



MASTER'S THESIS IN TELEMEDICINE
AND E-HEALTH

Coordinating Resources in Hospitals —
Complex Workflow

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Abstract

This paper attempts to provide an understanding of the intricacies in surgical operation planning and coordination; it followed the pre and post-implementation of DIPS ASA – an electronic surgical module introduced at UNN, Tromsø. Organizations are opting to grasp the promised benefits of IT. However, studies in past have showed that introduction of IT in large organisations are seemingly deemed to fail if integration of socio-technical aspects are not highly considered. Moreover, it is but natural, that changes in work practices are likely to follow.

As such, the theoretical undertaking of the heterogeneous work practices of the different groups, i. e. surgeons, anaesthesiologist, nurses and other collaborating personnel were inspired by CSCW and ANT perspectives. The intricate micro-elements in work practices were examined thru the lenses of CSCW; likewise perspectives in ANT guided the wider arena in the interplay of the socio- technical aspects.

Drawing on the participant observations, open-ended interviews, and literature reviews as source of research materials, the author will show how work boundaries justified and manifested by (physicians and nurses) at both micro and macro level affecting their daily work practices as they utilize DIPS ASA surgical planning module.

Key word: *CSCW, ANT, IT, DIPS, Surgical planning, Coordination, Coordination*

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1 INTRODUCTION

Management of operating rooms (OR) requires an extensive coordination of human and non human resources. The primary goal of OR coordination is to ensure the prompt, safe, and effective care of surgical patients. Communication provides a basis for judgments that are supported by a social network of surgeons, anesthesiologists, physicians, nurses, technicians and auxiliary staff. Planning involving OR coordination requires input from multi-disciplinary stakeholders.

As such, utilization of electronically supported planning and coordination tool has proliferated with the advent of Information Technology (IT). Seamless information flows are shared thru this domain. Within health and social sector in Norway, for instance, a national mandate has been recently pronounced stating the improvement of information flow; working with information infrastructure, information security, electronic patient record, exchange of electronic messages and access to professional support (Te@mwork 2007). These infrastructures are often chosen by hospital administrators and have therefore administrative or otherwise orientation. More often than not, their functionality is viewed according to the institutional needs.

Likewise, planning and coordination are indispensable among large team or organizations. A case study conducted in a hospital environment in the United Kingdom reported by Coiera and Tombs (1998) showed that clinical workers in a hospital setting suggested that communication problems among roles are a significant source of inefficiency.

In addition, such communication may vary from, for instance, face to face, electronic mail exchange (i.e. email, etc), video conference, shared white blackboard, as in the case in a hospital in Denmark (Bardram, 2003), among others. Physical proximity in some cases may offer an easier avenue of information exchange. Reddy et al (2006) argued the importance of physical proximity in collaborative settings only holds true if the co-workers were able to interpret what is going on around them thru their familiarity with their work and the practices by which their colleagues organize that work. Physicians and nurses have only a limited and superficial understanding of each other's work.

In addition, medical personnel are distributed throughout the hospital spatially and temporally; hence the loss of the benefits of physical proximity can be compensated then by the ability of the electronic system to make different representation of the same information. “Unlike paper records, computer systems offer the ability to decouple information from its representations to help smooth coordination.” (ibid, more details).

In conducting surgical operation, for instance, roles of heterogeneous professions interplays and share common understanding of communication or information flow, thus the more heterogeneous a set of differences is found in cooperative work, the more understanding has to be achieved across time and space, the more complex the achievement of shared understanding becomes, entanglements are likely to arise.

Moreover, to highlight the importance of planning Amalberti et al., (1992) in their study further explained that the pilots on the ground plan extensively prior to their missions. Such planning activities provided the pilots with guidance in foreseen as well as contingency action. As such, the close connection between planning and subsequent activities makes it necessary to examine the purpose which planning may serve in interactions with the work environment. Similarly, in healthcare scenario, the vitality of planning and coordination is central for anticipation in changes of patients’ health care status, emergency cases, among other, which may lead to cancellations and unutilized resources, i.e. OR time, availability of physicians, nurses, etc.

1.1 Purpose of the Research

The thesis focuses on the planning and coordination on surgical operation. The tasks of surgeons, anaesthesiologist, physicians, nurses and other none medical personnel and the surgical referrals and work practices around it are strongly interlinked. This illustrates the vitality of socio-technical interplay.

Therefore, the thesis aims to answer:

- How can electronic supported module surgical planning (DIPS) shape work practices?
- In what ways can DIPS contribute to a better workflow at UNN' surgical operation planning?
- What are the consequences in change of work practice?

1.2 Outline of the paper

The thesis is structured in six sections. After the context presentation of the study, role of IT in healthcares, the research objectives and organization of the text in the first chapter, chapter two presents different literatures akin to context of this paper, some insights to understanding Information Infrastructures and Actor Network Theories which serves as the ground for argument on the discussion part. Next, the thesis focuses on interpretive approach of conducting research, it's design, objectives and setting of the study is thoroughly discussed, the data collection and my reflection regarding the unfolding of the methods used.

Further, on chapter four, I will discuss the study locale, the different insights of users on DIPS ASA (the new surgery planning module). A thorough mapping of the old and new information flow and work practices at the department will also be presented. The vitality of this lies on the staggering problem that created bottlenecks at the department- the paper based planning system. Insights from the myriad of users (DIPS), my participant observations, reviews from existing literatures, e-mail exchanges might justify or contradict to some functions of the technology, the technology in use — did it served its expected functionality? What and why?

Next, the discussion part, which I may say the pivotal part of the study. Here, I will discuss some striking points from the case part, the interviews, participant observations, literature reviews, and email exchanges from the informants. Justifications and explanations on this different information presented on the case part will be grounded on some theories in part two of this study. Lastly, the conclusion and implication part, where I discuss my findings at UNN surgery department, and the conclusion along with suggestions (if any) for further work.

2 Theory

In this chapter I will present first a brief overview regarding the utilization of IT within healthcare, some insights on projects and or literatures will offer us what has been done the last few years, its success or failure will be briefly presented, with different arguments or confirmations according to perspective/opinions based on some studies presented by different scholars in IT, healthcare or telemedicine field. Secondly, I will present theories that I used as framework (analytical) for presenting and discussions of the empirical data. To get a fundamental idea of the interplay between the technology and the sociological aspect that commenced from the implementation processes (pre and post), the technology in used, the changes in work practices from the old practices of doing tasks, and lastly but no the least the adaptation phase.

In addition, I will first start to introduce a brief overview and description of the evolution and concepts of Information System/Information Infrastructure. From this perspective, I will outline key concepts underlying the transition and changes which will give us a better understanding why such transition and changes are vital in an organization.

Moreover, the discussion of Actor Network Theory (ANT) follows. A broader understanding of some of the theoretical concepts of ANT will illuminate the interplay between the technology and the users (sociological aspect); how, in what ways, to what degree their interdependent roles shaped the new technology. The vitality of human and non human roles, the artefacts that linked, intertwined them forming a heterogeneous socio-technical network.

2.1 Coordination/Collaboration revisited

Computer support for collaborative work activities is not a novelty within medical informatics. Modern hospitals have a much specialised organisation of medical work, which make communication and collaboration between health professionals and departments central to their work. In the early eighties a number of researchers from a variety of fields began to evaluate the acceptance and use of computer applications that supported electronic communication between people, such as electronic mail and computer conferencing systems.

While these messaging systems could be described as computer tools, it seemed more appropriate to view them as media through which people could communicate.

One of these tools is CSCW (Computer Supported Cooperative Work). Bannon et al (1989) defines CSCW as "an endeavour to understand the nature and requirements of cooperative work with the objective of designing computer-based technologies for cooperative work settings". Here the emphasis is on understanding cooperative work as a distinctive form of work, and on supporting these cooperative work forms with appropriate technology. Similarly, this definition is echoed by Lyytinen (cited in Robinson, 1990), who argues: "CSCW is neither solely a *tool nor technology for business, not just a new way to study computer impact on the work place*. Grudin (1988) underscores in his seminal paper on electronic calendars that CSCW applications fails because:

"it requires that some people do additional work, while those people are not the ones who perceive a direct benefit from the use of the application"

In addition, Kling (1991), Bannon (1998) Grudin (1994) stressed that in CSCW the core focus is only in *small group*. This further echoes the views of Suchman (1989), who describes CSCW as "...the design of computer-based technologies with explicit concern for the socially organized practices of their intended users." Looking at these different perspectives, this means that any organisational conflicts or clashes in individual personalities and cultures might not only be more readily apparent but will directly affect how well the system works.

It may well be the case that a computer system will be designed perfectly, with all the right sort of software engineering procedures, requirements analysis, and usability testing; but that the system is introduced insensitively, or it cuts across the way people have become used to working, or it changes the power relationships between workers at different levels of the organisation as in the case of practices in heterogeneous surgical planning, and this triggers a dilemma.

In Denmark, for instance, Awaremedia, an IT in a local surgery department has been running since December 2005 (Bardram et al, 2006). Awaremedia is 42 inches touch screen

interactive technology that supports Operating Room (OR) scheduling. In addition, the video streaming offered by awaremedia reflects/broadcast the unfolding of activities at the OR, this give spatial awareness to other member of the surgical team. Contingencies of OR schedules are updated from time to time.

