Assembling Agency for Viability: Videoconference in Orthopaedic Consultations

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***Abstract*— An orthopaedic videoconference (VC) service between a university hospital and a district medical centre was initiated by an orthopaedic surgeon/PhD candidate, who also ran the service. Four hundred patients were included and randomized in two groups for the PhD project, where clinical quality, patient satisfaction and cost effectiveness were investigated. Five years after its initiation, the service was still running even after the data collection was completed. The professionals kept the service running while waiting for the results of the study to be published because of its advantages. However, conditions and regulations established for the PhD project left the service constantly vulnerable to being closed down at short notice. Based upon empirical observations, documents, presentations, articles and interviews, I explore how the service was maintained; that is, the mechanisms accounting for agency/action in keeping the service viable under unclear and shifting conditions. Within a socio-technical perspective I adopt the notion of 'heterogeneous assemblages' to analyse such mechanisms, implying that action is understood as shaped by a number of shifting, heterogeneous conditions or influences which may translate into common strategies through interaction. The paper presents and analyses the assemblages that came into play in certain phases of the service, and reflections about the future of the service. I argue that meaning, issues of improvement of tasks and augmentation of the scope of related activities were main conditions that assembled and translated into agency for stabilizing viability. Human motivation and creativity was therefore crucial for utilising the advantages of technologies and overcoming unsteady conditions. This assemblage surmounted other assemblages that accounted for vulnerability. Studying agency as dynamic assemblages and translations fuelled by motivation, along with the innovative agency portrayed, may be applicable to other VC services.**

Keywords-video-conference in orthopedic consultations; heterogeneous assemblages and agency; vulnerability and viability

I. INTRODUCTION

Videoconferencing (VC) was established between a university hospital (UNH) and a district medical centre (DMC) to strengthen cooperation and to improve services for orthopaedics patients. The background was that 800 patients from the four northern municipalities in Troms County, Norway had travelled to the UNH for clinical consultations and follow up in 2005. Many of them travelled four to five hours for a consultation that lasted for 15 minutes and then travelled back home the same day. Elderly patients and parents of children found this tiring, and long journeys are costly. These experiences were coupled with results of research showing that VC use was clinically useful and entailed patient satisfaction and cost effectiveness; however, such research also indicated more follow-up consultations [1-5]. The results were not directly generalizable to the specific conditions at hand, and an orthopaedic surgeon at the UHN wanted to investigate the use of VC services. In 2006 she initiated a randomized controlled study to investigate clinical effects, economic conditions and patients' experiences with the use of VC. The study later became this surgeon's PhD study: 'Tele-orthopaedics: Decentralization of orthopaedic consultations by means of telemedicine solutions'. The goal for the PhD project was to provide decision-making support for the establishment of a regular service in orthopaedic consultations. Tele radiology, that is, digital transmission of x-rays was a pre-condition.

The service started in March 2007 and is still running in 2014. The initial plan was to include 400 patients randomized in two groups over a period of two years. According to the professional participants, they wanted to continue the VC service after two years because the data collection required more time. However, some of the national conditions, such as legal and economic regulations, necessary for such services as well as regulations that had been established for the PhD project left the service repeatedly vulnerable to being closed at short notice. However, it is still running, as professionals explain, 'on overtime'.

This paper reports on an investigation of the development of the service, as a case study. The contribution of this paper is to highlight mechanisms that account for viability and optimization of the service within shifting phases and unclear conditions. Such mechanisms are considered as dynamic and heterogeneous assemblages where micro and macro influences are shifting and reconfigured [6]. Highlighting not predicted processes that account for the use of certain technologies is a common socio-technical approach. By analysing heterogeneous mechanisms this paper has a sociological emphasis. The intention is to add to the understanding of why planned innovations succeed or

 ISBN: 978-1-61208-384-1

fail: why was this service still running when its conditions were shifting or unclear?

The paper considers the agency, viability and vulnerability of the service in the following phases: the initial phase of the PhD project before and during 2007; the phase when an additional service for new patient groups not included in the PhD study was established alongside the project around 2009–10; and the period in 2013 and 2014 which was focused on maintaining and securing the future of the services while waiting for the results of the PhD project to be published.

