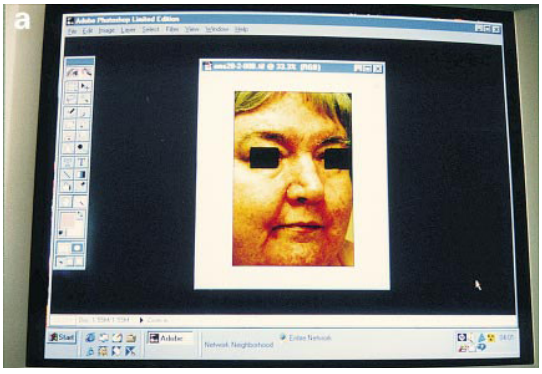

Fig. 5: Image sent via e-mail by GPs ((Source: Eedy et al. 2001)

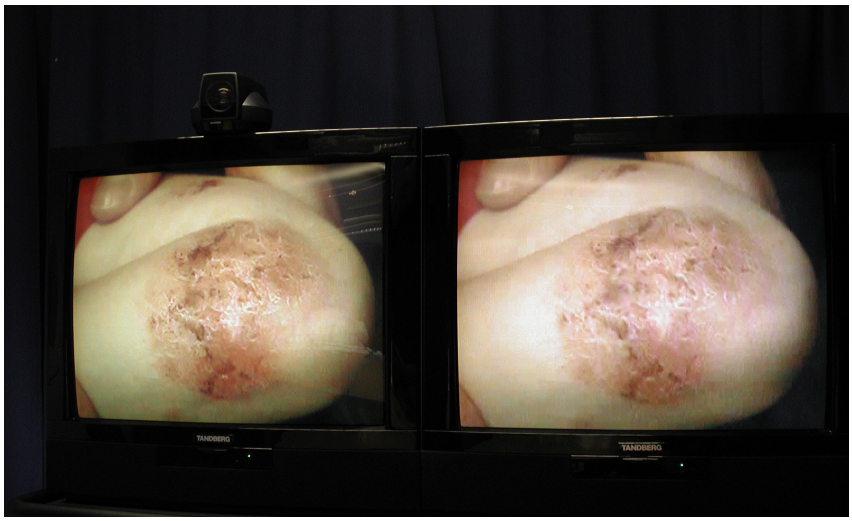

Fig. 6: Images of skin wound with two different imaging contrasts (Source: Dagfinn Moseng, Dermatologist, UNN)

Videoconferencing was found to be an effective way to deliver health services at a distance. Yet many physicians stated that for most consultations it is not necessary to have interactive video and it is inconvenient to schedule (Breivik *et al.*, 2006). So, NST started to develop services where information was transmitted using e-mail technology (Figure 5) or transmission of still image via one type of transmitting software.

In spite of the experience of the dermatologists have been overall positive, there have been feelings that "something is missing" in this kind of examination. Even though the patient may be pleased with the consultation, the specialist may feel the loss of some significant social aspects between patient and doctor. The specialist may feel there is no natural conclusion to the consultation. The diagnosis procedure is done collaboratively between the GP and the specialist. In addition to making a diagnosis and proposing a treatment for the patient, the dermatologist transfers some of his knowledge to the GP. In this way the GP increases his level of knowledge through use of telediagnosis. The service is now in ordinary use between the local hospital in Kirkenes and UNN (http://www.tft.tele.no/telemedisin/telektronikk/art4.html).

4.2.2. The 'Show Window' still image transmission project from Jan. 1999 to Dec. 2003

The project was funded by Ministry of Health, Norway with 4 million NOK with the motivation for mobilizing the users of health care services. The Ministry of Health had the genuine hope that such type of project was economically feasible with the given amount of money.

> *"In 2000, department of dermatology got one studio with the help of this fund for starting to receive still images. The costs of the studio was 200,000 NOK" (Project Member).*

There was a need for a secure Healthnet for these services and for the exchange of information in general. To meet this need, a project was initiated to set up the Northern Norwegian Healthnet as a regional intranet for all the health care institutions in Northern Norway. The Northern Norwegian Healthnet Ltd. was the initial step for the national health net (Breivik *et al.*, 2006). To say about the main drive and motivation of 'Show Window' or (in Norwegian, **'**Utstillings vinduet' project, a project member said that:

> *"It was the period of interesting and doing something new, and period of trying to get technology to work, in clinical work in some ways and the way to make the services for everybody" (Project member)*

The vision of this project 'Show Window' was to study the involvement or enthusiasm of general practitioners for sending still image via Well Communicator. The metaphoric words *Utstillings* and *vinduet* have come from Norwegian language. It means the shiny and nice window of a shop through which customer or passers-by can see the different dummy views of on-sell-products.

> *"I think the main objective was to get as much traffic as possible in the Health Net" (Project member).*

The four project members made appointments and recruitment of GPs. Four project members were traveling around Northern Norway for installing Well Communicator software and camera

on their systems and at the same time they taught GPs how to use software and camera. In 'Show Window' effort, still image was being transferred by general practitioner to specialist (UNN) via 'Well Communicator' software using Norwegian Health Net.

The figure 7 shows the main window of the Well Communicator. And the figure 8 and 9 show the wound-template without and with image attachment.

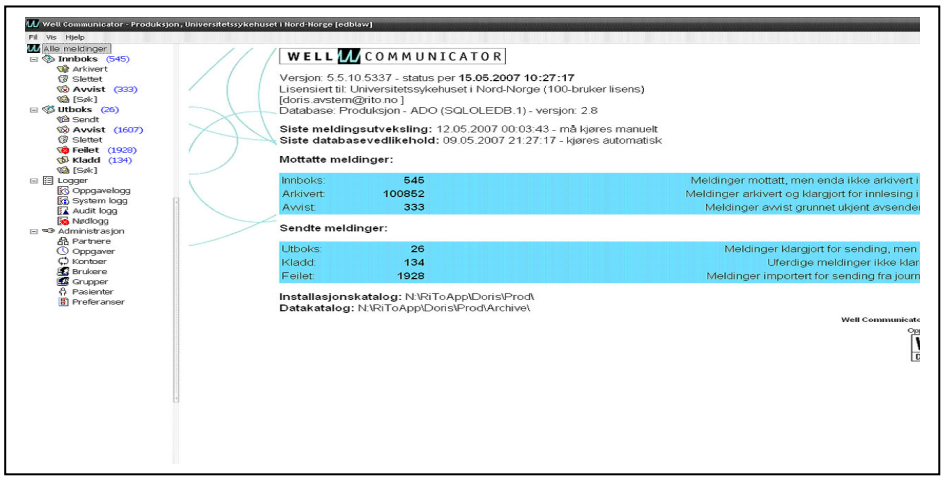

Fig. 7: Main window of Well Communicator

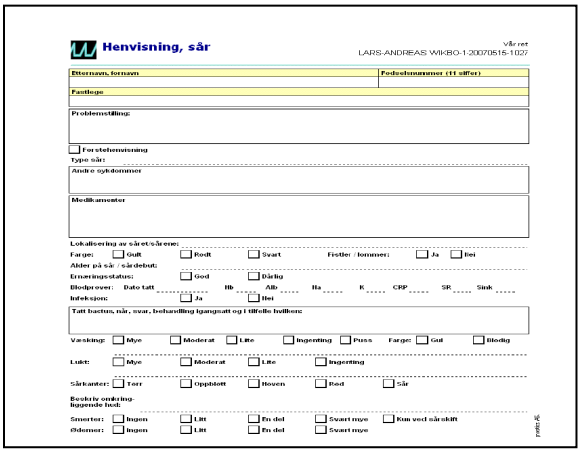

Fig. 8: Wound-template without attachment

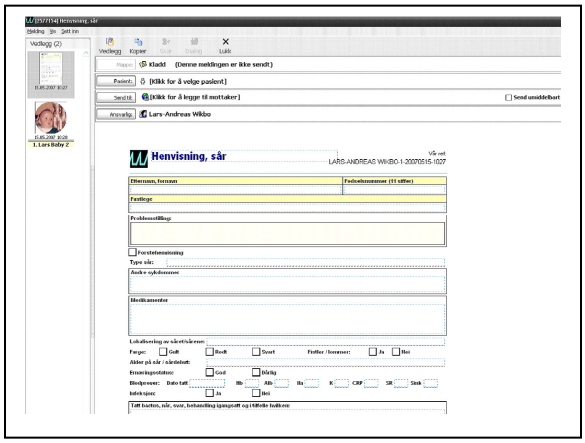

Fig.9: Wound-template with image attachment

In this project, 90 general physicians were offered 90 digital cameras (Figure 10) to take image of dermatologic case and asked to send the image to specialists via Well Communicator. All

services were free for the general practitioners. Helse Nord gave the Northern Norway health network free for them.