Likewise, context awareness is also embedded where it provides activities and whereabouts of the clinical staffs; this facilitates easier collaboration if so needed. It also support real time instant messaging that allows a simple written and spoken pathway between cooperating users. Accordingly, the utilization of aware media has increased a better coordination between users.

“effective coordination requires establishing and maintaining common ground” (Clark et al., 1991)

Similarly, within collaborative or coordinated work arena, for instance, the success of the Denver Project (Orr, 1993) was a result of the striking collaborative effort from the photocopier repair technicians. Orr found that the success of the photocopier business was not largely due to the manual designed to repair copy machines, but to the collaborative tacit knowledge, shared understanding and learning among the repair technicians. The provision of portable radios exclusively to the field technicians, viewed as an artefact in the field of information systems, and taking the radio technology out of the hands of technician managers indeed preserve the free flow of information from technician to technician - the sharing of stories triggers coordination among them (technicians) about their experiences in dealing with the customers, the varying modes of negotiations at the field was not obviously written in the “formal” manual designed by the managers.

Looking at these different literatures in CSCW and collaborative scenario, all the same reasons as in information systems; they are but compounded by the social embeddedness of the computer systems involved: in information system in general, cooperation takes place using the computer; in CSCW, that cooperative takes place via the computer. This means that CSCW utilizes IT merely for collaborative work among small group, denying the role of IT and work practices in a heterogeneous group as it co-evolves.

Nonetheless, looking at a wider arena, currently, there has been a growing interest of utilizing information infrastructure in governments. The Norwegian healthcare sector, for instance, the vision of more health for bIT foresaw the benefits in utilizing electronic information networks in billion of NOK per year.

Conversely, within organisations, information technology implementation decisions are often made at the departmental level, with each department choosing technologies and solutions based on its own needs and beliefs. More often than not, these applications are often not developed in a coordinated way but have evolved as a result of programs written in different computer languages, compiled on different platforms, run on different hardware and have different data structures, types and formats. As Ellingsen et al (2003) argues,

“information plays a productive role in facilitating robust, collaborative work configurations by establishing shared understanding, allowing local flexibility and performing consistence checks”

The aforementioned argument further illuminates the need for integration and coordination in organization (hospitals). As Boochever (1996) goes to say:

“system integration would provide the platform for improved workflow, patient throughput and patient safety, as well as decreased cost”.

In healthcare organisations integration of disparate information systems has therefore been viewed as high priority. Over the last two decades continuous efforts have been made to solve integration problems. Coordination and planning to improve healthcare services to patients has always been a focus of discussions. Governments undertake measures to curve increasing healthcare costs; one measure is the utilization of IT.

The introduction of IT in hospitals, not only changes work practices and information flows but it also affects the planning of workloads, rostering, and allocation of resources, etc. Changes in the organizational environment and technological developments (among others) require an adaptive allocation of resources amidst all kinds of uncertainties. Planning has

always been an important success factor and is becoming ever more important within organizations.

Moreover, whether the objects of planning are machines, goods or personnel, making a plan or making a schedule is a strenuous job for the planner. Attaining an optimal schedule is becoming more and more difficult since on the one hand, the number of aspects of the problem to be taken into account increases, and on the other hand, the scheduler is restricted in his/her capabilities. A computerized system/IT may offer or supports the integration of tasks in making of a schedule; a solution to conquer the difficulties of planning.

Planning and coordination in a high paced environment especially in conducting surgeries, where professional expertise (surgeons, anaesthesiologists, specially trained nurses, etc) are sometime scarce, the need to coordinate spatially and temporally across work boundaries demands great efforts. The workaround in carrying surgical operation, for instance, is highly contingent and numerous events and or ad hoc may affect and change the schedule; the plan must be adjusted and all the individuals involved must be notified and informed in due time.

However, workload is not an inherent property in planning, but rather emerges from the interaction between the requirements of a task, the circumstances under which it is performed, the skills, behaviours, and perceptions of the individuals. Therefore, currently some insights into new ways of utilizing IT as it co-evolves in heterogeneous group are discussed in the following section.

2.2 Change of practices

Currently, Information Technology has ballooned and even more popularly known as ICT (Information Communication & Technology). IT embraces an increasing number of users, developers and even is used in diversified areas. Therefore a transition is inevitable and hence presses to change from the stand alone, isolated system – IS.

“When changes are called for (and they often are), they do not change isolated elements of the infrastructure. They facilitate a transition of the infrastructure from one state to another.” (Hanseth et al, 1997)

Moreover, the design of infrastructure and information system is bifurcated. Inherent in IS design is closed or “stand alone” system, meaning the design process originates from opening and drawing users’ need.

“it has a close and ending timeframe and presupposes to have a defined start” (Orlikowski, 1996).

Conversely, owing to the fact that information infrastructures are founded/built from the installed base, not from scratch as opposed to IS, alignment with the pre-existing ones is a must. Therefore, on this process of alignment, design of the installed based is the pivotal point because it influences the outcome of the new element(s). In addition, infrastructures are developed and changed by several independent users without explicit coordination. As such, as the installed base increasingly expands and develops inertia the more difficult it is to modify or change.

“While resisting change, and having reached a certain level of distribution and use, it gains momentum and drives its own further growth. It becomes an actor and a designer”. (Hanseth et al, 1998 in Hughes, 1987).

To reverse the momentum, therefore he (ibid, more details) bluntly puts it

“we have to shift our perspectives to “cultivating” rather than “constructing” the systems”.

In addition, infrastructure construction implies that it is imperative that we have to know from the onset of the design of what really do we want from the system; its intended use and how it is being built. This further entails “cultivating” the already established system.

Nevertheless, it is not arguable that infrastructures are large, complex and thus heterogeneous; it does stand still in a long time, the degree of control may vanish in time, in the words of Hanseth (ibid), “recalcitrant”.

However, Berg (1997) argues that the degree of control vanishes when tools and practices are conceptualised as (into) networks that are too large to control. A rebuttal from Bergqvist et al., (1993) states that we must cultivate users’ way of doing tasks, not the infrastructure:

“it is the way of working that we cultivate, not the infrastructure”

It follows a paradigm shift then, that is, from system construction to system evolution. Conversely, Hanseth (Hanseth 2002) stressed that successful development of II requires strategies for creating and managing such processes, i. e.: cultivation and gateways which can link the varied elements around them.

Of course there are a myriad of strategies and mechanisms that could be tapped for conducting changes and transition. Revolutionary approach is one and it creates dramatic changes advocated by Hammer (Hammer, 1990) in his paper “Reengineering Work: Don’t Automate, Obliterate” managers should:

“use computers to redesign not just to automate existing business processes” (ibid, p.104)

In addition, Hammer (ibid, more details) and Davenport (Davenport, 1993), another author who advocates BPR¹, both supports that efficiency can be radically improved by breaking loose from out modelled business processes and the design principles underlying them. According to Hammer, reengineering cannot be accomplished in small and cautious steps: it

¹A management approach aiming at improvements by means of elevating efficiency and effectiveness of the processes that exist within and across organizations. The key to BPR is for organizations to look at their business processes from a “clean slate” perspective and determine how they can best construct these processes to improve how they conduct business. This is achieved by enabling discrete initiatives that are intended to achieve radically redesigned and improved work processes in a bounded time frame.
http://en.wikipedia.org/wiki/Business_process_reengineering

is rather “*an all-or-nothing proposition with an uncertain result*” (Hammer et al., 1990). This approach was very radical, though this resulted to an incremental financial result at both Ford motor company (American company) and Mazda (Japanese company).

Conversely in Norway, a paper reported by Hanseth et al (1998) the reengineering approach, ERP² at Hydro Agri Europe (HAE) — the European fertilizer division of Norsk Hydro was the reverse. SAP-based solution (infrastructure) was introduced into this large company designed and controlled by managers and IT personnel. SAP was first allied with top management, and played a powerful agent. Later on it was allied with other actors, like managers and users helping them to expedite the change processes to their (actors’) preferences. As it expanded, SDC (Single Distribution Center), a unit which does all marketing and production for HAE based in Paris, the integration of Lotus notes, the Bridge infrastructure, and other company’s infrastructure (refer to Hanseth et al, article for details) the more SAP became resistant to change.

Moreover, as SAP continued emerging, it became hard to control and its role in the future was harder to predict.

“One role, however, is becoming visible. It (SAP) is becoming recalcitrant to change; it may turn into a powerful actor resisting all organizational change” (ibid)

In the healthcare scenario, revolutionary approach, a hierarchal approach, meaning, the design of the infrastructure emanates from the managerial level (hierarchal or top to bottom approach) has change through the years. For instance, in Norway, dismantling of this hierarchal approach is obviously one of the core drivers of programs within the healthcare and social sector. In addition, from early 90’s the *S@y ah, more health for each bIT*, etc. to the recently mandated *Te@mwork 2007*; foresaw based on experiences underwent on these programs that within healthcare and social sectors, IT is a promising tool to bridge the gap.

²System or approach that attempt to integrate several data sources and processes of an organization into a unified system A typical ERP system will use multiple components of computer software and hardware to achieve the integration. A key ingredient of most ERP systems is the use of a unified database to store data for the various system modules
http://en.wikipedia.org/wiki/Enterprise_resource_planning

Nevertheless, no matter how visions are intricately planned, strands of studies done in Norway or somewhere indicates the full blown success of IT has not been realized. The emphasis on the resources beyond the EPR was central in the study of EPR in use (Ellingsen et al., 2000). On the same vein, Clark et al (2001) reported on their study that “trust” in journal information is maintained and undermine by technology, but in the knowledge of what lies behind the information which facilitate coordination.