The questions and approach means that this is a study that adopts an actor-network perspective. The questions that will be answered are as follows: What composes the assemblages that account for the vulnerability of the VC services? What composes the assemblages that enact agency in keeping the service stable during the three phases of the project?

The latter is the primary question in this paper, which is structured as follows: In Section II, I present the project within which the investigation was conducted as well as the data sources, theories and the analytical perspectives in this socio-technical study. In Section III, results are presented according to three phases: Phase A. establishing the service for the PhD project; Phase B. when the data collection was completed and additional patients also were offered the service; and Phase C. keeping it running while developing future prospects for making it an official and regular service. Section IV present two discussions: First the shifting influences that translated into vulnerability and then shifting influences translating to surmount the vulnerability and stabilize viability through the different phases. A conclusion section including future prospects closes the paper.

II. METHODS, DATA, THEORETICAL RESOURCES AND ANALYTICAL PERSPECTIVE

As already stated, this paper is based upon an examination of the development of the orthopaedic service, in terms of keeping it running through shifting phases. The examination was made possible through a research grant for a project designed to investigate processes accounting for video-conference collaboration in clinical practice, in general. This project: 'Modelling Videoconference Collaboration', began in 2013 and is still ongoing. Information about the project can be found at the website of The Norwegian centre for integrated care and telemedicine [7]. It investigates processes and outcomes through multi-methodological approaches, including quantitative and qualitative methods and process studies. The overall objectives are to explore new models for clinical VC collaboration and to analyse active mechanisms involved in optimizing the potential of services, that is, the process of attaining goals. Assembling agency as discussed in this paper is considered to depict such mechanisms. The paper thus reports on an investigation addressing dynamic processes. The orthopaedic video conference service was selected as an interesting case for investigating such processes.

The data for this analysis is collected through various sources: literature studies of VC in orthopaedic consultations, presentations of the PhD project, information material and media articles about the specific service from its start in 2007. Minutes from meetings concerning decisions about the project were also studied. This data collection was retrospective in order to understand the processes from the initiation of the PhD project that started in 2007.

In addition, the following observations were conducted from January to October 2014: five observations of VC consultations which included a total of 15 patients (three patients each time). Four of which were conducted at the UHN site and one at the DMC. The aim of these observations was to obtain insight regarding the significance of the service, the actions and collaboration between the professionals and their opinions and reflections on the service. Conversations were held with the professionals at each site after each observation and formal, semi-structured interviews with two nurses and one surgeon were conducted. Sections of the interviews contained factual information about use of VC services, number of patients that had been utilizing the services, economic and practical conditions at present and shifts during the life span of the service/project. Other sections addressed their reflections about the value or worth of the service for the patients and themselves as professionals, challenges encountered on any aspect of running the service and prospects in terms of continuing the service. The responses were written during the interviews and results were confirmed by the participants.

As mentioned, the results of the investigations will be presented and analysed as heterogeneous assemblages. Such assemblages are described within the body of research approaches captured in the notion of complexity studies. In these studies, information and communication technologies (ICTs) are understood as one influence in heterogeneous and dynamic assemblages stretching from micro to macro, gaining power to influence goal attainment in ever-changing constellations. Viability is considered to be an empirical question in such assemblages, resulting from ongoing transparent negotiations between influences, subtle power games and/or material, mental or scientific resource allocation [6, 8-10].

Assemblages may comprise (in various mixes and connections) a plethora of elements, such as professionals, political authorities, technical agencies, bureaucratic organizations, ICT providers, service firms, regulatory bodies, software engineering companies and research centres, together with technical, functional and normative components. In different and unpredictable manners, these

 ISBN: 978-1-61208-384-1

all influence whether goals are reached and how they are reached. By examining "how they are reached" the perspective indicates an interest in how the various influences affect the interpretation and enactments of the goals. It assumes that in certain ways assemblages of influences may fulfil the innovation within certain world views. All elements (conditions or goals) that are considered to belong within an innovation can in this perspective be subject to being strengthened, disappearing or changing.

An assemblage constitutes a loosely structured, ever-evolving ecology of heterogeneous elements where boundaries and linkages among administrative bodies cannot be unequivocally fixed, tending to shift and drift in time. Assemblages are considered always to be ad hoc, thereby needing constant re-conceptualization. The overall functioning of assemblages and the viability of the ecology itself are based as much on communications and functional relations as authority and norms [8].