> *"90 cameras were bought. And 90 licenses of the Well Communicator Programme were bought. We were travelling around to install the programme to all GP offices. I think, 180 GPs offices are in Northern Norway. We provided the facilities to half of them" (Project member)*

Fig. 10: Camera for taking the image of dermatologic case

After two years from the beginning of the project, only 10 physicians were using this service. In that case there was no link between Well Communicator and EPR system of hospital. There were a lot of challenges involved in that project, such as:

> *"Monitoring was not proper, probably, because of a large number of GPs involved, but the project members were only four in number; moreover GPs were not reimbursed for that extra services and some doctors were reluctant to take the skin images of the patients" (Project member)*

Again according to project member,

> *"I should mention that still some doctors from Kroken area are using such type of services" (Project member).*

According to dermatologist,

> *"In Norway, general physicians are practicing their profession privately. So they didn't want to spend their valuable time to take pictures of images of patients. Probably they thought that it was hazardous work to take picture and send them to specialists via well communicator. They are not getting reimbursed for their extra time used" (Dermatologist)*

According to dermatologist of UNN, young doctors got very interested in and they were very enthusiastic about this matter. But for older doctors (GPs), it was the opposite phenomenon. There are some activities in this project are still being continued but maybe mostly for follow-ups of known patients.

4.2.3. Still pictures transmission from nursing homes (Connecting a nursing home to GP and hospital / Kroken Project)

The project was funded by Directorate for Health and Social affairs with the motivation to provide the services for everyone and to find the new users of health services. In this project communication between nurses are involved at both ends instead of specialist-GP communication. The title of the project was 'Experience of connecting a nursing home to GP and hospital by using electronic communication in a dedicated network'. In short it was named as 'Kroken Project'. The Kroken project started in January 2003, and was initiated on basis of a national strategy – plan for introducing the use of information and communication technology (ICT) in the health care sector in Norway. The plan is called "Si@!". The project was in cooperation between NST, UNN and Kroken Sykehjem (Nursing home) in Tromsø municipality. Here electronic communication between nurses of Kroken Sykehjem and nurses of hospital was involved.

According to Abelsen (2003), the project was also based on the fact that the part of the healthcare system who take into care elderly people, traditionally don't have access to ICT-

solutions. This part of the healthcare system is often organized by the municipality, while the GPs are independent and the hospitals are owned by the state. Such different way of organising the healthcare service demands different solutions for communication between the sections. The purpose of this project was divided into four parts, such as:

- To establish and try out an electronic communication between a nursing home and a GP
- To establish and try out an electronic communication between a nursing home and a hospital
- To establish a kind of policlinic for professional assessment of sores and ulcers.
- To design a model for implementation of this kind of ICT solutions in the municipal part of the healthcare system (Abelsen, 2003).

The project time was planed to be one year. The main difference between the 'Show Window' project and Kroken project within the communication setup between EPR and Well Communicator. In Kroken project, there was a link between Well communicator software and EPR system of the hospital. Kroken project was converted to 'SES@m Tromsø' project after one year. According to the Project Manager,

> *"Within the one-year time frame, we understood that the result was interesting and we escalated the services by introducing the same solutions to other institutions and into the home care services in the municipality. Finally it created a larger project namely 'SES@m Tromsø' for the period of January 2004 to June 2006" (Project Manager)*

The main objective of 'SES@m Tromsø' project to improve coordination and continuity in the health sector by secure electronic collaboration (SES@m Tromsø, 2007) with the inclusion of home care services. More elaborately, it can be said that the objective is to improve the coordination and continuity in the health sector and contribute to harmonized and integrated services, emphasizing the quality and continuity through electronic interaction between various units and levels in the heath care sectors (Project Leaflet, SEA@m Tromsø). The given project period was from January 2004 to June 2006 and the given budget was 2.5 million Euro (approx. 20 million NOK). The different actors involved in this project are given in the figure 11:

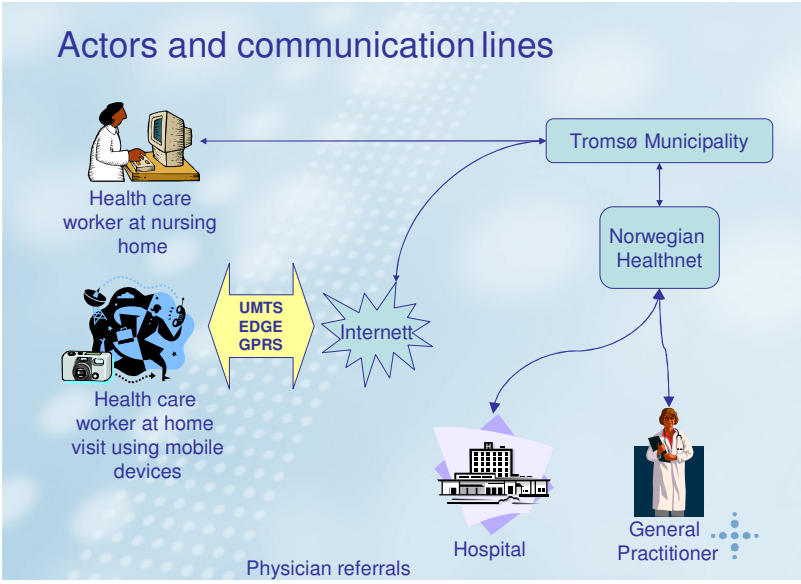

Fig. 11: Different actors involved in 'SES@m Tromsø' project (Figure modified, Source: http://www.eisco2005.org/fileadmin/files/eisco2005/BPs/Rotvold_Gunn-Hilde/02_Rotvold_Hilde_1.pps#277,8,The SES@m Tromsø's Telemedicine services)

In Kroken project Well Communicator software was used and in 'SES@m Tromsø' project Well Arena was being used as software. Figure 12 shows the picture of Camera used in 'SES@m Tromsø' project to take the wound skin image.

Fig. 12: Camera and laptop used in 'SES@m Tromsø' project (picture source: NORUT Samfunnsforsking AS i samarbeid med najonalt Senter for Telemedisin, Rapport nr 11/2005)

According to the project manager

> *''SES@m Tromsø' project is still working well. And now the project is being handled by Tromsø municipality' (Project Manager)*

However, there is no use of still image transmission in this project. Later on, the SES@m Tromsø' project has been extended to some extent as 'Wound Clinic' project which is still running on. Regarding wound counseling, project-involved persons do a good job for those patients that are involved, but the challenge here is to get patients involved, get the homecare nurses to use it, and the difficulties of having a broad specter of diagnosis. The project has only two diagnostic units to be able to do a good job.

4.2.4. Still picture transmission from the patients and public in case of eczema

The concerned motivations of the project were: to include another type of new users (public/parents in case of kid's eczema) of health care services; to survey if internet based counselling directly home to the parents of children with atopic eczema leads to improvement of the children's health, and if the parents feel increased management of their children's disease; to find out if such counselling will lead to fewer doctor appointments and hospitalizations; and to know whether it will reduce the costs for the families involved (Solvoll et al., 2007).

In case of 'Eczema counselling over the Internet' project parents of kids with eczema can transmit skin images to specialists of UNN via Well-Arena software developed by Well Diagnostics AS (Figure 13). The very first idea of this project (utilizing ICT for treating and managing Eczema for children) was initiated by paediatrician at UNN in 2000, many meetings were conducted within the hospital and with IT staff of the UNN. In 2002 with collaboration of Norwegian Centre for Telemedicine and the paediatric ward at UNN a pre-project was conducted taking 4 children with atopic eczema and their families over a period of 4 months.

This pre-project was very successful, it proved that such offer is technically possible and the patients were satisfied. The project was going on very smooth, as there were no problems with the organizational point of view.

> *"These types of telemedicine projects are not only cost-effective and efficient way of health care services by providers, but also empower patients by giving more awareness about their disease." (Project Manager)*

According to the dermatologist involved in this project, eczema was chosen for this project for three reasons (proposed by the involved paediatrician):

> *"1. About 20 to 25 % of children population suffers from Eczema disease, especially in north Norway. This disease is very common in cold climatic conditions.*
>
> *2. As this is chronic diseases, continuous treatment and repeated consultation will be required from dermatologist for many years.*
>
> *3. If the treatment is started in early stage, lot of resources (medication, hospitalization) and pain of patients can be saved. Getting appointment from specialist at a right time (early stage) was a great problem, due to long waiting lists".*

Therefore, the paediatrician felt utilizing telemedicine tools would be good idea, for consulting Eczema patients via internet (Figure 13).

Fig. 13: Patients send photographs to the specialists at UNN. So they do not have to wait for an appointment with their local GP (Source: http://www.telemed.no/control-with-a-click.550701-42659.html).

Additionally, it was planned to scale up the project with three communities which are 50 to 100 kms far from Tromsø. Official paper work was done and project plan was submitted to higher health care authorities, information inspectorates, and Norwegian Research Council for funding. By the time they got permission from information inspectorate and funding from research council it was June 2005. They got permission and funding for this project for 3 years. The funding amount 1 million per year, so it would be 3 millions in three year period. And this project would run from June 2005 to December 2007. Security, confidentiality and quality of image were given utmost importance by Well Diagnostics AS, given software developer.

The technical solution makes it possible for the parents to send messages with photos and text in a predefined template to the Paediatric and Dermatology ward at UNN. Specially trained nurses and specialist would answer that message with advice concerning treatment adapted to each individual child. There was no limitation in how often or how many messages the families can send. The technical solution (Well Arena was used) met the demands of computer safety in the protection of privacy legislation. The families needed to have a computer, an Internet connection and a digital camera to participate in the study (Solvoll et al., 2007).