“Coordination of the work across time ensures that collaboration takes place at the right time within and among groups through resource synchronization, scheduling and allocation” (Bardram, 2000, p. 163)

In many hospitals the responsibility of OR scheduling has traditionally resided with the OR coordinator nurse. Coordination or collaboration of tasks to come up with OR scheduling are hectic due to heterogeneous personnel’s role spanning from surgeons, anaesthesiologists, physicians, nurses and non medical personnel. Concurrent with this, in a local large local OR hospital in Norway almost two decades ago, a computer supported scheduling was implemented, dubbed PREOP, (Sætnan, 1991). Despite good intentions and the concerted effort from the IT personnel, representative from various departments, the project failed its intended use. It turned out that even on its initial plan to run a pilot, the director of the hospital was reluctant, however, other representatives, like the personnel officer, the head anaesthesiologist, a head surgical nurse and the surgical department supervisor’s secretary were enthusiastic about the project.

Further, negotiations among the representatives were thoroughly conducted regarding the project’s expected outcome. However, oddly enough, a number of issues emerged after evaluation of the project after the implementation, the project failed because from an array of reasons; no strong coordination between the powerful actors, secondly, delegation of responsibility in recruiting allies were not fundamentally founded, it stood in a very shaky ground to begin with.

Coordination and alignment issues like the one mentioned above are often perceived as organizational and cultural obstacles to the introduction of more or less perfect IT. However, no IT is just “out there” to be implemented; IT development and organizational change co-

evolve. Therefore, in most cases what appears as an impediment to the introduction of IT is lack of coordination and alignment, among others at the level of change in management.

Nevertheless, to fully reap the benefits of IT, organizations are no doubt steadily drawing measures to curve issues like, implementation, coordination, collaboration, standardization, etc., and this leads us to the next section for a better understanding of paradigm shift.

2.3 Information System/Information Infrastructures

To get a clearer idea of information system can be difficult. One way to get a better understanding is to decipher the definition and discuss the meaning of the two words: Information and System.

What is Information? Miriam Webster³ defines *Information* as the communication or reception of knowledge or intelligence and *System* is a group of interacting bodies under the influence of related forces.

The development of traditional IS always start at some point, the design starts by uncovering and specifying user's needs, and then the technical solutions is derived thereon. It does not necessarily contain links to other systems and not very complex. Moreover, the design process is supposed to follow its plan, carefully controlled by the project managers. This implies that the central control lies from the top ladder or hierarchal system of an organization-a project manager, for instance, hence, a top down approach and is closed to a specific organizations' boundaries.

“Traditional approaches to information systems development are implicitly based on assumptions where the information systems are closed, stand-alone systems used within closed organizational limits.”
(Hanseth et al., 1998)

³ www.m-w.com

As an illustrative example, the rostering of nurses at a hospital can be viewed as a system and it might be designed according to nurses' especial professional trainings, percentage of work to render, preferred duty of the day or shift, etc. This system of rostering is a stand alone and cannot be used by other organization (in some cases it can be) because the design is catered according to that specificity or demand of particular organization or group. The same system of rostering could not obviously be utilized if the specificity or design is different to that of the nurses' professional background in this regard.

Likewise, an infrastructure is defined by Webster as “the underlying foundations or basic framework, i.e., basic installations and facilities, such as railway tracks, power plants and or the telephone systems. Star (Star, 2002) also view infrastructure as:

*“...embedded, transparent, having reach or scope; is learned as a member; has links with conventions of practice; embodies standards; is fixed in modular increments, not centrally or from an overview”
(ibid)*

Information Infrastructure then is an infrastructure that carries a huge array of information, for instance, the internet or StudWeb at UiTø. Information Infrastructure has no fixed purpose to justify its existence, instead its overall goal is to offer shared information services. Hanseth et al., (1997) clearly puts it:

“Information Infrastructure is a vast field that covers all kinds of use and use areas, spanning from political, social, organization, human aspects and issues from the development of industrial at national or regional or even global level”.

In addition, infrastructures are traditional information systems fused with telecommunication. Hence, it start from being a system, thereon, integrates other system making it bigger or serving “global”. In contrast to IS, information infrastructure is open, complex and more often than not, its structure is conceived from a bottom up approach. Over a long period of

time, there has been a transformation from developing isolated ISs, towards the integration of large numbers of system that becomes part of a larger infrastructure.

2.4 Aspects of Information Infrastructure

The term Information Infrastructure (II) refers to the communication networks and associated software that support interaction among people and organisations. It is a collective term for present networks. Unlike information system, information infrastructure has no beginning or end. It *evolves* over a long period of time, and is never built from scratch. This evolution creates extensions and development and improvements as it accelerates, thereby resulting to an increase in new actors within the system. Moreover, an information infrastructure must be available every time and is serving large communities. Gradually, the infrastructure is extended to include new applications, new users and purposes of use also increases as well.

An information infrastructure can also be seen as a *shared*. The infrastructure is shared by a large community; it is viewed as a tool that can be used for a large number of entities. Likewise, an infrastructure supports and enables large number of component data. For instance, ordering of time slots in surgical operation makes it possible to schedule such ordered time slots on the process. II is a seamless web of communication networks, computers, databases, and consumer electronics, etc., that will put vast amounts of information. The infrastructure is shared by a large community; it is viewed as a tool that can be used for a large number of entities. There are no limits as to the number of users that can access the system; this concept means openness and delimiting its boundaries.

An Information Infrastructure is *heterogeneous* in the sense that it is not solely technical but also encompasses the sociological aspect. The EPR, for example, the system itself which represent the technical aspects is closely interrelated by various users, which represent the non-technical aspect; both mutually shaped by each others inter-operability. This heterogeneity is multi faceted, meaning that it can emerge in many different ways shaped by the socio-technical interplay.

Likewise, infrastructures are connected and interrelated by large ecologies of network (Star, 2002), integrating independent components, thereby making them interdependent and hard to

alter. Integration in this regard, is thru the use of software components; the radiology system-RIS/PACS, the laboratory EPR system and or the patient administrative system (PAS), to automate medical processes, for instance, such as patient admission, transfer and discharge of radiology results, and laboratory ordering and so on are based on a layered existing software component. Owing to its heterogeneity and irreducibility it also includes close interconnected components of ecologies of network such as human and non-human components, organizations, government among others.

Furthermore, another aspect of infrastructure is that it develops by extending the *installed based*. Installed based is the foundation of II and it influences the extensions and branching out of the continuous evolution of II. Work routines, practices, protocols, equipments, software, standards, etc, are also affected as infrastructures develops.

“An information infrastructure has to scale, hence change, to meet the new requirements stemming from its growth”

(Hanseth et al., 1998).

Nevertheless, infrastructures have set of *standards*, without standards the different components cannot be successfully incorporated into a larger system. Subsystems, for instance, may all support the same standards, but they are based on different versions of it and are connected with gateways which can also connect systems supporting different standards.

Further, the traditional information systems’ design methodologies focused on the development of a closed systems meaning single, isolated and stand alone systems (Hanseth, 2002) and design phase follows to have a pre-defined start and ending frame (Orlikowski, 1996), as a result, the role of the installed base becomes crucial as it heavily influences the design of the new elements. The installed base develops momentum which largely becomes more difficult to modify. Hanset (2002) prefers to view the installed base as:

“a sort of living organism that can be cultivated, rather some dead material to be designed”.

In addition, information infrastructure is not just mere technology but it encompasses as well the social aspect, meaning the users, stakeholders, vendors, etc that are involved on the infrastructure.

Similarly, Hanseth (Hanseth, 1996) stressed a need for a shift or transition in the way we think regarding the design of Information Infrastructure, and this implies that in designing II gives us the ability to know in advance of what is expected from the system and what the system is being built upon as opposed to IS. Hence, this implies the need to further understand how the socio-technical interplays in a larger and this leads us to Actor Network Theory on the next section.

2.5 Actor-Network Theory (ANT)

Owing to the fact that organizations are complex, deciphering or breaking down varied stances from different scholars in sociology and engineering among others, for instance, each claiming and advocating their own interpretative stance may offer us a richer insights into understanding these varied claims and arguments. It seems a fallacy to claim that neither technological determinism nor social constructivism alone clears the messy complexities and or heterogeneities in society and culture. These contradicting forces are better well explained in recognizing the strengths and weakness of both these claims, and treat human and non-human actors as part of a network that "glue" them together by a set of heterogeneous networks.

Unfortunately, literatures on infrastructures and organizational change do not currently support reliable generalization about the relationships between introduction of technology and organizational change. There are several reasons for this; literatures contains works by researchers from several academic disciplines and interdisciplinary specialities including organizational theories, management science, sociology, computer science, engineering, each with its own preferred concepts and theoretical and methodological biases.

Nevertheless, almost three decades ago, Actor Network Theory (ANT) was introduce and is one of the several theories which could further draw a better understanding on the interplay

between sociological and technological aspects affecting organizations. This theory was developed by Latour, B. and Callon, M. at the Ecole des Mines in Paris with the aim of explaining complex networks in scientific research settings. In addition, this field is devoted in observing, finding and analyzing science and technology, its development and impact on the society using historical, philosophical and sociological approaches.