These assumptions and concepts are underlying the approach to scientific inquiry submerged under the broad category of complexity studies in which the ways individual roles, groups and organizations emerge, evolve and adapt to their environment are studied [11]. In this paper I also consider human values and actions as influences in assemblages. To consider agency, I use the concept of 'translation' from actor-network theory, meaning that interaction between heterogeneous influences may translate to a common strategy, which in this case can be expressed as follows: assemblages enacting agency for keeping the service viable [9, 10].

For the analysis of conditions, translations and assemblages in different phases of the service, I have summarized data from the different sources and gradually interpreted this summary while considering and selecting concepts from theoretical resources. One of these was a systematic review that identified heterogeneous conditions for innovation in service organizations [11]. This is a combination of a qualitative analysis where I sought to understand how the participants made sense of what they did in the VC service, extended with the analysis of the heterogeneous conditions that made possible and supported enactments and materialization of meaning.

I argue that the three most significant influences that assembled to produce stability and viability through the phases were as follows: the service's compatibility with and support of the professionals' interpretation and actions for obtaining meaning; its affordances which helped accomplish tasks; and the options for augmentation of work practices. These stabilizing influences point to the important role of motivated professionals and their work to obtain meaning. In this case, their focus on the help they could provide surmounted other shifting assemblages which enacted vulnerability [9, 11, 12].

III. RESULTS

The results section describes heterogeneous conditions that formed assemblages during three phases: A. establishing the service for the PhD project; B. the second phase when the data collection was finished, but a regular service was also maintained with new patient groups; and C. keeping the service running while publication of results are pending and developing future prospects for making it an official and regular service.

A. Assembling the PhD project

One of the conditions for the project was the fact that the Department of Orthopaedic Surgery at UHN had decided to increase their proportion of research. At the same time, the Norwegian Centre for Integrated Care and Telemedicine (NST) was pursuing increased clinical relevance for the use of VC in UHN and had initiated a project in collaboration with the DMC in order to decentralize services and increase use of VC. Technical and financial support to set up the VC unit at UHN was provided by this NST project, thereby supporting the PhD.

Different challenges had to be addressed. For instance, there were no reimbursements for telemedicine consultations, which count as a condition for vulnerability. A group of experts were systematically working to establish regulations for reimbursement, which was settled in 2008, so this condition also gradually supported the service. As the orthopaedic service to be established for the PhD was used as an example in the negotiations for reimbursement, this settlement constituted a strong support for its viability. Additionally, only those who are employees of the organization that owns an IT system or service in the health care sector in Norway are allowed to access the system or service. This meant that only the employees of the UHN could legally access the system. The security team at NST negotiated with the authorities and a number of meetings were held. This challenge remains unresolved. To address the immediate challenge, the nurses at DMC were employed at UHN for this specific service. This was a creative move which was a necessary condition for establishing the service. Due to current legislation, UHN employment of nurses was essential as it enabled them to enter the electronic patient record and access booking where they could find out who had been referred for video consultation. This creative move also made routines simpler.

In addition, according to the head of clinic, UHN owns the equipment and is responsible for the radiology operations at DMC. The UHN department also signed a formal agreement to provide equipment for the completion of the PhD project. Before the project started, the nurses at the DMC who were now employed at UHN underwent a period of training through audit. They learned new skills, such as plastering and using the VC equipment. They were enthusiastic. The nurses and the orthopaedic surgeon expressed that being of help to patients was an important motivation for their work to make this happen. At initiation,

 ISBN: 978-1-61208-384-1

the project was also subject to extensive media interest. The queen of Norway visited the DMC and observed one of the first consultations, and delegations from around the globe also visited.

All these highly heterogeneous conditions, including enthusiasm, interacted to form the assemblage accounting for its success.

B. Assembling a service alongside the project

The service was running and accomplishing specific tasks, for instance, gypsum change, hip, knee and shoulder controls after surgery, and diagnostics of newly referred conditions, such as hallux valgus. Only patients who had been referred to UHN and met the inclusion criteria for the PhD project were selected for the service, which was organized and carried out by the PhD candidate/surgeon as an expert. As such, it was not an official service.