During implementation period the biggest problem was not related to technology or organizational aspects but it was of getting patients into project. The probable reason behind it

may be that eczema is seasonal diseases related to climate. Patients get relapsed of eczema symptoms more in winter in month between December to March. But the project has been started in the month of June.

As eczema is seasonal diseases related to climate, only in winters in months between December to March more patients would be consulting doctors due to relapsing of symptoms (Itching and redness), as the project was started (experimentally) by June 2005, the dermatologist had to wait till December 2005 for recruiting patients in project. According to him the project was going fine, upto August 2006 he had received 115 emails, 56 images from patients from 17 users, 2-3 patients were super users among them. He adds that

> *"Everyday work has been made easy, now patient can write their problems when they get time and I can reply them when I am free, usually I will check mails 2 -3 times per day, for emails requiring shorter reply I reply same time and for longer emails I will reply in evenings, so we use our time more effectively, me and my patients are satisfied with this system" (Dermatologist)*

The nurses who was recruited in this project, has learned the technical procedures very soon, and she had assessed to emails from patients, if doctor is out of town, or busy, she would manage to reply, if she was sure about the suggestion she was giving. If needed, she would contact doctor for clarification. Nurse was happy to work with new technology as she felt it is user friendly technology. The response received from patients was positive, patient found this project is saving waiting time to consult doctor, travel time and cost of travelling. They can send image of the infected area of skin at the earlier stage and can start treatment at the earliest stage. Patient even suggested for starting such projects for other disease as well (http://web3.custompublish.com/getfile.php/403077.357.xcextbxsdq/Eczema_counselling_via_the_internet.pdf?return=telemed.custompublish.com).

Moreover, in recent years, teledermatology has been extended to include services as the "Eczema school". Using hand-held cameras, parents of kids with eczema can submit pictures of their kids' eczema in order to receive guidance from nurses at UNN. In this case, the kids and their parents

do not need to travel to UNN (Tromsø). Also, parents are taught how to evaluate and treat the eczema, which gradually reduces the need to consult a specialist (http://www.v-chi.dk/shi2006/Webudgave_SHI2006_proceedings.pdf).

During interviewing, project manager told regarding future plans that they were waiting for the results of the evaluation of the project from the feedback of the patients, and would be calculating cost-effectiveness and satisfaction from doctors and patients, which was done at the end of the project i.e. December 2007. At the writing stage of this thesis paper, their calculation was under review and analysis.

Regarding sustainability and scaling up of this project, the project manager concludes:

> *"All depends on policy makers, higher health authorities and political leaders whether to continue this project or not, on the other hand, patients and health carers satisfaction is also important." (Project Manager)*

Here, it is easy to conclude that there is no plan to continue the given project.

4.2.5. Telemedicine as an aid in district medical centre (DMS)

The main motivation for the project is for the purpose to decentralize specialist's services and develop the community health services, sustainable local health region. The title of the given project or case is "Telemedicine as an aid in District Medical Centre (DMS) Nord-Troms". As the inhabitants of four municipalities are the inhabitants of Norway, so University Hospital of North Norway, Northern Norway Regional Health Authority and DMS all want these services to set up. UNN have, therefore, made cooperation with Kåfjord, Kvænangen, Skjervøy and Nordreisa for the development of district medical centre in Nord-Troms (DMS Nord-Troms).

I believe that DMS is a part of UNN. Because now it is acting as a local medical centre for the department of dermatology and orthopaedics of UNN. One nurse is getting paid 100% from UNN and another nurse is paid 20% from UNN.

A common factor for the specialists health care service for the population in these regions is long travelling distances (it is 314 km from Kvænangen and 240 km from Nordreisa to UNN), and a challenging climate. The Figure 14 shows the distances of four municipalities from Tromsø and the distances of Kåfjord, Kvænangen and Skjervøy with Nordreisa.

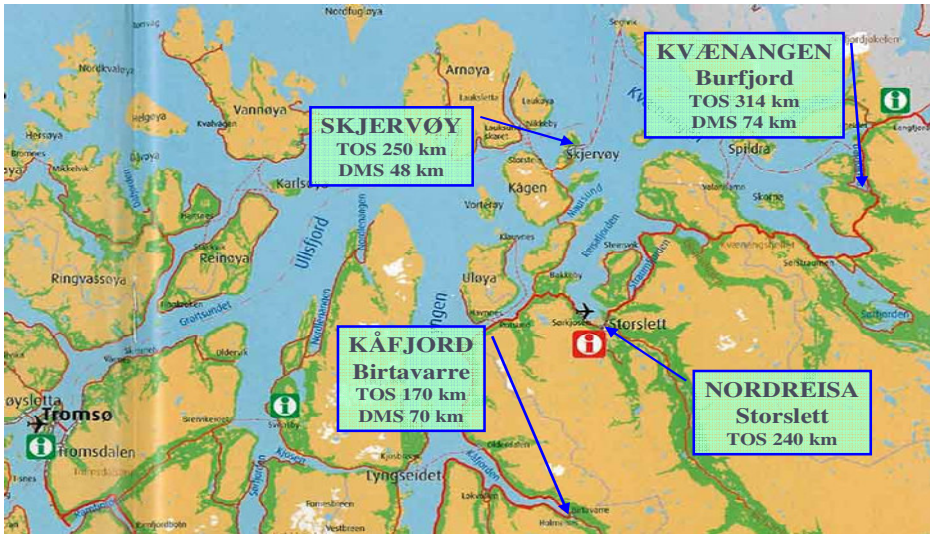

Fig. 14: Map describing the distance of four municipalities from Tromsø (Source: Project Manager, DMS)

The given project started 1 January 2006 and continued until 30 May 2007. After this period, the project is supposed to be extended on large scale. The project is supported by a grant of 1 Million Norwegian Kroner from the Northern Norway Regional Health Authority (Helse Nord RHF). The grant includes equipment, travelling and wages cost.

DMS centre is mainly located in Nordreisa, more specifically in a building namely 'Sonjatun'. 5 general physicians (GPs) and 5 nurses are working there. GPs are working as partially involved persons. There is a combined laboratory in this building. In Sonjatun, Nordreisa, there is a X-ray department. This department is working with DMS by special agreement. Nordreisa municipality is playing the leading role among four municipalities mentioned above. Patients from other three

municipalities come to Nordreisa to take their health care services in case of dermatologic problem, when light-therapy is needed.

To balance the teledermatology consultations being carried out using videoconferencing, a store-and-forward teledermatology service has been developed in DMS Nord Troms Project. The orthopaedic department mainly uses the high resolution digital X-ray system. But in our opinion, it is also possible to use this system in dermatologic case as well. The equipment used is a multimedia PC and a high resolution digital X-ray system. Pictures of skin lesions or bone fracture can be captured, text added to them and sent via secured email / dedicated network to specialists to be reviewed (Figure 15, 16, 17 and 18). In videoconferencing room, the image is transferred as well to a PC. This PC (used by nurse) is connected to specialist's PC via dedicated network. This system mainly can be applicable in wound treatment. An email message with an attached image can be sent by a nurse to a specialist for interpretation. The consultant / specialist responds by email, suggesting a specific therapy or recommend that he would like to see the patient via a videoconference (videoconferencing is situated in another room in Sonjatun). Only if needed the patient can see a specialist face to face in serious case. Of course, two dermatologists visit Sonjatun (Nordreisa) fortnightly and alternatively to see the patients with severe skin disorders face to face.

> *"When we get at least 7 to 8 patients, then we arrange a videoconferencing programme on predefined date" (Nurse, Sonjatun)*

Fig.15:Responsible nurse calibrating and adjusting system.

Fig.16:Digital X-ray system (A mobile set is on the bed demonstrating a patient)

Fig. 17: (From right hand to left hand): Mobile set image shown in Computer (Com)-1, Com-2 enlarges the image; Com-3 shows enlarged image; Com-4 and Com-5 for email message exchange between nurse and specialist or radiologist. When nurse confirms that image quality is OK, then S/he can send the given image to specialist (dermatologist) or radiology dept. of UNN via Com-1.