This theory enlightens and describes the interplay between technology and social as opposed to bifurcated belief in technological determinism and social constructivism. Advocates in technological determinism or reductionism support that society and its actors develop the technology it wants and use it as they want it, denying the role of sociological components/aspects. Accordingly, this concept is more towards a deterministic flavour, which is common in information systems or hierarchal concept approach. In addition, social constructivism denies the vital role of the technology; it further denies the obduracy of objects and assumes that only people can assume the status of actors; power hungry stance.

These two beliefs are extremes that it is but unimaginable to function in such a large heterogeneous and complex organization or society. Nevertheless, between the demarcations of the two aforementioned extremes, exist interplay; Hughes (Hughes, 1987) describes the technological system of electric networks as a “seamless web” of social and technological factors. Hughes position is akin to concepts in ANT.

“ANT assumes that all networks are heterogeneous or socio-technical. There are no networks that consist of only humans or only of technological components. All networks contain elements of both. And a socio-technical network is the smallest unit.”(Hanseth et al., 1997)

Likewise, actor-network theory views human and non-human as one; in short there is no dichotomy. The human and nonhuman co-exist with the same “rank” and they relate mutually to each other thereby forming a network.

Monteiro (Monteiro, 2000) on the other hand reiterated that we need to view the machine as humans too. Thus, recruit them (machines) to be our allies, to treat them like humans, to

delegate, mobilize and authorize them as one of us (humans). He (ibid) further stated that ANT is rather a process towards alignment, or stability where the different actors pursue their interests:

“it is heterogeneous, meaning that there is an open array of things that needs to be aligned; including work routines, incentive structures, training, information systems modules and organizational roles.”

An actor network is a heterogeneous network of aligned interests, including people, organizations and standards (Walsham, 1996). In addition, Latour (Latour, 1996) supports the same line of reasoning stating (alignment) as; the achievement of a process of bottom-up mobilisation of heterogeneous “things”.

ANT proposes the possibility to look at the different components at both macro and micro phenomenon. The theory tries to conceptualize the relationship between the social and technical artefacts by introducing them as “*actor/actant*”.

Who or what is an actor then? Both human and non-humans are considered as actor. According to this theory, an actor network involved with the development of a new technology consists of all the non-technical and technical elements that influence action and decision-making in the development process. The theory grants all elements of such networks the same explanatory status. Examples of actors include individuals, groups, texts, graphical displays, and technical artifacts among others.

Hence, each actor in the network influences other actors so as to create an alignment of their goals and interests with their own interests. When this interactive process becomes stable, it results in an aligned actor network. Monteiro (Monteiro, 2000) for instance stressed an illustrative example like an individual driving a car, there’s a lot of things that influences one’s performance; the traffic regulations to be followed, prior driving experiences and the car’s manoeuvrings techniques, all these factors influence how an individual actions is formulated, thereby creating a network.

*“you do not go about doing your business in a total vacuum but rather under the influence of a wide range of surrounding factors”
(ibid)*

The concerted effort or act doing then as presented above is the central core of actor-network. These links or alignments which interconnect forming the totality of an outcome from these acts and bind it together forming a network are the heterogeneity nature of actors. Heterogeneity in the context of ANT is:

“an open-ended array of “things” that need to be aligned including work-routines, incentive structures, training, information system modules and roles” (Monteiro, 2000)

The diverse sets of actors are the outcome of the interplay between different forces while actors are emerging and retreating from the interplay, they are also defining themselves the characteristics of the interplay. The process of stabilization of the relationships in the network is the outcome of the alignment of the actors, irrespective of whether they represent the technical or social aspects.

Further, in a seminal paper presented by Akrich (1992), she reiterates that semiotics⁴ goes beyond signs, which also lays the foundation of ANT where:

“semiotics maybe applied to settings, machines, bodies, and programming languages, as well as text” (Monteiro, 2000)

Thus, in heterogeneous setting, where it embodies different professional backgrounds, work tasks, temporally and spatially located, for instance in a hospital setting, introduction of a new technology supporting work tasks, responsibilities, among others, the vitality lies of viewing each actant/actor as an important component of a network. Their (actors) position in this setting is positioned into a higher level, not neglecting either micro or macro roles; actor-

⁴ a general philosophical theory of signs and symbols that deals especially with their function in both artificially constructed and natural languages and comprises syntactic, semantics, and pragmatics

network goes beyond the tangible thing, but rather embraces all the components of this organizational setup that are bound by networks, each negotiated, forming an array of network that “talks” the same language and breaks up the demarcation line of either technical or sociological component. Hence, two relevant concepts from actor network theory are essential to understand on how goals and vision are transcribed and “carved” or inscribed into a technology will be presented on the following section.

2.5.1 Inscription

The notion of inscription maybe used to describe how concrete anticipations and restrictions of future patterns of use are involved in the development and use of technology (Akrich, 1992). It attempts to define a framework for possible action (a program of action) and it may be more or less strong (ibid).

“Inscriptions includes programs of actions for the users, and it delegates roles and competencies to the users as well as the components of the system” (Latour, 1991)

Consequently, users should follow these inscribed programs. Where these programs of actions do emanates and who inscribed these programs of actions then? “Designers thus define actors with specific tastes, competencies, motives, aspirations, political prejudices, and the rest, and they assume that morality, technology, science, and economy will evolve in particular ways” Akrich (Akrich, 1992). This means that these programs of actions are based on the actors’ — human and non human, desired goals and or visions on how a technology and the users are expected to carry on or perform tasks. In short, it is a process of creating technical artifacts that would ensure the protection of an actor's interests (Latour, 1992). Similarly, as this process of negotiations and or compromises escalates it reaches to a point of “saturation” where the network is impossible to change and this is called irreversibility.

In addition, as the number of networks increases and the more they become aligned, the information infrastructure becomes irreversible, (Monteiro, 2000), similarly it reaches momentum, Hughes (Hanseth, 1994). On the same vein, ANT coined irreversibility as *black box* when it reaches stability. Once a network reaches the black box state, the network is

difficult to identify, it becomes recalcitrant only unless otherwise a break down occur can it only be opened.

Thus, by inscribing programs of actions into a piece of technology, the technology then becomes an actor by imposing its inscribed program of actions on its user. Consequently, users should follow these inscribed programs; however, the inscribed pattern of use may not succeed because the actual use deviates from the intended or prescribed use. Latour (Latour, 1991) argues that the users may use anti-programs. He (ibid) presented an illustrative example; a case where a manager at a hotel wanted to make sure that the guests left their keys, when they walked out. The manager inscribed many solutions on how to make sure the guest left their keys. He tried to inscribe his desired pattern into the existing actor network, but found it very difficult to succeed. By changing a series of strategies, he (manager) finally succeeded his desired objective.

“It is this incessant variation that we obtain access to the crucial relationships: the user’s reactions real environment is in part specified by the introduction of a new piece of equipment” (Akrich, 1999)

The process of negotiations, compromises, and or intermeshing of vision, goals and intentions, among others leads us to the next section.

2.5.2 Translation

Actors in their interplay within the actor-network negotiate their interest in a process called *translation*; a process which is viewed as alignment in network of the different actors’ goals, and or visions, constraints among others.

“a process during which the identity of actors, the possibility of interaction and the margins of manoeuvre are negotiated and delimited”. (Callon, 1986)

Through translation, actors negotiate according to their interests and come up with a unified interest. In ANT terms, *design is translation*:

“users’ and others’ interests may according to typical ideal models, be translated into specific needs, and the specific need are further translated, into one and the same solution” (Monteiro, 2000)

In short, translation is the designing process, or the arena and convergence of varied interests between different actors – they (actors) create scenarios how a technology, per se, will serve its intended use according to visions and goals generated within this process. Hence, configurations of vision and goals, is critical on this phase. Similarly, as this process of negotiations and or compromises escalates it reaches to a point of “saturation” where the network is impossible to change and this is called irreversibility (Hanseth et al., 1998). Likewise, the more numerous and heterogeneous the interrelationships exist, the greater the degree of network co-ordination and the greater the probability of successful resistance to alternative translations” (Callon, 1991).

Moreover, translation is a process that consists of three stages. During *problematization*, a focal actor identifies other actors that have goals and interests consistent with its own, and establishes itself as an *obligatory passage point* (OPP) (Callon, 1986). The OPP is a mechanism that has to be passed by all the actors in order to satisfy the interests that have been attributed to them by the focal actor. The mechanism can consist of a formal code, such as legislation or contract, but can also be based on a technical device or an informal social norm.

The second moment of translation is *intressement*, which means the process of persuading the other actors to accept the definitions initially provided by the focal actor. The third and final

step in the translation is *enrolment*, where the other actors in the network progressively adapt common definitions and goals.

3 METHOD

In this chapter I will first discuss the research design. To get a better grasp why I choose interpretative approach, I will compare and contrast the different approaches to conducting research. Thereafter, I will discuss the data collection. In addition, reflections on method will be discussed on the last part; the experiences I encountered during the collection of data during my field work, the interactions with the informants, among others.

3.1 The Research Design

Research design is yet another lens or set of analytical techniques and perspectives for performing research. A research study typically has an underlying epistemology, which influences and guides the research, and determines how the phenomenon being studied will be disclosed (Myers et al., 2002). Epistemology refers to the philosophical assumptions and criteria for constructing and obtaining knowledge; namely: fixed (quantitative) and flexible (qualitative), each of these has diversity of assumptions. However, in this study it is worth mentioning that I used the interpretative approach.

