Growing Networks: Detours, Stunts and Spillovers

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Abstract. This paper describes the open-ended, exploratory and evolutionary development of a communication infrastructure, through an empirical case study of the introduction and utilisation of telemedicine technology in a hospital department. Developing and using a communication infrastructure necessarily require partners, and in order to enrol the partners and build a network, detours were necessary. In the case the detours mainly consisted of staging individual transmission events ("stunts") in cooperation with prospective partners. These stunts provided a concrete opportunity for cooperation, and although the stunts were singular and specific, knowledge and experience from these events also had general value (spillover). Thus, far from being just a secondary and non-productive activity, the stunts provided the core learning situations in the exploratory development project.
1 Introduction

New multi-media information and communication technologies are widely assumed to enable a wide range of new medical services, usually labelled telemedicine. Telemedicine services can be developed based on a wide variety of technologies, from video conferencing technologies supporting synchronous communication to e-mail technologies supporting asynchronous communication. Telemedicine services may support diagnostic as well as treatment processes, they may be used in emergency as well as non-emergency situations, and in non-patient-related activities like teaching and meetings. New services may support work and communication both within a medical profession and between different professional groups, they may support communication and collaboration between primary care centres and hospitals, and between hospitals on a national or global scale. The specific technological solutions used in different situations or supporting different telemedicine services should be shared by almost all users (for instance, standard infrastructural technologies and services like e-mail and real time video conferencing). In addition they will provide functions designed and implemented because of specific needs of larger or smaller groups.

This implies designing new technological solutions, it is not just about organizational implementation of e-mail or video-conferencing solutions. If these grand visions shall become reality, an extensive, global and highly heterogeneous information infrastructure has to be built. The challenges associated with this is addressed in this paper, and this should have relevancy for other attempts at design of large information systems (e.g. “horizontal systems” (Braa and Rolland, 2000) or information infrastructures), where both the technical base, user groups and actors are highly heterogeneous and where the design should allow for novel, innovative and unanticipated use. The first challenge is to choose the most appropriate development strategy for these kinds of projects.

2 Challenges to design

2.1 Design strategies

Should we adopt the most widely used strategy and select a method based on the waterfall model, i.e. first specifying the user requirements, then designing the system, and finally implementing it in the user organization? Obviously this does not make sense. Working out user requirements for an infrastructure that should support the work of and collaboration between all medical doctors in the world and then implement it in a big bang is impossible in practice. We will at least have to adopt an evolutionary approach. Should we develop a prototype first and then the full system (Budde et al., 1991)? Should we
follow the spiral model (Boehm, 1988) and identify the most critical risk first, resolving this and selecting the next one? Or should we follow the traditional path of development of communication technologies, which is through processes leading to agreement about standards. This is for instance, the path chosen by of the largest standardization efforts for IS in health care (De Moor, 1993, McDonald, 1993).

The problem with all these IS methodologies as well as the telecommunication strategies for defining standards, is that they focus on the development of one shared, unified solution for all users which are designed by one body (group or project) in a coordinated manner, and managed from one central point. This is simply impossible, for several reasons: the complexity of the solutions to be designed, the novelty of the work practices into which the technological solution will be integrated, the unpredictable dynamics of the health care sector (partly to be generated by telemedicine technology), the high degree of conflicting interests among various groups of health care professionals, etc. These issues (i.e. complexity, lack of knowledge, dynamics, conflicts) are also present in ordinary IS development projects, often making the traditional IS development methodologies inappropriate. We will in this paper primarily discuss issues and challenges related to two of these aspects, i.e. complexity and novelty.

2.2 Complexity and novelty

The general strategy for dealing with complexity is to deploy modularization, i.e. split the overall system into modules, implement the modules individually, and integrate them. In case of telemedicine (or other large scale networks or infrastructures) this means that we are designing solutions for specific use areas, user groups, or new medical services separately. We have to do this without having an overall design (which is usually supposed to ensure that the individual pieces will fit nicely together). Then the only feasible approach is to let the actors design their own solutions, but not independently, only in collaboration with partners so that everybody develop solutions that fit their partners’. The actors can do this by selecting one of – or may be better: combine – the following two strategies:

The first strategy contains the following steps:
finding out what kind of telemedicine services and solutions they want to establish,
finding partners,
make solution in collaboration with partner(s), implement and use it.