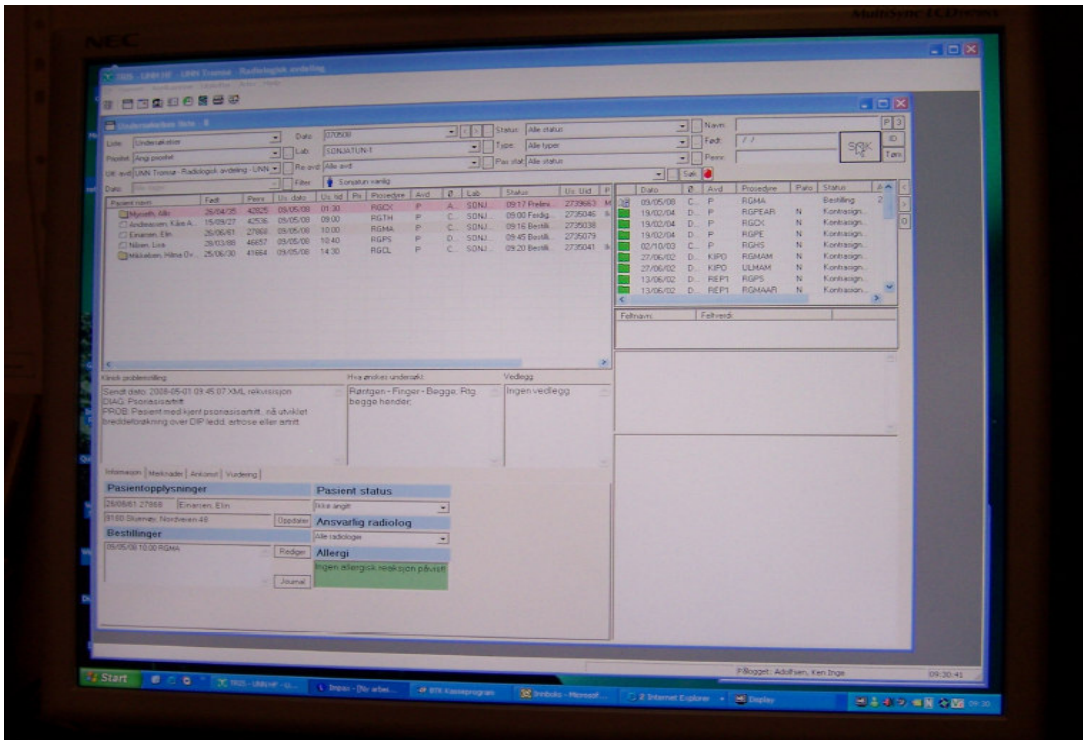

Fig. 18: Computer-5 screenshot in large size

The main role of DMS is to communicate with University Hospital of North Norway, Tromsø, if special health services are needed for their patients. Now they are communicating with only two departments of UNN such as dermatology and orthopaedic department. It is mentionable that Department of Radiology is involved partially in this project. But in the future the project has plan to encompass other departments such as department of ophthalmology, gastroenterology etc. The project has even plans to educate nurses and patients in the DMS area via videoconferencing system.

Both UNN and communities in DMS area has been viewing telemedicine as an important aid to develop good cooperation in DMS Nord-Troms. In future, the project has visions to encompass various municipalities of Hammerfest, Kirkenes and some parts of Verkhoyansk in Russia within the defined timeframe. This vision of this project will be named after BARENS 2020, which is a high ambition or vision of this pilot DMS project. Videoconferencing, a telemedicine tool, will

be employed to decentralize specialists' services and develop the community health services in those regions from UNN.

For this project, the specialist's services from UNN are provided via "videoconferencing" with Nordreisa, the main municipality which connects with other three municipalities. UNN has a well-functioning telemedicine service / centre with its high degree of competence. The four municipalities involved in this pilot project have no such types of mentionable specialist health care services of their own. In case of dermatology department, they arrange the videoconferencing systems when more than, for instance, 7 or 8 patients come to Nordreisa. According to the dermatologist's statement:

> *"Arrangement of videoconferencing is not fixed. It depends on the need of patients. Generally we arrange videoconferencing system four or five times a month" (Dermatologist).*

In DMS project, for dermatologic case, dermatologists have access to still pictures of a given patient via synchronous videoconference system. A special auto focus, auto-iris camera is attached to a codec of videoconferencing system. The camera transmits the images to codec of the videoconferencing system. Codec compresses and decompresses still and video images.

Fig. 19: Camera showing the back side of patient

Fig. 20: Patient showing her palm with skin disorder to specialist (in realtime, specialist will be shown on left-hand screen)

It also manipulates the audio information and ensures synchronisation of voice and image (Figure 19 and 20). In synchronous services, a further task is to control the interface between videoconferencing unit and the network and the peripherals. During interview, Project leader said that

> *'In future we will use EPR system for image transmission. At that case nurse will put the image of skin into EPR of the patient. In that case, specialist will see the still picture via EPR of the patient' (Project Manager, DMS).*

According to project manager and dermatologist, the two departments involved of UNN are actively providing their specialists health care services to the patients of Nordreisa, Kåfjord, Kvænangen, Skjervøy municipalities via videoconferencing systems. Patient and trained nurses consult with specialist via videoconferencing system. Nurses had been trained by dermatology department of UNN.

> *"I think, the DMS project was the best from two parts. Firstly, videoconferencing and transmission of still images were well established. Secondly, the hospital paid for nurses and Nordreisa kommune (for hiring nurses). The hospital also paid for the given room-rent of 'Sonjatun' bulding. Nurses were well-trained and financing is okay" (Project Member)*

5. DISCUSSION

Teledermatology consists of a great potential for revolutionizing the delivery of dermatology services, serving equitable service to remote areas and permitting primary care physicians to refer patients to dermatology centre of excellence at a distance. However, before its regular application as a service tool, its accuracy and cost-effectiveness, reliability needs to be verified by thorough evaluation. Teledermatology can be applied in one of two ways: it may be conducted in real-time, utilizing videoconferencing equipment, or by store-and-forward methods, when transmitted digital skin images are presented with a clinical history (Eedy *et al.* 2001).

In Northern Norway, several teledermatological services had not been sustainable, although at initiative stage, they had the main motivation to improve the health care services in the field of teledermatology. According to Berg (2001), the implementation of comprehensive information systems or telemedical services in health care practices has proved to be a path ridden with many types of risks, dangers and complexities. According to him, to implement a health care information system is a process of mutual transformation; the organization and the technology transform each other during the implementation process. In addition, the management of health care service implementation processes is a balancing act between initiating organizational change and taking information system as a change agent, without attempting to pre-specify and control the process.

Here I will try to discuss some of the problems as well as complexities associated with implementation and management process of previous teledermatological services. In addition, in this section, some potential challenges involved for mobilizing users will be analyzed. Mobilization of users is one type of networks of people and things. In this connection, actor network theory will be implemented to analyze such types of network. At this moment, it is very important to recall the research questions of this thesis:

- What is the content of teledermatological services from the mid 1980s onwards in North Norway?

- How can sustainable teledermatological services be established?

- How can we find out the actual strategy for establishing teledermatological services from the perspectives of different historical transformation?

5.1. The content of teledermatology changes

Within the two decades time-frame, in case of telemedicine of North Norway, a lot of changing pattern can be seen. In the beginning, telemedicine was associated with an experimental approach, and where the focus was on peer to peer communications between physicians only. Later on the notion of telemedicine changed towards telecare where nurses are involved on the other side instead of general physician and the telemedicine projects turned towards nursing homes, homecare services. Nurses of nursing homes transmit the necessary information or skin image to the trained nurses of hospital for proper interpretation where no longer physicians are involved. Of course, in severe cases, nurses in hospital contact with specialist for more interpretation or information.

Later on the notion of telemedicine changed towards e-health as mentioned in chapter two. Empirically this is supported by the eczema projects (health on the internet). In this case, e-health project includes another type of new users (public/parents in case of kid's eczema) of health care services; to survey if internet based counselling directly home to the parents of children with atopic eczema leads to improvement of the children's health.

5.2. The challenges of mobilizing users

In my opinion, so far I understood, although all first four efforts had high ambitions for developing the existing technology, but the concerned organizations were going to be incapable, like story of electronic calendar (Ehrlich, 1987; Grudin, 1988) to take the full advantage of technology, because some actors or users are not actively involved in this technology. The technological systems are complex and heterogeneous due to their components (Hughes, 1994)

and can be intractable if not brought in line or into the actor network system (Latour, 1987). So it is necessary to negotiate with each other in the system. Again, infrastructure within the process industry consists of many interconnected layers and has a high degree of complexity. This implies that it is difficult, if not impossible, to predict (or even detect) all consequences of a change in the infrastructure. The challenge is maintaining stability in the installed base in spite of continuous change and evolution. The installed base is stable in the sense that it is difficult (practically impossible) to replace due to its size and complexity. But, importantly, since the layers and elements in the infrastructure are interconnected and interdependent, it is at the same time fragile in the sense that one faulty part or incorrectly indexed table can do substantial damage and cause all kinds of problems (Rönnbäck et al., 2006). Here, in the beginning of negotiation phase of all five efforts, I found some discriminations or some isolated behavior from some users.

In case of videoconferencing-based teledermatology between UNN and Kirkenes Hospital (from 1988) and Hammerfest Hospital (from 1996) to onwards, the videoconferencing equipments were old. They were good enough to send the quality image. But when they got new equipments and close up camera, the new equipments caused another problem. The new equipments were not, at first, suited to the present systems. Later on, when the equipments were suited, but the involvement of GPs showed relatively less. So the challenges of involving users are inevitable.

Again in 'The Show Window' still image transmission project, there was no link between Well Communicator and Electronic Patient Record system of the hospital. There were a lot of challenges involved in that project, such as:

> *"Monitoring was not proper, probably, because of a large number of GPs involved, but the project members were only four in number; moreover GPs were not reimbursed for that extra services and some doctors were reluctant to take the skin images of the patients" (Project member)*

In Norway, general physicians are practicing their profession privately. So they didn't want to spend their valuable time to take pictures of images of patients. Probably they thought that it was hazardous work to take picture and send them to specialists via well communicator. At the very out set of the project, according to dermatologist of UNN, young physicians were very much interested in and enthusiastic for this type of project. But older general physicians were reluctant to take the pictures of the patients and send them to specialist to UNN.