New conditions, such as new x-ray equipment at the DMC in 2006 and improved gypsum expertise, led to fewer referrals to UHN and challenges to reach the sufficient number of patients during the planned period of the PhD project. The challenges influenced the timeframe, which was adjusted. The service was also considered to work very well, and the professionals opened for 150 additional patients who had not been eligible for inclusion. These additional were for instance, patients suffering from senile dementia. They had been excluded because they were not expected to be able to respond to a questionnaire intended for all the included patients. Travel was considered difficult for this group, and the service was important. This expansion thus enacts compassion as a condition.

Motivation to improve knowledge was another condition for the service's expansion and endurance. One of the nurses at DMC stated that, 'It represents a breathing break, a positive element in working life. There is much running at the lab ordinarily, but of course it depends on what is to be done. Like plastering, it is a little more exciting. We learned casts at UHN. We have increased our competence and we also ran inter-municipal plaster courses here'. A nurse at the DMC also described the emotions of the patients: 'The patients feel safe when we are secure; they see the x-ray on the screen and the surgeon informs them about the developments and examinations to be done by the nurses. It is a reassuring situation'.

The surgeon and the nurses both stated that the DMC's access to the patient record was an important facilitator. The DMC can log on to the record and see what has been planned for VC. One nurse from the DMC said: 'We do not need to make appointments with UHN, but can read and plan our resources according to the booking system. It is simple and easy, but the UHN computer (a personal computer assigned for UHN patients and employees) is locked into a separate room and only the two of us have access". The nurses and surgeon described that the service entailed meaningful work processes and that they also learned new skills. The service entailed an augmentation of their daily routines and action. These were conditions for its expansion. However, security issues concerning access to sensitive patient data for unauthorized personnel made it still vulnerable.

C. Assembling the future of the services

In 2014, the results of the PhD project are pending publication. Meanwhile, the surgeon and the nurses keep the service running and they intend to use the results from the PhD project to argue for its continuation provided these results are positive. They informed me that the service now runs under tacit agreement. This tacit agreement is a necessary condition for its viability. The employment of the nurses at the DMC and the ownership of the equipment is still in operation, The x-ray equipment has been improved, but the VC units are old and need replacement. For instance, new versions of programs have been installed, disturbing the compatibility between the x-ray machine and the personal computer.

There are no plans for continuation of the project, nor have any new routines been worked out. At the DMC the need for a new doctor to take care of new patients with fractures has been communicated. Additional doctors who have skills in plastering will increase the resource base. In general, it is also important that additional orthopaedic surgeons at UNH participate in the services. The skills at the DMC have improved, also leading surrounding municipalities to use DMC for examination and plastering of fractures. The good of x-ray labs and professional radiographers have improved the quality of X-ray taken. X-rays are described by a radiologist at UHN. The evaluation of severity, and subsequent decisions about whether or not to send patients to UHN, are taken by the general practitioners. The general practitioner can take contact with the orthopaedic surgeon at call for discussion of the case if needed and the X-ray is easy accessed for the orthopaedic surgeon in the hospitals X-ray records. Some patients can have their treatment by their general practitioners in primary care, who have skills in plastering. The VC unit has not been in regular use for emergencies, but this is an option.
The situation concerning legal regulations is still under development. When it comes to financial issues, reimbursement is partly resolved, but it also depends on the results of the discussion about legal communication between units.

The professionals await decisions on legal regulations.
One of the nurses stated: 'We run it because it works fine and we want it to develop further. It is necessary to have a sense of common meaning and be able to discuss challenges. Now it is dependent on the professionals and their motivation. It is vulnerable but there are great opportunities'.

 ISBN: 978-1-61208-384-1

IV. DISCUSSION

In this section I consider shifting and heterogeneous influences in the different phases. According to the assemblage perspective outlined, I first discuss the influences that interacted and translated into vulnerability. The second discussion addresses heterogeneous influences interacting and translating to a stabilizing common strategy which made the service viable. The second assemblage is emphasized as it surmounted the influences accounting for vulnerability.

A. Shifting influences translating to vulnerablity

The empirical findings support an impression of some ad-hoc, heterogeneous and shifting influences. These are identified on different levels and in different domains: i.e. political, operational, organizational and economic [13]. The political influences can be illustrated by the ongoing negotiations concerning how to solve legal issues of electronic collaboration between employees at different institutions. As this question is not solved yet, the political domain provides unclear conditions for the future of the service. On an operational level, the character of the routines that have been developed are shifting and ad-hoc as there are no plans for how they should be established if the service continues. The need for new equipment is also an operational challenge. On the organizational level, the need for more resources at the UHN site and at the DMC is communicated. The continued service is rendered vulnerable. With respect to economic considerations, the financial arrangements established for the PhD project, i.e. the UHN ownership of laboratories and employing the nurses, are running without any guarantee of continuation.