The second strategy is to
check out what potential partners are planning
join forces with those most relevant, and
collaborate about the development and implementation of a shared solution.
A second major challenge is to design for novel and unanticipated use. Before we have some experience with the use of a new technology, we cannot specify requirements for general solutions. This may be a general feature of introducing open network technologies into complex work practices (Aanestad and Hanseth, 2000). Communication technologies are open and generic; the usage is not very much specified by the technology designers and producers. This means that the usage must be designed when the technology is incorporated into the specific work practices, e.g. surgery. This is more than merely designing the technological solution. Many personnel categories need to collaborate around the technology, i.e. also in the design of the new work processes. This can only be done during an experimental process related to real work practices.

2.3 Key concepts: Detours, Stunts, and Spillovers

The challenges from complexity and novelty need to be handled, and services and applications therefore must be developed iteratively and in cooperation with other partners. Both of these factors will influence the strategy chosen, and probably make it impossible to approach the primary or main goal directly, e.g. because partners with similar interests may be hard to find. This implies a detour or a deviation from the original plan or interest. The concept of detour (from Actor-Network theory) emphasises the need to form alliances with other actors in order to be able to act, and consequently action is a collective achievement. Also it brings the focus to the consequences of the alliance, its impact on the original goal. A couple of citations from Bruno Latour’s latest book may illustrate this concept:

“… if the accomplishment of the agent’s goal is interrupted for whatever reason (perhaps the agent is not strong enough), then the agent makes a detour, a deviation…. Agent 1 falls back on agent 2… and a third agent emerges from the fusion of the two. The question now becomes which goal the new composite agent will pursue…. (Latour, 1999: 178)

“What interests me here is the composition of action…Action is a property of associated entities. Agent 1 is allowed, authorized, enabled, afforded by the others.” (ibid, p.182)

“A third possibility is more commonly realised: the creation of a new goal that corresponds to neither agent’s program of action…. I call this uncertainty about goals translation… I used translation to mean displacement, drift, invention, mediation, the creation of a link that did not exist before and that to a certain degree modifies the original two.” (ibid., p.179)

In this paper we argue that a detour of creating “stunts” was inevitable and also that it provided lasting value. Stunts were necessary for exploratory and evolutionary development in this context because they provided concrete use situations where using the technology provided immediate
benefit without jeopardizing the primary medical activity. The word “stunt” may be regularly heard in colloquial use. Within a context of telemedicine it usually denotes a unique, singular event, often a show-off of resources and ability (e.g. a live transmission of an operation to a large medical conference). There appears to be a dichotomy between stunts and “useful” activities, as it is commonly agreed that one of the challenges of telemedicine is going from the phase of such stunts and projects, to the everyday routine utilisation.

The concept of spillover is from (Steinmueller, 1996), where the unintended dissemination of knowledge (spillover) is claimed to have been a significant stimulus of innovation, competition and technical progress in the IT industry. We use the concept to emphasise the unintended and unplanned benefits and consequences of the stunts, where experience from specific settings “spill over” to become general knowledge about solutions and their use. A stunt was usually staged for a specific purpose (e.g. a professional meeting), but provided additional benefits. The stunts served as learning opportunities for technology designers and enthusiastic medical users, and also as demonstrations of the technology’s potential for the sceptics.

3 Method

We present the empirical material through a chronological narrative that describes selected parts of the history of the Interventional Centre at Rikshospitalet (Oslo, Norway), related to telemedicine activities. The term “telemedicine” in this paper should be taken in its broadest sense as denoting use of communication technology within a medical context, including local transmissions and non-patient-related use. The material was gathered mainly through participant observation by the first author through three years (1998-2001) and through interviews with the head of department, the technology research coordinator, and the technical consultant on the history of telemedicine activities at the centre. Relevant documents, e.g. plans for the centre, yearly reports, published papers, project documents and transmission logs, have also been studied.