Regarding wound counseling or clinic project which is the extension form of SES@m project, project-involved persons do a good job for those patients that are involved, but the challenge here is to get patients involved, get the homecare nurses to use it, and the difficulties of having a broad specter of diagnosis. The project has only two diagnostic units to be able to do a good job.

In case of 'Eczema counselling over the Internet' project, there was also problem to recruit patients. As eczema is seasonal diseases related to climate, only in winters in months between December to March more patients would be consulting doctors due to relapsing of symptoms (Itching and redness), as the project was started by June 2005, the dermatologist had to wait till December 2005 for recruiting patients in project. In case of Eczema project, during implementation period the biggest problem was not related to technology or organizational aspects but it was of getting patients or users into project. The probable reason behind it may be that eczema is seasonal diseases related to climate. Patients get relapsed of eczema symptoms more in winters in months between December to March.

In DMS Nord Troms project, mobilization of users is almost successful. Patients from all four municipalities come to Sonjatun during light-therapy.

> *"We are able to arrange a vioconferencing system any time, if we have sufficient patients present" (Nurse, Sonjatun).*

With the help of trained nurses (nurses are trained by dermatology department of UNN), patients can participate in videoconferencing system and talk to the specialists.

5.3. The need to link into practice

It is very important to all of the telemedicine technologies that they should be properly linked to practice. According to Berg (1999), getting such technologies to link or work in health care practices appears to be a politically textured process of organizational change, in which users have to be set up at centre-stage. But it has some prerequisites. This requires an iterative approach. In the iterative approach, the distinctions between 'analysis', 'design', 'implementation' and 'evaluation' blur.

Secondly, a socio-technical approach, which is very important to get the work into practice, sheds new light on the potential roles of IT applications in health care practices. It is critical theme of these approaches that denounce the 'messy' and 'ad hoc' nature of health care work, and that attempt to structure this work through the proper, standardized and 'rational' nature of information technology systems. Optimal utilization of information system applications, it is argued, is dependent on the continuous interrelation of the system's functioning with the skilled and practically oriented work of health care professionals (Berg, 1999).

Grudin (1988) and Law et al. (2005) argue that the previous theme in different way. According to them, information technology applications will have to be more group-friendly than systems. In this case, the emphasis of information technology will shift to user interface issues so that it can minimize the interruption and additional work required of any user of the application. Also in the workplace, building consensus among the people is very important whether collective benefit is achieved or not. Sometimes collective benefits can raise some new or different tasks. At that stage, educating all users to the collective benefit may create motivation to do that work. In information systems application, it is important to know more about individual differences in responding to technology and the functional mechanisms of groups and organizations. To find suitable places where the problems don't arise or to prepare users for the introduction of

applications may be some possible approaches for the success of information technology or systems applications (Grudin, 1988).

In all first four efforts we can see, those efforts were not very much linked into practice. In videoconferencing-based teledermatology between UNN and Kirkenes Hospital (from 1988) and Hammerfest Hospital (from 1996) to onwards project, we can see that in this project technology is not in real control. In 'Show Window' project we can see there was no proper management.

> *"Our focus was not to get large things and volume; it was to get them to use it. And we did not make it. And there is no actually great management for the project. We were four persons and none of us was pointed out as project manager. So no reports, nothing. And we just used the money and travelled around" - (Project Member)*

Kroken project and eczema project were not linked very much to practice due to lacking of user availability. This means that in the long run they did not become sustainable. In contrast, the DMS in Nordreisa is to a much higher degree linked to practice because there are nurses working there who are trained by the hospital. The hospital is also financing this together with the municipality. The telemedicine services are integrated with the dedicated network. Electronic Patient Record will be integrated to their system very soon.

5.4. Evaluation in telemedicine services

The scope of each type of evaluation of telemedicine services is dependent on the explicit purposes for which it is being conducted. Evaluation consists of several sets of activities such as: analysis to the design of telemedicine services, monitoring of technology implementation and assessment of telemedicine service effectiveness and efficacy. The evaluation of telemedicine services belongs to this comprehensive evaluation. Evaluations in telemedicine have typically been done based on a quantitative approach. It seems that each of the projects was evaluated successfully in this quantitative approach. Maybe, we need a more process oriented way of doing evaluations such as actor-network theory and important aspects of information infrastructures.

According to Stoop et al. (2003), the organizational decision maker, who is confronted to implement or manage an information system or IT system as well as who wants to know what types of questions may be relevant, and how these may be addressed. By the dimension 'domain of evaluations' Stoop et al. (2003) focus on the technical performance of a system on the organizational matters. Evaluation can occur at different moments or stages in the organizations dealing with the health care systems: before, during or after implementation of the systems.

According to Stoop et al. (2003) statement, when evaluating a health care information system, many different decisions have to be made: decisions about why to evaluate, what to evaluate, when to evaluate and how to evaluate are the most important ones. Again by *domain*, the given authors elaborated in this way: the different viewpoints that an evaluation can take – technical, professional, economic, organizational, ethical and legal. Secondly the *moment* of evaluation is important. Three phases can be identified: pre-implementation, during implementation and post-implementation. Within these phases of implementation, different evaluation questions may be pertinent. Evaluation during the pre-implementation phase can be done to test the practicability of the intervention. In the implementation phase, evaluation feedback helps optimizing the implementation processes. It may be called formative evaluation. Finally in the post-implementation phase, evaluations provide final outcomes or impacts of the intervention. This is called summative evaluation. In combination of two dimensions, a distinctive set of questions can be emerged which primarily turns to overall outcome measurements. Stoop et al. (2003) also point out that qualitative research methods are optimally suited to understand a phenomenon from social and institutional contexts.

In case of five projects, evaluation plan can depend on a modification or expansion of an existing effort instead of new case or new intervention. But in case of VC-based teledermatology between UNN and Kirkenes Hospital (from 1988) and Hammerfest Hospital (from 1996) to onwards effort, I can call it new intervention.

In case of DMS, in Kåfjord, Kvænangen, Skjervøy and Nordreisa municipalities, there are no mentionable specialists' health care services available. Even the specialists are so reluctant to go there due to inappropriate communication and economic facilities. That is why the implementation of telemedicine tool is very important in this area. Regarding DMS, here is a quote of a dermatologist:

> *"DMS is not a new telemedicine system, its concept originated from late 1980s' (Dermatologist)*

In case of evaluation stage of telemedicine services**,** I can compare dermatologic experience of DMS and 'Show Window' project of NST. In 'Show Window' still image was transferred by general practitioner to specialist (UNN) via 'Well Communicator' software using Norwegian Health Net. It is also possible to compare between DMS and teleconsultation of dermatology department of UNN with Hammerfest Hospital. It is also possible to compare each other of our five concerned teledermatologic efforts. These comparison and preliminary observation may give some ideas of assessing programme theory. This programme theory stage also can tell us how this case is supposed to bring outcome. Practice oriented processes such as ANT, IIs etc. always find social needs, logic and plausibility of all IT efforts. Only in DMS, patients and nurses directly communicate with specialists via videoconference and it is an integrated approach where the hospital in control.

In case of assessing telemedicine programme impact, the design of impact evaluations needs to take into account two things: on the one hand, evaluations can be undertaken with sufficient rigor so that relatively firm conclusions can be reached; other one is practical considerations of time, money, cooperation limit the design options and methodological procedures that can be employed (Rossi et al., 1993). Efficiency assessment is another important consideration for evaluation plan of telemedicine services. The degree to which a programme shows benefits in relation to its costs, called efficiency of that case or effort. In most cases, knowledge of impact alone is insufficient, the outcomes produced by this telemedicine efforts or programme should be judged against its costs. This evaluation plan is applicable in case of modification or expansion

of an existing telemedicine effort (case) instead of new case or new intervention or health service. More specifically this evaluation plan may adopt to revise existing e-health service one.

In case of teledermatology, there are lots of evidences that this service is cost-effective. Asynchronous teledermatology may serve as an important tool for triage of dermatology referrals and for delivering care and treatment to more patients than in urban areas. It can be assumed that it can decrease waiting time for a dermatology diagnosis. In an urban multi-specialty clinic based primary care practices, the results suggest the cost of a teledermatology consult is less than that of an in-person service (Mckoy et al, 2004).

5.5. Evaluation of five efforts in context of notions of IIs and ANT

Here we can recall the important notions of information infrastructure, such as: Enabling function of infrastructure, infrastructure is shared by a larger community, infrastructures are evolving, open and heterogeneous, they are socio-technical networks, infrastructures are connected and interrelated (ecologies of networks) and infrastructures develop through extending the installed base. Again we know, in ANT, translation has four moments, such as: problematization, interessement, enrolment and mobilization.