In the field of research two research designs/tools are labelled as “*fixed*” and “*flexible*” (Robson, 2002), commonly known as quantitative approach (former) and the qualitative approach (latter) respectively. The dichotomy of these two approaches lies on some parameters like for instance; quantitative method is most suitable for establishing the size, extent or duration of certain phenomena that a specific cause or intervention results in a pre-specified effect (Stoop et al, 2003). This is tantamount to saying that the core or expected result in quantitative method is drawn at the onset of the study and is proven to be true or otherwise during the course of the study and can be described by measurable properties independent of the researcher and the instruments that are being used.

Moreover, in quantitative method as stressed by Robson (Robson, 2002) “utilizes variables to measure the effect of a given exposures”, e.g. a web-based reporting among cancer patients vis-à-vis face to face reporting to a GP⁵. Fixed design (quantitative method) adheres to

⁵ General Practitioner

statistical generalization; the relative weakness of this design is that they cannot capture the subtleties and complexities of individual human behaviour (ibid, more details). It seemingly tends to deny that a varied social interpretation evolves in different social settings, see for example Klein and Robson (Klein, 1999; Robson, 2002). It is but natural that in a large, complex, intertwined organization, especially in hospitals, varied human behaviours encompasses and utilizes these common information systems supporting daily activities and or tasks.

Generally, within information system, as reflected by Stoop and Berg (Stoop et al., 2003) quantitative research methodology has been seen as one of the approaches to evaluating information system. Likewise, Robson (Robson, 2002) claimed that scientific design in Randomized Control Trial (RCT); one of the approaches in quantitative research as the *gold standard* of evaluation. Conversely, Van der Loo and Kaplan (Van der Loo, 1995 and Kaplan, 2001): argued that, ‘*Scientificness*’ is but illusive because it comes in many guises:

“Building a theory explaining a specific social phenomenon, for example, is an equally scientific endeavour, which may or may not be amenable to quantification”. It is often impossible to disentangle the ‘effect’ caused by the PCIS⁶ itself from the effect caused by the changes in the work practices induced by the PCIS implementation”

Furthermore, the idea is that a one-to-one mapping exists between the measures and the phenomena that are the focus of the research, to the extent this mapping holds, the data collected by positivist researchers are deemed valid. Research methodologists within the positivist tradition have articulated different types of validity that need to be considered for example, construct validity, internal validity, external validity, and statistical conclusion validity (Robson, 2002). Positivists tend to use laboratory experiments, field experiments, and surveys as their preferred research methods.

Conversely, Qualitative research methods were originally developed in the social sciences. The research topic and questions being addressed are the reasons for my motivation in

⁶ Patient Care Information System

employing qualitative research methods. This method has a specific strength in helping to understand people as well as social and cultural phenomena.

Qualitative research methods are used among other methods, for describing what is happening in the settings, meaning the participant's views of processes and collecting subjective accounts of phenomena. Qualitative approach is applied for analysis of the data, including finding connections and relationships, the influence of the context, and different perspectives toward phenomena in terms of meanings that people attach to their subjective understanding and experiences of the social world. According to Robson, (Robson, 2002), interviews, participant observation and literature reviews respectively are employed in qualitative research.

Since the 1990's, there has been a shift in Information System (IS) research from a technical focus to managerial and, to more organisational issues. In other words, an increasing interest in has been focused on the relationship between IS and organisation as a whole. Taking an ethnographical approach to the design of my study, as one of the types of studies in interpretive field studies; namely ethnography and case study is in line with the ontological view from Forsythe and Harper (Forsythe, 1999 & Harper, 2000); both cited that ethnography plays a crucial in design and evaluation in information systems. The researcher attempts to understand the culture of their informants and "see the world through their eyes".

Likewise, ethnographic research is a valuable starting point for the consideration of the philosophical basis of interpretive case studies, and this has emerged for the last decades or so (Walsham, 1995). The need for "thick description" (Walsham, 1995 cited Gertz, 1988) goes on saying the importance of trying to understand what is happening in connection with a complex computer-based information system, involving managers, users and designers.

Acknowledging that the ethnographic account can only offer at best a partial and contested truth allows ethnography to be understood as an interpretative endeavour, in which the data are presented as a certain but far from exclusive account that does contribute valid knowledge of lived experiences of participants (Van Maanen, 1988).

Ethnographic research is similar to other qualitative research methods because the researcher becomes part of the cultural scene and, therefore, is deemed as an instrument of research. Researchers must go into the field to observe and interview people from the culture of interest. One could appreciate the importance of a researcher actually being in an OR⁷ environment, for instance, to learn about the enormous amount of equipment, smells, essence of time, and multiple demands of resources from both medical personnel and non-medical personnel experiences interplaying and coordinating each other respectively. For instance, to only interview nurses about the preoperative setting would not be considered ethnographic, as the researcher has not immersed himself or herself in the peri-operative and post operative culture. The actual experience of being in the OR, for instance, provides great contextual meaning to phrases such as an "irate surgeon" or a missing updated patient's journal, etc. This however reflects the fundamental of hermeneutic circle (Klein et al, 1999)

“all human understanding is achieved by iterating between considering the interdependent meaning of parts and the whole as they form” (ibid)

Furthermore, qualitative research is naturally strongly associated with an interpretive position and one that deny adopting the scientific model of a generalized and objective product of the research endeavour. Within IS, interpretive research does not predefine dependent or independent variables or does not set out to test hypotheses, but aims to produce an understanding of the social context of the phenomenon and the process whereby the phenomenon influences and is influenced by the social context (Walsham, 1995).

Flexible design utilizes data in the form of words and is an alternative to fixed designs (Robson, 2002). The goal of qualitative research is to understand issues or particular situations by investigating the perspectives and behaviour of the people in these situations and the context within which they act. Likewise, to prove the extent of phenomenon mixing methods (quantitative and qualitative approach) could also be utilized as well (ibid).

Likewise, contrary to positivist research where they predict certain outcome of behaviours, for instance, and confirm or deny this phenomenon later on their study, or a predictive

⁷ *Operating Room*

approach (Orlikowski et al., 1991), interpretive approach insist that any organizational patterns, people and technology are fluid or volatile, they are constantly changing. Hence, due to this fact, it is crucial to understand the underlying unpredictable issues behind these changes as is created among the interdependent “participants” (human/technology entities) within organizations.

“the subject matter is set in its social and historical contexts so that the intended audience can see how the current investigation emerged” (Klein et al., 1999).

Similarly, the crucial role of the researcher in data gathering being an insider or outsider in the organization being studied is as important (Walsham, 1995). As an outsider, the researcher is free of being viewed with vested interests, as such, a rapport of trust is established (ibid), and thus the informant will often relatively share their true meanings or behaviours of certain event. One takes the perspective of a stranger as a way of highlighting the taken-for-granted practices of the natives under study. On the contrary, an insider gains more access to information to sensitive data, however, informants might be wary of information being shared due to the fact that the researcher is perceived with vested interests (ibid).

In addition, in interpretative studies, the relationship which emerges from the interaction between the observed and the observer can be seen as situational (Klein et al., 1999) Meaning, the preconceived ideas of both, i.e., observers’ cultural background (this is just an illustrative example) and the observed/participants gained concepts from interaction with a failed system, for instance, affects or alters when they interacts. Therefore, interpretations of data gathered may not be the same in cases where a different researcher conducts an interpretative study of the same setting.

By contrast, results in positivist approach are drawn from parameters and therefore these parameters can be applied to a different setting and results can be put to test or compared in another setting. Nonetheless, in positivist social science prejudice or prejudgement is seen as a source of bias and therefore a hindrance to true knowledge; objectivity is best attained through a value-free position and does not interfere with analysis. Gadamer (Gadamer, 1976)

argues that in interpretative approach, prejudice is the necessary starting point in our understanding.

“distinguishing between the true prejudice by which we understand and the false ones by which we misunderstand” (ibid).

Hence, the very nature of interpretivist research means that researchers themselves in effect become measurement instruments. The researcher becomes “the research instrument, one which is calibrated first through training in theory, methodology and then through experience” (Forsythe, 1999). The researchers interpret (measure) the phenomena they observe as they unfolds and illuminates to an openness or an array of possibilities; redesigning new approaches and data-gathering guided with the philosophical stance and conceptual structure in which they are grounded in order to unlock complexities of a certain behaviour and thereby derives conclusions. Interpretive studies assume that people create and associate their own subjective and inter subjective meanings as they interact with the world around them. (Orlikowski et al., 1991).

On the other hand, quantifying the diverse interests of the heterogeneous roles played by the different actors, i.e. surgeons, anaesthesiologists, nurses, etc., is anathema to cases such as electronic supported surgical planning. This means that work organizations are a meeting place of a group of people in a complex, fluid world of social interactions. The continual changes of interactions are very diverse and situational. In addition, interpretive research can help to understand human thoughts and actions in social and organizational contexts; it has the potential to produce deep insights into information systems phenomena (Klein et al., 1999)

The core meaning of interpretative field studies is to produce an understanding of the context of the information system, and the process whereby the information system influences and is influenced by the context (Walsham, 1993). A basic premise of this research is that organisations are not static, and that the interrelation between people, organisations and technology is continuously changing and dynamic. Hence, given the aforementioned insights, I find the interpretive approach to be the most appropriate for my research framework. Using such a perspective asserts that through social constructions such as language and shared meanings I can gain access to reality.