4 A History of Telemedicine Activities at the Interventional Centre

This description does not pretend to be an explanation of driving forces or success factors for development and implementation. The material should also not convey the presence of a master plan, neither on behalf of the Interventional Centre nor any other actor. No matter which intentions and agendas an actor has, it is unable to see the whole picture and can only decide
the next few steps. Therefore the focus of this paper is a description of one actor’s (the Interventional Centre) navigation in a heterogeneous world, and on the actual choices and actions that have been undertaken, rather than an analysis of the actors’ strategic intentions and hidden agendas.

4.1 In the beginning…

The Interventional Centre was established in 1996 at Rikshospitalet by an Act of Parliament to do research and development on interventional radiology, image guided and minimal invasive procedures. Interventional radiology describes the radiology that goes beyond a purely diagnostic examination to also include treatment (i.e. an intervention) when the patient is on the examination table. Minimal invasive surgery is also called “keyhole surgery”, and the idea is that instead of making a large split in e.g. the abdomen in order to get access, small incisions are made and the surgical instruments are entered through these ports. The surgeon gets the visual feedback from a video image from the operation field.

Experiences from similar research centres indicated that one could expect lots of guests, who preferably should not enter the operating rooms. This is the reason behind a wish to establish a local transmission facility where the guests could view the rooms and watch the medical procedures without entering. With the assistance from an external consultant firm, the cabling for this was included in the initial building plans for the centre. The room was equipped to provide two-way interaction with the team inside the operation room and with the possibility to select among a variety of image sources.

4.2 Looking outwards – thinking telemedicine

The hospital’s managing physician wanted videoconferencing facilities at the hospital, and the Interventional Centre was the only department interested in and willing to host and run the videoconferencing studio. ISDN videoconferencing equipment (384 kbit/s) was hired and later purchased, and the video room worked as the whole hospital’s video conferencing studio. Several other departments had previously performed local transmissions of images and sound to meetings, as well as irregular telemedicine transmissions.

The presence of the local transmission facility in the videoconferencing studio spurred thoughts of exploiting it for telemedicine. The local transmission network was connected to the equipment, and several “virtual tours” of the centre was conducted for remote viewers, mainly cooperating R&D centres around the world. Telemedicine was viewed on one hand as a tool that could be of benefit for the communication with cooperating partners in the R&D activities. But the centre also had as its mandate to do research on different tools for medicine and acquire competence on new technologies, and thus telemedicine was also seen as a research object in itself. A natural starting point for such research was to focus on the feasibility for the available
ISDN technology for transmission from the procedures performed locally (radiological and videoscopic procedures). ISDN transmission at 384 kbit/s gave visible degradation of video due to heavy image compression. The image quality was considered inadequate for image-guided procedures like minimal invasive surgery, and other technological alternatives were explored. Some potential and expensive broadband technologies were satellite transmissions or ATM (Asynchronous Transfer Mode) networks. In 1997 and in 1998 there were some of attempts of cooperation with technology providers (satellite companies and a telco) about a closed TV-channel for health care, but these projects did not take off.

4.3 Looking for partners

The main partner in the early years was to be Ullevål hospital, the other large hospital in Oslo. All the three persons interviewed at the Interventional Centre, as well as one of the senior surgeons, maintained personal contacts with central surgeons at Ullevål hospital. The persons at Ullevål were involved in a regional telemedicine project, and they wanted to test out different technological alternatives before decisions were made. The project had a focus on broadband technology so as to facilitate surgery, which was seen as the most demanding application in the network in terms of demands to bandwidth, image quality, and reliability. The telco Telia (Stockholm, Sweden) was trying to get market share in Norway as the deregulation of the telecom market was approaching (January 1st, 1998). Telia was one of the potential network providers for the regional broadband network and had offered Ullevål a technology demonstration. Telemedicine naturally requires both senders and receivers, and the Interventional Centre was a natural partner for this demonstration in terms of medical content (video from minimal-invasive surgery).