Problematization and Interessement: In first VC project between UNN-Kirkenes and UNN-Hammerfest, UNN, GPs, patients with dermatologic disorders, Kirkenes Hospital, Hammerfest Hospital are important actors. In 'The Show Window' project, dermatologist of UNN, GPs, patients are important actors. In Kroken Project, nurses of nursing home and trained nurses of UNN are main actors. In eczema project, dermatologist, Internet connection, patients with eczema are principle actors. And, in DMS project, Norwegian Centre for Telemedicine, Dermatology and Orthopaedics department of UNN as well as four municipalities are very important actors. Also radiology department, technical department, Helse Nord RHF, X-ray department located in Nordreisa, nurses, computers, EPR systems , patients are involved actors.

In first VC project between UNN-Kirkenes and UNN-Hammerfest, one type of initiatives has been created in case of teledermatology in North Norway. Telenor and UNN (more specifically

UNN-Kirkenes VC project) were interested in to initiate the project in experimental way. In 'The Show Window' still image transmission project, involvement or interessment of general physicians have been created. So it is the one phase of mobilizing of GPs. Kroken project or 'Connecting a nursing home to GP and hospital by using Electronic Communication in a dedicated network' followed by 'SES@m Tromsø' project created interessement among only nurses such as nurses of nursing home and trained nurses of UNN. The 'SES@m Tromsø' project extended into 'Wound Clinic' project. The main problem involved here is to get patients involved, get the homecare nurses to use it, and the difficulties of having a broad specter of diagnosis. Eczema counseling over the Internet project created interessement among eczema patients.

The DMS project, so far I understood, involves the telemedicine technology in a new approach trying to reengineer the existing work for improving the performance (Hammer, 1990). But evidence proves that the escalation of such type of ehealth or telemedicine services face a lot of problematic issues when organizations put these services into daily practice (May, et al., 2001). Sometimes, as we prefer to use technology to mechanize previous or old ways of doing the business (Hammer, 1990), and for huge technical experiments or evaluations, we can not reach our expectations. Sometimes the technological application fails because it demands some people to do additional work, while some other people get a direct benefit from this application (Grudin, 1988). That is one type of problem associated with the implementation of new technology.

During the assessment of previous related projects, in my observations, I found, several problems were involved in the previous related projects prior to starting DMS. In videoconferencing between UNN and Kirkenes or Hammerfest Hospital, the still skin image could not be shown in videoconferencing system, as it is enclosed at email. Later on to recover this problem, new equipments have been bought to do the real time consultation and image seeing. In 'Show window' project, there was no link between Well Communicator and EPR system of hospital. So the specialists could not see images in the records of the patients. Alternatively, DMS project involves skin image transmission in another way where the specialists could see the images during videoconferencing system simultaneously. In addition, Norwegian Government suggests to provide continuity of care for patients and clients through electronic services focusing on step-

by-step advancement (Te@mwork 2007). For decentralizing the specialists health care services in four small municipalities, a body of allies, consisting of human and non-human (Walsham, 1997), has been created in this project. So, they have developed the information infrastructure in a new approach.

Construction of Information Infrastructures: We have realized in problematization phase is that in the first four teledermatologic efforts, all of the efforts lack any of the important notion of the information infrastructures such as: infrastructure is shared by a larger community, infrastructures are evolving, open and heterogeneous, they are socio-technical networks, infrastructures are connected and interrelated. Probably we can call the first four efforts as information systems rather than information infrastructures.

To overcome some problems concerning previous telemedicine applications, the management of DMS tries to decentralize resources to local contexts as related to 'decentralizing a resource gives better service to those who use it' (Hammar, 1990). Of course, Hammar (1990, p.108) also argues that 'no one sees enough of the big picture to be able to respond quickly to new situations'. But the system or infrastructure must have enabling activities or functionalities (Hanseth et al., 1998). The infrastructure of DMS is designed to support a variety of activities; not specifically designed for one activity. It is enabling to some extent, in the sense that the telemedicine technology involved here is projected to create a field of new activities but does not cover the all characteristics of integrated network or "radically-tailorable" (Malone et al, 1992) technology. The explanation is that patients of three municipalities (other than Nordreisa) can not communicate directly from their own place in case of orthopaedics or dermatologic problems that needs light therapy. Here telemedicine technology, in my opinion, acts as non-customizable technology. So it is very important for the management to recall a suggestion of Orlikowski et al. (1995):

> *"Because new customizable technologies are so general, local adaptations and ongoing accommodations of such technologies and their use are necessary to make them relevant (and keep them relevant) to particular contexts and situated work practices.""*

If I look through the lens of information infrastructure to DMS, its enabling functionalities are being shared, according to Hanseth et al., (1998) by a larger community (collection of users and user groups) of four municipalities and UNN. In my observations, the management did not think it from any standardization aspect. One patient of Nordreisa municipality can get instant emergency treatment or advice than do patient from other three municipalities. As infrastructures can act as a shared resource for community (Hanseth, 2002), DMS could consider equal facilities for every patients of those four municipalities. Hanseth (2002) also refers that it will be considered beneficial if all users adopt one shared standard.

In case of openness aspect of information infrastructure we can view this project into two different contexts. If we see this project in context of UNN departments involved, the project, on pilot basis, may have limited openness as it includes only two departments of UNN. The two departments are not interdependent. But telemedicine technology requires coordination mechanisms, power relationships (Nicolini, 2006). Alternatively if we see it in context of its vision it is 'open, evolving and heterogeneous' (Hanseth, 2002). In this project, there are no limits for number of users, stakeholders, technological components. The two departments of UNN involved are exchanging information with an institution of Nordreisa. Department doctors may be engaged in some research programmes. In Nordreisa, 5 general physicians and 5 nurses are working. This DMS has an agreement with an X-ray department of Nordreisa. In a nutshell, all components make this project heterogeneous. And it is so along with many different dimensions (Hanseth et al., 1998).

This project itself has socio-technical networks, as it involves people from four different municipalities. This project covers humans, organizations, technological components etc. But individuals, organizations and society demands a lot from this technology. Individuals of society demand other treatments options such as telecardiology, teleophthalmology etc. Still the project does not have any 'learning-in-working' (Brown, et al., 1991) practice which is very important for the DMS staffs, more specifically, for the nurses. Nurses can get their training in Videoconferencing system from Nordreisa. But they have been trained earlier from Dermatology department of UNN. In case of dermatology, for skin image transmission, DMS is trying to use EPR system. Then a lot of issues, such as legal matters, compatibility of systems

will be concerned. Because incompatibility among information systems may arise from differences in use, responsibility across sites and organizational units (Ellingsen et al., 2003a).

The infrastructure of this project is connected and interrelated 'using a combination of telecommunications and information technologies to accomplish an organizational task' (Townsend et al., 1998), more specifically, to decentralize the specialist health care services. The given infrastructure is connecting UNN and Nordreisa municipality. The other three municipalities are communicating with Nordreisa. The project has 'scaling up' properties in limited way considering that 5 GPs in 'Sonjatun' are not directly involved in this project. Constantinides et al. (2006) assumes that the development, use and scaling up of technology do not originate solely through the intentions from selected few individuals, for instance, manager or designer. Its development is negotiated in practice over time with all involved actors (Constantinides et al., 2006). The infrastructure, in future, can add other users of municipalities providing consistent level of services. Even the four municipalities are trying to set up a common network among them, although they have a lot of technological challenges such as there is no broadband connection between Skjervøy and Nordreish municipalities. It prevents instant communication between nurses of Nordreisa and patients of Skjervøy. According to Hammer (1990), by cutting fat or automating existing processes, we can not attain breakthroughs in performance; so accordingly, the management must challenge the old rules or assumptions.

According to the dermatologist involved in this project, the project is using the previous existing telemedicine link between Kirkenes Hospital and UNN which is existing from 1988. Therefore the project has been developed through an installed base. Here the existing telemedicine link is acting as installed base. Installed base is not a unique feature of information infrastructure as it changes over time (Hanseth et al., 1998). The given 'installed base'- telemedicine (videoconferencing system) link between UNN and Kirkenes Hospital has been improved over time in a historic way.

In 1988, the videoconferencing system has been started between UNN and Kirkenes Hospital. This telemedicine system or link is not open-system, having no 'many dimensions' (Hanseth, 2002). According to Hanseth et al. (1998) argument, it belongs to traditional approaches of

information systems that are closed in organizational limits. Also it meets the 'stability' property which is a mentionable characteristic of traditional telecommunications solutions. This system is not being shared by larger community. So it can not be split into separate parts being used by different groups independently (Hanseth et al., 1998). Obviously it lacks the heterogeneity property. In 1996, another telemedicine system between UNN and Hammerfest hospital has been added to this installed base. Hanseth et al. (1998) argues that the installed base is a powerful actor, so its future can not be designed consciously – but designers have influence- they can cultivate it. This telemedicine (videoconferencing) system (link between UNN and Hammefest hospital) is also based on same installed base and thus acting as traditional information system.

In 1999, in 'Show Window' the installed base has been cultivated to some extent in this sense that here a new technology 'Well Communicator' has been added to the installed base. According to definition of information infrastructure (Hanseth et al., 1998; Hanseth, 2002), this information system (Show Window) tends to be information infrastructure. Unfortunately the project was not completely sustainable but it provided knowledge of cultivating installed base in dermatology field.