3.2 Data Collection

In this section I will introduce the different methods I used in collecting my data. I preferred to use dynamic techniques for generating my empirical data; interviews, and participant observations. In addition, textual data sources gathered were memos, brochures, forms, etc. gathered from either from the surgery department at (UNN) or the project manager (electronic module), the internet, email exchanges from informants, telephone calls (I took notes after brief inquiry), among others. Tape recorded interviews were transcribed the soonest time possible. This is because “the quality of the notes diminishes rapidly with the passage of time. Without the discipline of daily writing, the observation will fade from memory, and the ethnography will all too easily become incoherent and muddled up” (Schatzman et al., 1973).

In total 10 interviews were conducted among different professional ranging from 30 minutes to one hour and forty five minutes and an approximately 12 hour meetings attended. Interviews structures were open ended. In addition, key informants were almost all with medical personnel profession except one. Identifying key informant was through “snow-ball” technique, starting from the leader of the main surgical ward. She (surgical leader) provided me with email addresses and telephone numbers of prospective informants, more often than not accommodation of interview thru email were almost all successful in some cases except few and a crash interview with a physician. All the interviews were conducted in Norwegian language and later transcribed into English language.

Profession	Type of specialization	Locale
Nurse 1	DIPS function/use	Senter for kliniske IKT-systemer (SKIS)
Nurse 2	DIPS function/use	Senter for kliniske IKT-systemer (SKIS)
Nurse 3	Surgical nurse	Section Leader, Surgery department
Nurse 4	Surgical nurse	Section Asst. Leader (main surgical ward)
Nurse 5	Recovery nurse	Recovery ward
Nurse 6	Recovery nurse	Main surgery ward
Physician 1	Specialist	Ear, Nose & Throat
Nurse 7	ENT nurse	Ear, Nose & Throat
Nurse 8	Surgical nurse	Surgical theatre (main surgical ward)

Figure 1. The tabular representation of the key informants

3.2.1 The pre-deployment phase

The study was introduced to me by my supervisor around the last week of February 2007, and I was interested and reflected back of what the challenges were awaiting owing to the fact of a large heterogeneous fast faced arena of different professional backgrounds. However, I took at it as a challenge and looked forward to uncover the complex coordination, planning, integration within a large hospital. In addition, my supervisor further introduced me to the project manager thru email. Later on after exchanging email and confirming my position as a researcher, I met her personally after a week and conducted an interview not knowing what to seek for. The interview was focused more on a general background of the project.

Nevertheless, as soon as I started collecting data on my research study, I interchanged e-mails with the project manager responsible for the deployment of new surgery planning module system at UNN requesting to notify me and get permission to participate meetings, and hands on training, which I was always was permitted to do so. However, I would like to emphasize that those meetings done prior to February 2007 was foreign to me, accordingly, the project team started deliberation about the project approximately around the last quarter of 2006.

Furthermore, the first meeting with the different personnel (super-users) from the hospital was during a hands-on training on the new electronic surgery planning module conducted outside the hospital premises. Here, I also got a copy of the brochure on the preliminary literature of purposes of the project, operating brochure of the new surgical module and studied them to prepare myself before embarking the surgery ward at the hospital. Doing this gave me the chance to prepare possible questions later (post implementation phase) with my interaction among the users at the surgical ward.

To familiarize myself to the actual field work locale (surgical ward) and start data collection, my supervisor introduced me personally to the leader of the main surgical ward. Thereon, I signed a contract and was issued an electronic ID and with the security division at UNN (refer to appendix B and C). It was important to get an ID because entry to the main surgical department was restricted only to hospital personnel. Having an ID also gave me an access to “dress” like them (the surgical personnel); wearing surgical scrubs, masks, head cover and

proper “sandals” every time I was inside the ward somehow gave me the feeling to be “one of them” —an insider, it was not at all of what I expected though. I will elaborate on this later on the last sub-section (reflection of method).

Nevertheless, my first contact and interview was with a surgical nurse who happened to be a member of the implementation team (new surgery planning module). From this key informant, I gathered rich information about the project, the old work flows, and the information exchange between the departments served by the surgery department and practices during the paper-based surgical planning. Different forms (paper based) utilized to facilitate surgery planning were also given to me. Mapping out the workflow as much as possible was challenging because the atmosphere at the ward was hectic, each and every participant of the day’s surgical team were focusing on their tasks for the day. Furthermore, on this phase, as I frequented to the surgical ward, I had the chance to familiarize myself at the main surgical ward, and to observe actual surgery in progress.

Similarly, I observed the coordination pattern ranging from the receptionist where the registration of incoming surgical referrals (paper-based) from the different wards was first received, written down on the registry book and so on. Here my first “flavour” of the actual surgical coordination setting started to emerge. The reception office was so busy, telephone ringing, incoming referrals, sometimes some personnel in surgical scrubs come by browsing at the registry book, asking or looking for something. In addition to this, the receptionist also receives and counter signed incoming supplies, sometime blood plasma for a patient was handed over and she has to leave the station to further hand over the plasma to the personnel within the surgery ward.

Further, the table at the receptionist was a bit chaotic, a vertical plastic racks stocked with different forms was attached to the wall about size of an A4 coupon bond and beneath it was a table with different drawers containing assorted forms, and other office supplies. The office was rather small, compared to the myriad of tasks being handled.

Moreover, during this phase, since I was not fully prepared and or not clear on what to look for, conducting of interview was quite haphazard, not knowing exactly what to ask, sometime “butting-in” something I learned later (and regretted) to be a disadvantage in my behalf. I took notes as much as I could though since I had no tape recorder at this time.

3.2.2 The post-deployment phase

The new planning module was implemented 27th March 2007. To find out how the users' adapted to the new module, a week after, I conducted a participant observation mostly among the nurses and brief, informal talks, avoiding not to be posing questions because I observed that some were still obviously adapting the module.

In the meantime, I was busy with school works and right after my last final examination (mid-June 2007) I worked as a summer substitute in a hospital outside Tromsø and came back in time for the fall session at school again. During the fall session, my knowledge on conducting research studies within healthcare broadened. Among others, seminal papers from different scholars in socio and technological field were continually discussed, debated at our classroom among my professor and colleagues, citing and comparing sometimes to our on going research field works (if any).

In addition, to establish back my contact at the hospital after the summer work, I wrote an email to one of the nurses inquiring about the status of the new module; was there any change, how was the adaptation. She wrote back that no noticeable change has occurred. Nevertheless, in this very busy department getting an appointment especially to physicians is never easy, I sent emails, but to no avail. There was only one specialist I happened to get an interview, and this was unplanned. I gathered lots of information from this specialist, his views about the new module as well as some suggestions.

During the interview with the specialist, after few minutes, he (specialist) turned to the computer with the DIPS new module on, as I was observing, it took him awhile to get to the right window he wanted to access, at the same time he commented the cumbersomeness of the module. "Need to do many clicks before I get to the point where I want to have access into, this is very time consuming and confusing" he (physician 1) lamentedly said. The interview was tape recorded, of course with his permission. Nevertheless, I could say that the key informant I interviewed was informed enough regarding the new module.

In the last period of my interview and participant observation, I had the chance to do more in depth interview, well because I guess, the informants were not that busy anymore compared

to the “mid-implementation phase”. This informant (nurse 2) showed me some of the bottlenecks of the module which were being reported to her department. The department, by the way, where my informant belongs to is responsible for maintaining the technical operation of the new surgical module, where they act as a bridge between the DIPS ASA and the hospital, but they are employees of the hospital itself. Accordingly, a planned 30 minutes refresher course on usage of the new module was to be held among different participating which I desperately wanted to attend, and might give me the chance to get hold of a physician was not realized.

On the following sections, I will present some insights which justify points on the method used during the progress of this research.

3.3 Reflections on method

On this section reflections on the methodology used in line with Klein et al., (1999) seven principles in conducting and evaluating interpretative studies will be presented, however, the presentation is not in chronological order accordingly.

In the beginning I was still debating to myself if I should push through conducting the study because of language barrier. Although I have had experience working in Norwegian hospitals within medical field before I started my master’s study, still I felt the need to gain more mastery of the language. Nevertheless, I manage to communicate in Norwegian language at least, so to speak; hence I decided to go on.

As mentioned earlier, the research subject was introduced to me by my professor. In the beginning I was not quite sure which role I was playing within this organization, having attended meetings, I considered myself then that I was an insider, reflecting Walsham (1995) that an insider is perceived having an stake on the organization, hence, informants will be guarded on their expressed interpretations, reflecting on this ground, to avoid conflicting stance, I cleared my ground and stood firmly as an outsider.

Similarly, being an outsider has given me the benefit to be considered not having a stake on the organization and that informant will be more open on their opinions, knowledge and

experiences, etc. Although, not being able to attend on many occasions and not having a direct sense in the organization as a disadvantage, Van Maanen (Van Maanen, 1979) argues that staying too long in the field is not a guarantee that an interpretive researcher will collect valuable data.

Furthermore, on the early phase of data collection, I would admit that my research design were vague partly due to my preconceptions and not having a wide background on telemedicine subjects. Nevertheless, Gadamer (Gadamer, 1976) argues that contrary to positivism where prejudice or prejudgement is seen as a source of bias and therefore a hindrance and best attained thru value-free position, prejudice in interpretivism is the necessary starting point of our understanding.