This resulted in a trial set-up of a broadband network (ATM) between the Interventional Centre and Ullevål hospital for 14 days in the summer of 1997, where the equipment and network access was provided by Telia. The tests were promising with regard to the technology’s feasibility and the cooperation was continued and turned into a formal project, Development of Interactive Medical Services (DIMedS). The project partners were the Interventional Centre and Ullevål hospital, with Telia as provider of network access, and Ericsson as equipment supplier, and with the Department of Informatics at the University of Oslo as a research partner. The activities in connection with this project account for the majority of telemedicine sessions and experience in the period of interest, and some of the project activities will be further described.

4.4 The activities of the DIMedS project

The first sub-project was focused on using broadband technology for distant learning in surgery and radiology, but the actual activities expanded outside
this use area (Hanseth et al. 1999). A wide variety of transmissions were performed (meetings, demonstrations, seminars, discussions, live operations) for different groups, and even more was planned but not executed. Part of the reason for this drifting (Ciborra, 1996) was the difficulties with summoning the intended receivers (surgeons) at given points of time, as it was difficult to coordinate the work schedules of different institutions. In order to utilise the network access and video digitising equipment fully, the scope was expanded.

Before the DIMedS project, the thoracic surgery department’s meeting room had been connected to the Interventional Centre’s video room, and thus the thoracic surgery department could utilise the ISDN facility to transmit from or receive to their own meeting room. Conversely, the Interventional Centre got wired access to this other meeting room. This was convenient on occasions where the group of viewers was too large to fit into the local video room (e.g. a class of students). A transmission from the Interventional Centre’s operation rooms could then easily be forwarded to the Thoracic Surgery department’s meeting room. This facility was used extensively in the DIMedS project.

In order to enrol partners in the telemedicine activities, the Interventional Centre offered to arrange several sessions that would demonstrate the technical possibilities, e.g. regional seminars or lunch meetings. At one instance early in the project (October 1998) the large weekly staff meeting at Rikshospitalet were conducted on-line with Ullevål hospital’s staff meeting, with some speakers at each site. As the two hospitals were well known for their competitive attitude towards each other, this was seen as remarkable and attracted quite a lot of attention. The session was also transmitted to a nearby hotel hosting the yearly national telemedicine conference. This was the first high profile session where the equipment and network of the DIMedS project was used. The planning and support work was undertaken by the Centre’s staff in cooperation with the technical consultants, and it provided valuable experience.

Other major high-profile transmissions were to Sweden’s yearly medical conference (Rikstämman) in November 1998, and to a minimal-invasive surgery conference at the Sechenov Institute in Moscow (where the founder of the Interventional Centre had contacts) in April 1999.

In addition there were several smaller transmissions. This includes a transmission for ear-nose-throat (ENT) specialists where two regional meetings were coupled together, one at Ullevål and one at Rikshospitalet. This was the first instance where the support technicians handled the planning and set-up of the technology on their own, and only needed to borrow some pieces of audio equipment from the consultant. Later all the equipment needed was acquired, and the technicians would do everything themselves.

There were arranged weekly lunch lectures for radiologists, which gave experiences from novel use areas (transmission of radiological images). Also lectures for undergraduate students, live operations and other procedures for post-graduate surgery students, and several demonstrations for non-medical
personnel (newspapers, TV-channel, visitors) were performed. Some of the transmissions were forwarded onto the regional network that Ullevål was connected to as well.

The expansion of the DIMedS project’s activities was done in order to utilise the equipment fully, but also to analyse the feasibility of the present technology for different use areas. The learning process through gradual expansion of use areas is further described elsewhere (Aanestad and Hanseth, 2000). Here we want to emphasise the growing experience with how to organise and perform production work in different settings. Much of the planning work (e.g. plans for cabling, placement of microphones and cameras) was very specific for the actual transmission, and much of the equipment would be installed before and dismantled after the transmission. Still the experience proved valuable for later planning work. For example, experience was gained with the suitability of a particular set-up of equipment for a particular kind of transmission (e.g. How many free microphones are needed for a meeting where 30 persons participate? How many support technicians is required for camera control, mixing and monitoring? How much time does it take to install and troubleshoot the equipment in a meeting room? What kinds of devices are problematic and should be duplicated?). As more demanding productions were undertaken, more equipment was purchased and the set-up of the video room became more complex. This led to a more systematic approach to management of equipment, standardisation of technical set-up, labelling of cables and connectors etc.