In 2003, the Kroken project also provided the relevant idea regarding cultivating and maintaining of installed base in the field of dermatology. This system had not been sustainable as well.

In 2005, in project 'Eczema counseling over the Internet', the Internet has been using for treatment of dermatologic problems. According to Hanseth (2002), the Internet itself acts as global infrastructure and it is a shared resource for millions of users over the whole world.

In 2006, January the DMS project developed its infrastructure mostly based on 'cultivated' installed base. Electronic Patient Record system (DIPS ASA), that makes patient information transportable (Berg et al., 1999), had been used to keep the records of the patients. In this project, specialist can see the patients' skin image through videoconferencing system simultaneously. In future, the management has planning to use EPR for transmission of still image. Here, according

to Hanseth et al. (1998) the 'cultivated' installed base acts as mediator or coordinator for development activities of information infrastructure.

According to Hanseth et al. (1998), information infrastructure development can be seen as installed base cultivation from actor-network perspective. In addition, for developing the existing telemedicine service in an innovative or new approach, translation of common interest must be aligned according to the actor-network theory.

***Observed translation of interest in five efforts*:** In first four projects, we have seen different types of lackings of translation of interest in various stages. For example, in VC-based teledermatology between UNN-Kirkenes and UNN-Hammerfest, general physicians became less involved in the project due to not getting reimbursement for their extra time. Many of the telemedicine services go through phases with higher or lower enthusiasm and willingness to invest time and effort in maintaining and developing a service. Typically the early years are characterized by enthusiasm and a willingness to bear over with problems and technical difficulties. Then that phase changes to a phase of operation and then a phase when the persons who have invested time and effort in the early phase often get involved in new projects and the transfer of knowledge has changed the need and the effort people are willing to spend on keeping a service running. In this case, the GPs are having to make an additional effort, while the specialists get the benefits of more effective services and additional reimbursement. This disparity in work and benefit could be accepted in an early and enthusiasm-phase of a project, while it becomes more and more an issue that limits the interest of GPs in a project as time goes by. So, GPs showed less interessement in some efforts.

Even they (including specialist) were not so confident enough in VC based teledermatology. The dermatologist interpreted it in different way:

> *"We are not so confident in new patients, because they need diagnosis properly, but the VC system is very compatible for follow-up patients" (Dermatologist).*

Although GPs enrolled in the project, but due to their less involvement, project mobilization has been very slow. The same problem concerning with translation of interest again happened in the 'Show Window' project. Here translation of interest in case of GPs was very less. In Kroken and wound clinic project, it was challenge to get proper users. In eczema counseling over the Internet project, very little translation of interest of patients has been shown. Whereas, in DMS, the interests of NST and UNN to set up a sustainable local health region via telemedicine link are negotiated with Helse Nord RHF. The main common interest here is to decentralize specialist's health care services. The common interest is very important parameter to implement a project. In this case, for economical factors, NST and UNN's interest is being aligned with Helse Nord RHF interest. Here translation tries to set up of, as argument of Latour (2005), 'a relation that does not transport casuality but induces two mediators to co-exist'. To set up a common interest, the translation of interest or moments of translation is very important for implementation of a project.

Here the DMS itself is an important actor in this project. It involves several nurses and general physicians. In this case, trained nurses are involved to communicate the specialists of UNN. DMS has made an agreement with an X-ray department located in Sonjatun, Nordreisa. X-ray department is another necessary actor for orthodpaedic case specially, as orthopaedic problems can be taken from here. It may be an important actor for dermatologic case as well; in that case image of skin lesions can be transferred from here to UNN directly.

In the middle phase of the given pilot project, orthopaedics department joined this project in August 2006. The more the actors will be involved in the process, the process or project, then, tends to irreversible. Irreversibility is a degree to which it is subsequently impossible go back to a point where alternative possibilities exist (Walsham, 1997).

Mobilization of translation in five efforts: In the first two projects (VC-based teledermatology between UNN and Kirkenes Hospital (from 1988) and Hammerfest Hospital (from 1996) to onwards and 'The Show Window' still image transmission project), mobilization has been retarded due to lacking of active involvement of GPs in those two projects. And the 3rd and 4th projects (Kroken project or 'Connecting a nursing home to GP and hospital by using Electronic

Communication in a dedicated network' followed by 'SES@m Tromsø' project and Eczema counseling over the Internet), it was difficult to get potential users. Regarding the Wound Clinic project (extension of SES@m Tromsø project, funded by NST),

> *"We are doing a good job for those patients that are involved, but the challenge here is to get patients involved, get the homecare nurses to use it, and the difficulties of having a broad specter of diagnosis" (Head nurse, Dermatology Dept., UNN)*

In case of DMD Nord Troms project, for mobilization, all three principal actors (UNN, NST and Helse Nord RHF) borrowed the force of their passive agent allies (Stanforth, 2006) such as patients, DMS and turn themselves into their representatives or spokespeople. These three principal actors are in black box conditions, as they are in stable condition. In this case, in the beginning, the technology that means telemedicine link or videoconferencing system has been adopted by a small user community that subsequently will grow. In this process, both the technology and the users will be continuously changed and aligned to each other. All the time, together they constitute a collective of humans and non-humans (Latour, 1999).

In case of vision of DMS project, if the project grows with its vision of BARENS 2020, there might be creation of stable and sustainable health region. Latour uses the term 'immutable mobile' to elucidate these things as when they are moved around they remain stable and unchanged (Singleton et al., 1993). Application of this actor-network theory has helped to identify that telemedicine implementation in DMS area involves networks at both the broader (the sponsorship, UNN, NST, inclusion of Verkhoyansk in Russia etc) and the local (the implementation, DMS) levels. According to Law et al. (1992), if the project has higher degree of attachment of actors in broader network and higher degree of mobilization of local network actors, then the project may become solid, indispensable project. We can see, in this project, the different systems values of different actors involved have been translated into one common interest. So, this project has solid common interest or language. Further this translation has been inscribed as developing a whole system. Here degree of mobilization for local network actors is highly significant. Also the project has the vision to attach Verkhoyansk in Russia in a given

time frame in global or broader network. So it is a solid and indispensable project according to advanced analysis of ANT.

Although the mobilization of translation seems to be positive, but a lot of problematic issues are involved in this project those of which can be analyzed by network analysis.

Network analysis of five teledermatological efforts: In my opinion, so far I understood, although all five projects had high ambitions for developing or implementing the new technology, but they did not achieve all advantages from the technology. The technological systems are complex and heterogeneous due to their components (Hughes, 1994) and can be intractable if not brought in line or into the actor network system (Latour, 1987). So it is necessary to negotiate with each other in the system.

We have already seen in previous four efforts that according to the notion of information infrastructure, all four projects are of not socio-technical networks completely; they are not connected and interrelated. In DMS, in the beginning of negotiation phase of this DMS project, I found some discriminations or some isolated behavior from some actors. For example, X-ray department at Nordreisa which is working in DMS project. It is an isolated department in the 'Sonjatun' building of Nordreisa. So, it is probably not possible, to capture the image of patients (in case of emergency orthopaedical or dermatological problems) instantly, if the x-ray department is busy with some other own purposes or other patients (patients not from DMS). So it may fail to meet the criteria of 'seamless integration of a collection of information systems' (Ellingsen, et al., 2003a) or 'stable networks of relations' (Law et al., 2005).

Again, if I count patients of four municipalities are one type of users of this technology, they had not been interposed (or placed in the count) during the development of interessement process (Stanforth, 2006) at moments of translation. Even the management did not try to establish patients as 'gatekeepers' or 'obligatory points of passage' (Law, 1987). The management did not take into account mental models (Orlikowski, 1992) of patients as well as concerned people of X-ray department. Orlikowski (1992) argues that considering the mental models of users and prior necessary training to implement technology are factors of great importance. Although

different local needs (for example, here orthopaedical problems of patients) makes the heterogeneity property of information technology or systems (Davenport, 1998), the enrollemnt of orthopaedics departement of UNN at middle stage of DMS project, may create imbalance in information infrastructural context and actor-network perspective. As 'the increase in organizational, institutional, political and technological complexity has been seriously underestimated' (Ellingsen et al., 2003b), so for working such type of technology, it is necessary to set up a balance between sensitiveness to local contexts and a necessity to standardize across contexts (Rolland et al., 2002). Some problems that will arise later due to suddenly enrollment of orthopaedic department, may not follow the organizing vision – 'focal community idea for the application of technology in organization' (Swanson et al., 1997). If orthopaedics department of UNN would be involved from the beginning, a well-balanced network would be formed. Swanson et al. (1997) also propose that if the organizing vision remains underdeveloped after early adoption, later diffusion and institutionalization of the innovation can be retarded.

Another reflection from my observations (from several interviews) is that Project Leader of DMS rarely communicates with dermatologist, orthopaedician as well as people of Nordreisa. In my opinion, group or management meetings play an important role for maintaining actor-network and for developing activities. But in DMS, group or management meeting is almost absent. In case of teledermatology, small scale based videoconferencing or operation is another challenge for DMS. Five general practitioners are working in Sonjatun building. They only supervise the nurses (of DMS) activities without participating actively. So here the project deviates, to some extent, from interessement phase of translation in actor-network perspective. The radiology department of UNN, similarly, partially involved in this project, so it is also an isolated actor. Only one technical person is involved in this project to maintain the videoconferencing system. Even the project lacks another important actor, for instance, legal advisor to address the legal issues of DMS.