The interaction between these heterogeneous influences translates and summarizes into an assemblage of vulnerability, ongoing through all phases of the service, and stretching into prospects for the future.

B. Surmounting vulnerability and stabilizing viability through shifting phases

The initiatives and work to establish a PhD project, to increase the level of research at the clinic and to improve clinical relevance at NST, as well as the nurses' actions to improve their skills, support a view that actors in this field are not passive recipients of change and innovations. Rather, they seek innovations, search meaning in them, develop feelings about them and modify them to fit particular tasks. The discussion of agency therefore acknowledges participants as actors who purposefully and creatively interact with the complexity of levels and conditions for the service described [11]. The influence of human actors, especially those running the service, is distinctive in all the phases.

One of the most influential elements of agency was the professionals' understanding and actions for making the service compatible with meaning. An example of such an effort was the expansion of the service to groups who initially were not included in the PhD project. The compassion for the most vulnerable patients depicts a value-based driving force. This finding is supported by Dearing et al. who also found that the meaning of the innovation for the intended adopter has a powerful influence on the adoption decision [14]. Service innovations which are made compatible with expressed values and norms have been discussed as an additional support for uptake [15]. The orthopaedic VC service is an example of such an effort.

A second influence that stands out from the results is issues around accomplishment of tasks. The decision and work to keep the service running under unclear conditions, along with the way the professionals described the tasks they were able to perform by using the service, support notions of task accomplishment. This point of view has also been discussed by Yetton et al. [16]. They contended that if the innovation is relevant to the performance of the intended user's work and if it improves task performance, it will be adopted more easily.

The third important influence in keeping the service viable which I derived from the results is the service as augmentation of work practices. Aubert and Hamel asserted that if a new technology or service is supplied as an 'augmented product', e.g. with customization, training and a help desk, it will be assimilated more easily [17]. Examples of such augmentation are the surgeon's pursuit of a PhD; the nurses' accounts of the audit at UHN where they learned new skills; the provision of a new x-ray machine; the way the service accounted for a breathing break in a stressful working situation and the inter-municipal plaster courses that came with the service. All of these elements augmented the service and were referred to as being positive.

The influences discussed, i.e. realizing meaning, improving tasks and augmenting work activities, are considered to influence each other in a network of relations. They translate into a common strategy and provide enough firmness and stability to surmount the changing, ad-hoc and vulnerable influences previously discussed for this case. This viability is vulnerable, however, as influences and assemblages are always changing. Human motivation and work are overarching influences.

Assemblages are usually considered as composed of heterogeneous elements, and the main 'engine' driving the agency in assemblages is considered to be an empirical question. In this case, compassion, willpower and meaning fuelled human agency, helping to utilize the advantages of the technologies and overcome the disadvantages that were encountered. The portrait of the assemblages for agency, including the distinctive role of human agency in this specific situation, can be transferable to other clinical areas. Thus, the results may help to understand and develop other services.

 ISBN: 978-1-61208-384-1

V. CONCLUSION AND FURTHER WORK

The paper contributes empirical knowledge and a discussion of mechanisms for vulnerability and stability in a VC service for orthopaedic consultations.

I argued that the following heterogeneous influences interacted and were translated into a common strategy for keeping the service viable through shifting phases: the professionals' understanding of - and actions for making the service compatible with - meaning, task accomplishment and the service as augmentation of work practices. The interacting influences surmounted shifting assemblages which made it vulnerable. However, the ongoing dynamic of shifting heterogeneous conditions still renders the future service vulnerable.

The next phase of the project will address collaboration models in viable videoconference services which have existed at least from the beginning of, and through the project period. The data collection is limited to services within the North Norwegian Health Region, where the UHN is located.

ACKNOWLEDGMENT

The project was funded by the North Norwegian Health Authorities 2013 and 2014. I am grateful to the informants who offered me their time and knowledge, and to orthopaedic surgeon Astrid Buvik also for commenting the article.

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