It means that we need to confront ourselves and understand the true prejudice, by which we understand and the false ones by which we misunderstand. Similarly, principle on dialogical reasoning stresses on the vitality of prejudice which formed the basis of research design (Klein et al., 1999). Reflecting from these and comparing my initial data gathered, i.e. literatures, initial interviews, etc, and presenting and or discussing my objectives with my professor at class and colleagues, I revised my objectives so thus the research design. Not only but also, after gaining a wider understanding and concepts on actor network theory guided me the research design, like for instance, tracing actors' alignment, their visions, goals, interests and negotiations, among others.

Nonetheless, I would admit that during data gathering, I was not quite sure what to look for; my prejudice was so enormous, not knowing what to look for and where to start. Like for instance, the very first time I conducted interview, I asked haphazard questions, sometimes irrelevant, talking too much almost not wanting to hear the interviewee. Geertz (Geertz, 1973) argues that what our data are really our own constructions of other people's construction of what they and their compatriots are up to. Reflecting on this, I changed my interview pattern, instead of talking too much I let the informant talk, however, Myers et al., (Myers et al., 1999) argues that a balance between excessive passivity and over direction should be respectively established.

However, getting access to inside views from a heterogeneous social group can be challenging. To solicit an in-depth inside view, it is crucial that the researcher should

establish trust first between the informants, otherwise loss of richness of the data will likely to follow (Walsham, 1995). Then again in my case, it took me awhile to win the trust from my informants (but not fully), especially in some cases where tape recorded was used and this was an disadvantage and can be looked as an advantage (ibid) as well because the informant seemingly become more open, however, to curve the absence of tape recorder I tried to take notes as much as possible and transcribed them as soon as possible. Schatzman et al (Schatzman et al, 1973,) argues that without the discipline of daily writing, the observation will fade from memory, and the ethnography will all too easily become incoherent and muddled up.

Citing Klein et al., (Klein et al.,1999) third principle — “participants and researchers are interpreters as they alter horizons by the appropriations of concepts used by IS researchers, consultants, vendors, and other parties interacting with them, they are analyst in so far as their actions are altered by their changed horizons”. As I reflected on this, I would admit that the language barrier, my ethnicity and educational background, etc, somehow affected my interpretations of key informants’ knowledge, the interactions with the informants may raise a possible bias in this regard.

Although I was dressed like them (informants) and even had a nameplate attached to my scrubs, stating that I was an student (researcher) and also stating my purpose on email when requesting an interview, for instance, still my position at times were questioned. For instance, after I had a more than an hour interview and about to leave the surgical department, an informant commented that “your DIPS” employer should do something on this module, I sighed and explained again my position before saying goodbye. Similarly, I became a part of the broader socio-historical process (Kahn, 1989), hence, if a different researcher will conduct the same study with the same setting, the interaction process will likely to vary, so thus the findings of the research.

Likewise, the importance to decipher observable organizational patterns varies accordingly, Myers et al (Myers et al., 1999) argues that the relationship between people, organizations and technology are static. As I reflect on this principle, contrary to positivist research, where a priori or fixed relationships within phenomena (Orlikowski et al., 1991) are premised, interpretive (as this study is grounded on) believes that people are active makers of their social and physical reality, hence, it is idiographic or situational. I became more open and not

neglecting to follow up questions clarifying what the informants had just shared to. There were times that after listening to the interview, I realized that I needed to clarify something, then it was either I exchanged email or personally meet the concerned informant again.

Furthermore, it also has contributed a lot to my understanding of zooming down the variance between true and false prejudice and consequently offered me a wider view of gathering data in a more open minded passion, not neglecting blurry responses, for instance from interviews, but tried to follow thru questions eliciting a wider understanding of what has been said from the different informants, I did this by consulting back at my notes and interviews from earlier sessions and revising my approaches from thereon.

In conducting interviews in organizations, organizational and professional loyalties and fear of being perceived as not loyal are hardly bracketed when people respond to interview questions (Alvesson, 2003), he goes on saying that; there are good reasons to be more restrictive than is presently the case in our reliance on this as a technique for getting knowledge of what goes on outside interview situations.

Thus, as I reflected on this point, I became more motivated that I should increase participant observation and not just relied on interviews. More so reflecting back on “thick description” (Walsham, 1995) stressing that the subtleties of behaviours emerges by going deeper inquiry because it is due to the fact that each person construct her/his own reality. Hence, it is but critical to zoom in and out the different perspectives of heterogeneous informants in order to capture the true reality.

Finally, reflecting on the principle on abstraction and generalization which it presupposes the need for interpretive researcher to identify which social theories were the interpretations were grounded on; Walsham (1993) in (Myers et al., 1999) argues that contrary to conclusion or inferences drawn in positivist approach where statistical tools are utilized to deny or accept certain inferences, interpretivist rely on “plausibility and cogency of the logical reasoning used in describing the results from the cases, and in drawing conclusions from them”. In this research, presented in earlier section of this paper like literatures on the transition from CSCW, to information system, both being viewed as deterministic or apparently denying the interplay of socio-technical aspects which affects organizations were clearly presented, hence finding in this research were based on information infrastructure and ANT.

4 THE CASE

4.1 The setting

This study was conducted at the University hospital at Northern Norway (UNN), Tromsø. UNN is one of the 5 trusts under the umbrella of The Northern Norway Regional Health Authority (*Helse Nord-HF*). Helse Nord 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.

In addition, UNN serves within psychiatry (158 beds) and somatic 461. The hospital also offers special functions to UNN Narvik hospital and UNN Harstad hospital as part of the hospital organization. As a university hospital, UNN is involved in research and education. Approximately 4500 employees are working at UNN.

4.2 A brief background

The surgical demand at UNN's surgery department has steadily been increasing through the years incongruous to what the department can offer. Despite wide utilization of electronics system for planning and workflow at other departments of the hospital, paper based planning and registration of surgical services at the surgery department continues to exist. In addition, this results that coordination and review of preoperative cases, ordering of surgical equipments, OR theatre and recovery department capacity are difficult satisfy or maximize. Daily surgical operation program is so huge; hence it is difficult to coordinate thru paper based system and better overview of activities. Similarly, it demands many resources for coordinating to achieve good workflow and avoid cancellations and registration of all surgical workflow tasks are done double; first on paper (real time) so thus electronic after. Hence, on September 2006 the management of UNN passed a mandate concluding the use of electronic supported surgical planning — DIPS ASA.

4.3 The Surgery Department

The surgery department at UNN carry out about 10, 5000 surgeries per year, and these surgeries covers gynaecologic surgery, oncologic surgery. gastrological surgery, urologic/endocrinologic surgery, orthopaedic, plastic surgery, heart and lung surgery, ear, nose and throat surgery, neurological surgery and other general surgeries.

UNN's surgical operation department is composed of 22 surgical wards more or less 60 surgical nurses and a large number of doctors. About 50-60 surgical interventions and or therapy are performed on regular day, that is, from approximately 08:00-15:30. Surgeries can be urgent, emergency or be elective cases. Urgent cases are those patients that cannot wait 3 days and needs to be prioritized. It is expected that less urgent cases will automatically be moved to the next day in the event of over scheduling due to emergency cases. In addition, elective case just require an overnight stay at a certain department, either before or after surgery to be considered in-patient and therefore eligible for hospital service.

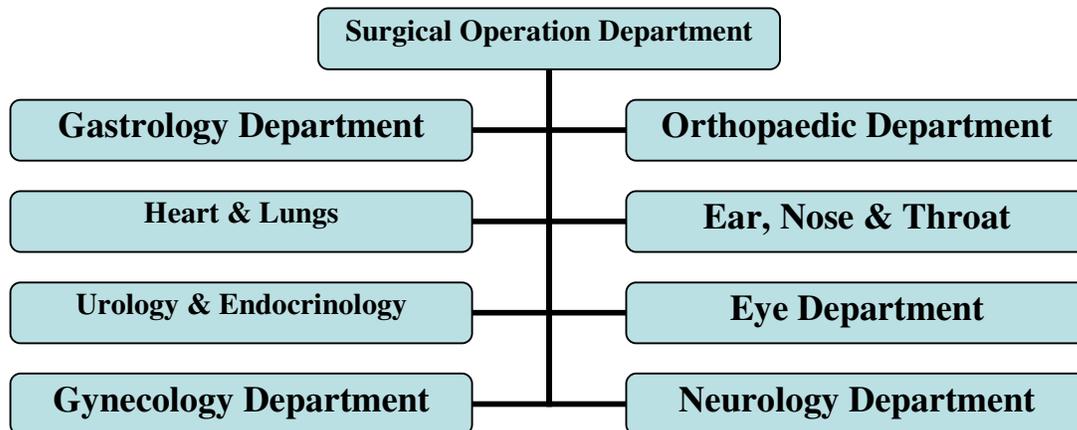


Figure 2. Schematic diagram of the departments

4.4 The multiple groups

There are normally nine groups involved in surgical services: Surgeons, anesthesia personnel, waiting list personnel at the different department, physicians not connected to the operating department, coordinating personnel in the surgical and anesthesia department, surgical nurse, anesthetic nurse, nurses at the recovery department, and on-call general surgeons. Two other groups that are not primary care providers but key players are housekeeping and sterile central.