A crucial resource for this expansion of activities to be possible was the availability of temporary workers as support technicians. The technicians were conscientious objectors working for 14 months at the hospital as an alternative to army service, and an active recruiting policy resulted in employment of motivated and technically skilled personnel in this function.

4.5 Events beyond control, changing environment

The Interventional Centre was located in temporary premises while the new Rikshospitalet was planned and built. This precluded large investments in technical infrastructure that would not be moved. The original plans were to move to the new premises during the winter 1998/1999, but this move was postponed several times, and it eventually occurred in May 2000. The time scope of the first sub-project in the DIMedS project had to be expanded, both due to delayed start and in order to exploit the time until the hospital actually would move. When this sub-project was ended (June 1999) no further sub-projects were initiated, as the date for the actual move was still undecided. The overall DIMedS project was discontinued in the autumn of 1999 even though the initial plans were a three years project (until 2001). The industry partners’ hesitation to continue the project may have several explanations, but one significant factor at this point in time was an expected merger between the Norwegian and the Swedish telcos, Telenor and Telia (the project partner).
This led to postponing of strategic decisions regarding telemedicine activities within Telia. Although the attempted merger eventually failed (autumn 1999), the project was not reactivated.

As telemedicine has not been a core activity, the department has had the time to wait and see while going along with its other activities. When the DIMedS project was discontinued, no alternative broadband connection was in place, and the telemedicine activities were restricted to occasional ISDN transmissions. The planning for the communication infrastructure at the new Interventional Centre has been based on experiences from the DIMedS project, and the technical set-up has been expanded and changed after the move into the new premises. The control room now functions as the technological hub for external and internal audio/video transmissions for the whole Rikshospitalet.

5 Cultivating networks

As we argued in the Introduction, open and unspecified network technologies call for evolutionary, prototyping approaches to design and development. Our description of one such process clearly shows the open-ended and unplanned character of the process. Telemedicine was not an intended activity of the Interventional Centre from the start, and the way forward has been planned one step at a time. This does not mean that the process was random, neither that it was passive.

5.1 Detours

The telemedicine activities reflects an ad hoc exploitation of opportunities that was considered relevant and interesting:

“We have used possibilities that we have seen, and there have also been many that we haven’t managed to exploit. This has not been a programmed or planned process.” (Technology Research Coordinator)

“We had many antennas out, we were open to many things and we exploited possibilities.” (Head of Department)

As telemedicine implies cooperation, a shared vision and common activities (e.g. services and applications) were central. This happened through a combination of the strategies mentioned in section 2.2., both cooperation with partners with similar interests (mainly Ullevål Hospital) and also through mobilisation and cooperation with “different” partners, both within and outside the hospital. To mobilise other partners was not trivial, however, and required a detour through arranging stunts that were not directly relevant to the Interventional Centre’s primary goals. Usually medical personnel will prioritise the immediate medical concerns higher than participation in development projects with long time horizons. Any non-primary activities
have to provide immediate benefit, and our claim is that this is the reason for the importance of stunts in this setting. It was a detour around a real-life event that allows the other actors to be mobilised and enrolled. The stunt detour both provided immediate benefit for the participants and also served as an opportunity for learning and development for the initiators.

5.2 Stunts

The stunts (the singular transmission events) were planned in an ad hoc-manner, seizing opportunities to ally with potential partners. Typically the event was scheduled, and the partners agreed on a date and the content and scope of the transmission. Then the scheduled event would serve to mobilise the local organisation (the participants and the support personnel). The necessary amount of planning, preparations and tests were performed, with the aim to manage the performance well. As mentioned before, the stunts were poly-motivated events; they were intended both to be useful in their own sake for the participants and provide learning for the Interventional Centre. Some partners were interested and able to cooperate, and a transmission could be planned rather directly. The learning focus would then be on the technology’s quality and feasibility for this specific use area and on how to organise the support and production work. Other partners were not convinced about the benefits of the technology, and an additional detour was necessary to enrol them. This was attempted through demonstrations of the technology’s potential, and the stunts served as such a demonstration for potential users.