IIs, ANT and strategy for establishing sustainable teledermatological services: In actor-network theory, according to Hanseth et al. (1998) if an infrastructure wants to develop on the basis of previous installed base, it must follow transition strategy. Hanseth et al. (1998) argues that in case of information infrastructure, a transition strategy corresponds to a situation where

one well-aligned actor-network is modified into another well-aligned actor-network. Again Grindley (2005) argues that transition strategy corresponds to "backwards compatibility". Hanseth et al. (1998) clarifies this term in this way: backwards compatibility depicts a case when a new version of a product, for instance, an application, system – functions also in conjunction with older version of associated products. Microsoft's Words application is an example of backward compatible product, as the latest versions of Word may read files produced by older versions of Word.

Similarly DMS can acts as backward compatible infrastructure, as it already gets a solid 'cultivated' installed base. But at the same time, the DMS should recall Hammer (1990) suggestions, to challenge the old rules that made the business underperform in the previous place. Nicolini (2006) also argues in the same way that 'the take up of telemedicine results inevitably in the reconfiguration of the existing work practices and socio-material relationships'. For DMS, it is possible to develop a modified 'well-aligned actor-network' (Hanseth et al., 1998). It is true that technology, actors and society need to be thought together as part of the heterogeneous network, instead of separate worlds (Law, 1986). The aspects of information infrastructure and actor-network theory can help to identify the gap between different individual actors, organizations units within the society. Stanforth (2006) argues that technology is just a heterogeneous sociotechnical element that must be considered and managed in the design and implementation of a successful information systems project. Here ANT has a contribution for answering some analytical questions such as about the interplay of the social and the technical; and practical questions, for example, about how to build networks around implementation (Stanforth, 2006) of telemedicine projects in small municipalities.

From network analysis, we have seen a lot of discriminations among different actors involved in DMS and all other four projects. It also supports some of the aspects of information infrastructure in limited context. Through the solving of raised problems found in network analysis and information infrastructures perspective, the management can address the challenges in establishing sustainable telemedicine services in case of teledermatology. Such types raised problems may be solved by developing a 'well-aligned actor network' (Hanseth et al., 1998) and open-mode, 'interrelated' (Hanseth et al., 1998) information infrastructure. Similarly from the

findings of network analysis, it is possible for management of such type of projects to coordinate human and non-human elements of the project applying actor-network theory and notions of information infrastructure.

6. CONCLUSION

The rapid advances in science and technology have enabled the treatment, cure, and potential eradication of many of the world's illnesses including dermatologic diseases. Now we are living in an age which may be titled as *The Information Age*. And telemedicine is the one of the benedictions of information technology. The present hyperbole about *telemedicine* depicts that it may act as *An Important Medicine* (here medicine alternatively means an aid, method or process) to reduce some of the most important skin related problems or disorders including atopic eczema, wound problems, psoriasis etc.

In Norway, people enjoy a comprehensive range of health services, as the Norwegian Government being committed to the universal access to high quality healthcare services. Norway has a well-functioning public health service with a high level of competence. Healthnet is the backbone of telemedicine in North Norway. Teledermatology is one of the effective telemedicine or e-health services in North Norway. The main advantages of teledermatology are: cost-effectiveness of care services, quality of care, reduced travelling time etc.

The technological systems are complex and heterogeneous due to their components of technology and environment. It is very important to all of the telemedicine technologies that they should be properly linked into practice. The five teledermatological projects, discussed in this thesis, were not connected to each other in any way. So they were stand-alone efforts, where little learning from one project was transferred to the next. In this situation, no lessons learned and therefore, the same mistake was done repeatedly. They lack the properties of integration or network approach.

In case of implementation of a new IT health acre services, we have to emphasize the structural elements of the given organization. According to Orlikowski (1992), the central influence of people's cognitive and structural elements is very important to implement a new information system. Cognitive elements are the mental models of frames of references that individual have about their organization, work, technology and so on. People may resist using a new technology, or may not integrate it appropriately into their work practices, when they have a poor or insufficient understanding of the unique and different features of a new technology. Actually,

these two elements have considerable implications for the adoption, understanding and early use of the technology. In case of implementing new technology such as our five concerned teledermatology efforts, it is very important to investigate whether and how the use of a collaborative tool or a new system changes the nature of work and the pattern of social interactions in the organization and to know the intended and unintended consequences.

Weakly or poorly developed cognitive elements of a new and different technology are a crucial problem in technology transfer because people act towards technology on the basis of the meaning they have. In conditions where the premises underlying information system are contradictory with the organization's policies, culture or reward systems, a change in structural properties is needed for effective cooperative computing. These types of changes usually meet with resistance. Without such changes, the present structural elements of the organization will serve as critical barriers to the suitable use of technology (Orlikowski, 1992).

Resources are important facilitators of shared technology use. In first four dermatological efforts, except DMS Nord Troms, there had been no change in the resources allocation after the implementation of new technology or IT system in dermatology. This is why, GPs had not been given their time to use and experiment with the new system (Orlikowski, 1992). Here individuals are not given resources to learn and experiment with the new technology. The training was not given to users with the emphasis of collaborative nature of new system. In case of training, we should provide training to users in such a way that they will have a new way of thinking differently about their work in terms of new information system.

Telemedicine techniques appear to be well-suited for reducing the health problems in dermatologic diseases. We can hope that in the next five years there will dramatic changes in telemedicine and e-health. The transmission and all telemedicine equipment prices will be dropped. But its functionality will increase. The enthusiasm among health professionals as well as patients of different health problems will increase. Although to set up the telemedicine equipments is costly in initial phase for a country, but when it will be used on very large scale to address the health problems of a country, it will be very much cost-effective.

In case of implementation of a new information systems or health care services, one of the two strategies may be considered. One strategy considers todeploy the technology through the experimentation and use over time, creative ideas. Another strategically approach is that prototyping the technology in a representative group of the organization on a pilot basis, and then deploying this to the rest of the organization (Orlikowski, 1992).

From the history and analyzing teledermatology of twenty years in North Norway, the main findings in this thesis paper is that among the five teledermatological efforts, DMS tries to set up itself as innovative way for decentralizing the specialists health care services utilizing second strategy of implementation of Orlikowski (1992). But it lacks some negotiations among different actors. Some departments such as X-ray department of Noedreisa, radiology department of UNN, GPs of Sonjatun bulding are working as isolated actors. Again, as it comprises only two departments (Dermatology and Orthopaedics Department) of UNN, so it does not comply the properties of open-mode information infrastructure. But the project has been developed through the 'cultivated' installed base. In this project, looking through the lens of actor-network theory, the languages or interests of 'some' important and principal actors are aligned with each other. I think, by using ANT and important aspects of information infrastructure, it would possible to create a well-aligned actor-network (Hanseth et al., 1998) including 'all' actors involved in DMS. In my opinion, the enrollment of a legal advisor may be suggested to address some legal issues faced by the project. Government or UNN management (not only two departments) itself can be enrolled as influencing actor to maintain the demand of general physicians reimbursement. Then all existing actors and two aforesaid would-be enrolled actors (legal advisor and Government) may negotiate each other to address the challenges of the project. Finally the project should consider its inscription of design into social context. Telemedicine link or videoconferencing system will work, then, in full swing and properly when it will work under social-network context. According to Latour (1996), 'to compromise, to accept sociotechnological compromises' is the only way to increase a project's reality.

From the discussion of content of teledermatological services from the mid 1980s onwards in North Norway, several lessons can be learned: cost saving and cost-effectiveness depend on volume, general physicians can be modernized within dermatologic knowledge, because

specialist knowledge is being transferred to general physicians. Patients from Kirkenes, Hammerfest or Nordreisa do not have to travel to university Hospital of North Norway, Tromsø. They need only to meet with their respective general physician. For wound treatment, psoriasis and other chronic dermatological diseases, teledermatology can play an important role.

In addition, from the discussion of five efforts in context of notion of information infrastructures and actor-network theory, several lessons can be learned. To make the project sustainable, it is highly necessary to link the project very much to practice. We have seen in our study, several of the projects such as 'Show Window' project, Kroken Project, Eczema project were not linked very much to practice. Those three were fragmented efforts. So, in the long run, they could not become sustainable projects. In contrast, the DMS in Nordreisa is to a much higher degree linked to practice because nurses of DMS have been trained by the hospital, UNN. The hospital is also financing this together with the municipality. The teledermatology services are under process with the integration with the Electronic Patient Records. DMS is an integrated, inter-related, well-aligned approach where the hospital in control. Another predictable lesson is also important that all telemedicine projects should be evaluated by process oriented ways such as notion of IIs, ANT etc.

Finally, from the trend-observation of previous 20 years history of teledermatology in North Norway, we can expect that in future 20 years, some very sophisticated e-health services will be added in teledermatology in North Norway.

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