“We need to tell the clinicians about what is possible to achieve. Ideally, it is the clinicians that should come with a definite need, a problem that should be solved. Here however, we need to tell them what is technically possible to achieve. When we demonstrate the possibilities, they get ideas about what this technology can be used for.” (Technical Consultant)

In order to attract partners in general, and in particular the sceptics, the „useful“ component of the stunt should be strong. This usefulness is related to common professional interests, e.g. to cooperate around a given case, or to disseminate knowledge. The importance of this professional content is illustrated in the Head of Department’s reflections on choice of partners:

“Ullevål Hospital was the natural partner for our cooperation, because we both wished the same thing. Even though Tromsø has organisation and structure in place, which Ullevål didn’t, Tromsø did not have the same needs as we did, so it was not a natural partner, other than for demonstrations.” (Managing Director)

(Comment: the National Centre for Telemedicine, which is located in Tromsø, has mainly focused on low cost, mass technologies and telemedicine applications for primary and secondary health care).

In order to succeed in the attempts to enrol other partners a strategy that focused on high technical quality was paramount:
“I have always had a focus on … the user interface and the quality of the equipment. We should go for quality, and not compromise on this. If the technology does not deliver high enough quality, people will lose interest. Both the use value and the educational value will disappear.” (Technical Consultant)

The recognition of this is also the basis for the strong focus towards a well-performed session, and explains the large amounts of manpower used for planning and execution of these events (more than 400 hours through the most intense 9 months, or above 50 hours per transmission at some instances).

5.3 Spillover

The stunts were demonstrations of broadband network technologies’ potential for several different use areas. This is a development of a general more than a specific technology, and it would involve users with different requirements to telemedical cooperation. Such an approach therefore required an open and flexible strategy as regards technology:

“…I’ve focused on modular technological choices. One should not be restricted to one specific system. It should always be possible to build on, replace or change the technical equipment. Stepwise improvements are central.” (Technical Consultant).

The approach also requires quite a lot of support work, both technical and logistic support, which was undertaken by the staff at the Interventional Centre in cooperation with the partners. The staging of the stunts led to a cumulative and incremental growth of experience. This learning relates to the use areas’ requirements, the different partners’ strength and weaknesses, the organisation of production and support work, the technology set-up, and the requirements to mediated communication. This specific experience contributed to a knowledge base that could be drawn on also for entirely new use areas. Based on practical experience, the technology set-up was modified and standardised, and planning, production and support work was routinised (logistics, cabling plans, distribution of tasks). The knowledge generated in different and specific settings (stunts) becomes accumulated and “spills over” to become general knowledge. Some of the stunts were high profile and as such risky (a lot of people were involved, and a technical or logistic failure would be public), but there were no simple correlation between size and importance in terms of learning benefits. The complexity of the production were at its highest for some of the small-scale transmissions, depending on the medical content’s demands to technology and the interactivity of the session.
6 Conclusion

The growth process of the Interventional Centre’s telemedicine activities has not been a pre-planned and linear process of implementation. It has been unplanned and exploratory, constantly open to evaluation of new opportunities, technologies and partners, inspired by (unclear) visions and exploiting the synergy effects of technology and a wide contact network. The complexity of the task, as well as the novelty of the usage, dictated an evolutionary and iterative approach. The active creation of events (“stunts”) provided a way to perform this exploratory development. Thus the stunts, far from being just a secondary and non-productive activity, provided the core learning situations in the development project.

Developing large IS systems with infrastructural characteristics may have characteristics similar to the case described here. They may be large in scope, highly heterogeneous in terms of technology, use areas and users, and they may be expected to support novel, innovative and unanticipated use. In such situations characterised by high complexity and novelty, there are no shortcuts. The shortest (in fact the only possible) way to reach your goal may be through detours. Here the detours of stunts was important, as it allowed other partners to become involved in activities that all parts benefited from.

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