1.) *Surgeons* reviews and confirms surgical orders from different physicians that a patient will be operated. She/He conducts a physical/health check-up with the patient prior to surgery and carry out surgeries and fills out surgery protocol after surgery.

2.) *Anesthesia team* are responsible for conducting a brief discussion with the patients at the pre-operative wards, anesthetizing patients, monitoring patients during surgery, waking up patients and supplying information on patients health status before and after surgery, for instance, what sedatives were used, etc.

3.) *The waiting list personnel at the participating department (office nurse)*. Each and every participating department is allocated with a number of surgeries. The office nurse is responsible for setting up the elective surgery program of the department where she belongs to. Incases of cancellations, it is her/his responsibility to cancel the planned surgery and allocate new time for a surgery if so needed.

4.) *Coordinating personnel at the surgery and anesthesia department (coordinator nurse)*. When surgery orders are received the duty of personnel is to distribute the patients to respective OR theatres and revises the program (surgical) in cases of changes (plan), for instance, unavailable surgery equipment or delayed blood plasma, etc. and prioritizing and reporting of emergency cases before the late day shift starts, that is about 3:00pm. Coordinator nurse working on late shift is also responsible of relocation of patients listed on the previous day's program over to the next day's program who are categorized in "waiting today" (*venter i dag*) and emergency cases (*Ø-hjelp*).

5.) *Surgical Nurse* reports the time of the surgery and make sure that all surgical instruments are meet. She/he also assists surgical operations.

6.) *Anesthetic nurse at the OR theatres*, monitors the patients' health status while patient is undergoing surgery and fills out an anesthesia report before surgery is finished.

7.) *Nurse at recovery department*, monitors patients after surgery and make sure that patients are stable (health) enough before transferring to in-patient departments (dependent to which department is a patient categorized before surgery).

8.) *On-call surgeons (general)* are responsible of prioritizing patients according to health status classification; for instance, fresh patients who have no organic, physiological or psychic disorders are classified 1, it implies that these patients are on the lowest priority.

9. *Physicians who are not within the operating departments* are responsible to supply the necessary medical information in registration of surgery form (*operasjonsmelding*) of patients who need sedatives without surgeons consent.

4.5 The patient flow

To illustrate the complexity of managing and coordinating in surgery planning, I will present the out-patient multiple flows as the base point. However, UNN treats both inpatients and outpatients cases.

Supposed a patient is scheduled to undergo surgery, he/she is advised to report to the respective department, usually a day before the planned surgery, for instance, ENT (Ear, Nose, and Throat) department. The attending nurse retrieved her/his EPR, a brief interview was conducted and the patient was admitted to the department and instructions to change clothing and other protocols prior to next day surgery are given. Nurses monitor the patient for vital signs throughout the pre-operative time. On the day of surgery the anesthesiologist, in some cases might conduct a brief interview and so the same with the requesting surgeon or

specialist. Inquiries are raised regarding how the patients' health status. After which, the attending nurse prepares the patient for transport to the surgery department.

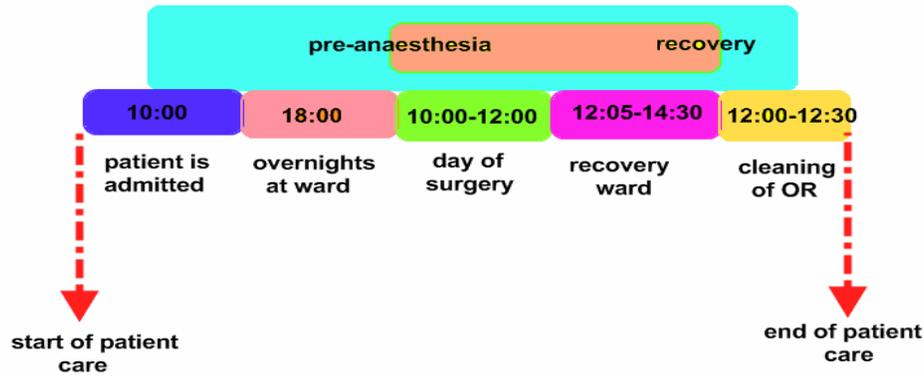


Figure 3. The patient's trajectory

In addition, the patient is turned over to the surgical nurses and anesthesia team for surgery. The above scenario implies the different group trajectories that intersect with and join with other groups at different times. A surgical operation trajectory involves patient trajectory, staff trajectory and resource trajectory. Different trajectories need to interweave and intersect at specific times to provide timely, safe and high-quality patient care.

4.6 An integrated topography

At UNN different Hospital Information System (HIS) are used; the aim of HIS is to achieve the best possible support of patient care and administration by electronic data processing. It can be composed of one or a few software components with specialty-specific extensions as well as of a large variety of sub-systems in medical specialties, the patient administration system/electronic patient record (PAS/EPR), radiology systems (PACS and RIS), and the blood bank or laboratory information systems.

These electronic systems are supposed to be integrated such that patient administration, ordering and retrieving of laboratory and radiological examination and results, could be accessed immediately across different work boundaries.

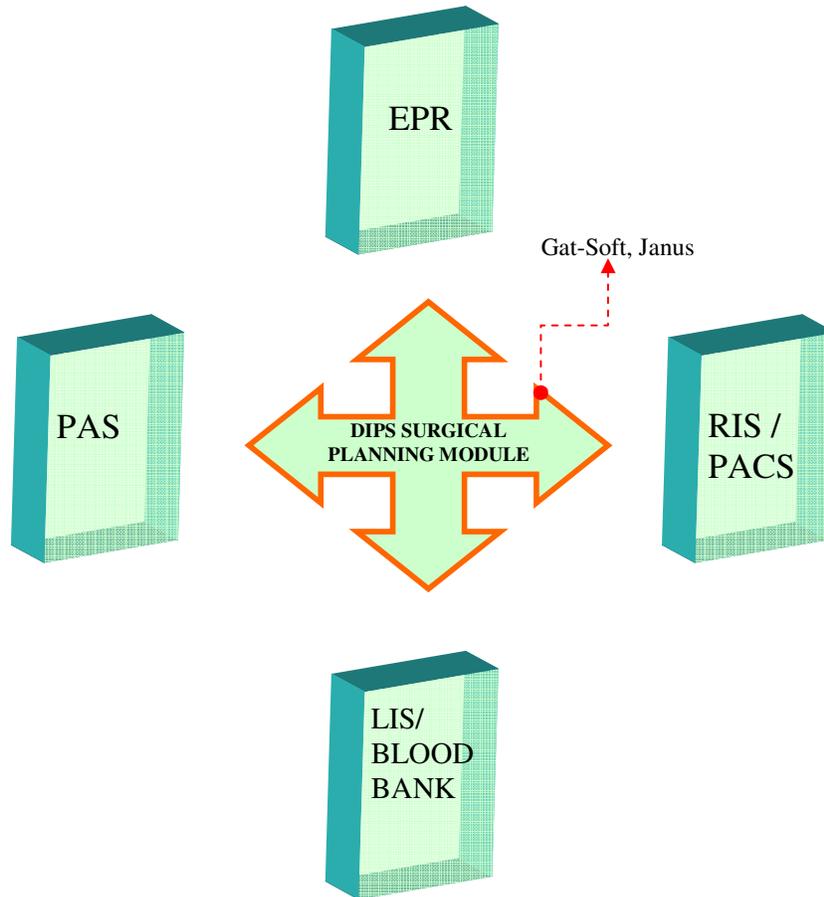


Figure 4. A schematic diagrams of the 4 systems.

4.6.1 PAS & EPR

A patient administration system is one of the earliest components of a hospital computer system which records the patient's name, home address, date of birth and each contact with the outpatient department or admission and discharge⁸, basically, the patient administrative system hold information or data needed to run hospitals as business. The PAS can also

⁸ www.wikipedia.org

include selected clinical diagnoses and contact history. Implementation of PAS precedes EPR, whereby, the two subsets of systems serve different needs; administrative and clinical, respectively.

4.6.2 Radiology Information System (RIS)

A radiology information system (RIS) is used by radiology departments to store, manipulate and distribute patient radiological data and imagery. This kind of application systems comprise of patient tracking and scheduling, result reporting and image tracking capabilities.

4.6.3 Picture Archiving and Communication Systems

A picture archiving and communication system (PACS) replaces film archives and other kinds of hard-copy based means of managing medical images. It provides the capabilities of off-site viewing and reporting, and enables practitioners at various physical locations to use the same information simultaneously. The decreasing price of digital storage provides PACS with a growing cost and space advantage over film archives. In addition, most PACSs handle images from various medical imaging instruments, including ultrasound, magnetic resonance, PET, computed tomography, endoscopy, mammograms, etc.⁹

4.6.4 Laboratory Information System / Blood bank

A laboratory information system (LIS) is a class of software which handles receiving, processing and storing information generated by medical laboratory processes. These systems often must interface with instruments and other information systems such as hospital information systems (HIS). An LIS is a highly configurable application which is customized to facilitate a wide variety of laboratory workflow models.

There are as many variations of LIS' as to the types of laboratory work. Some vendors offer a full service solution capable of handling a large hospital laboratory needs, others specialize in

⁹ [http://en.wikipedia.org/wiki/Picture archiving_and_communication_system](http://en.wikipedia.org/wiki/Picture_archiving_and_communication_system) _

specific modules. Disciplines of laboratory science supported by LIS' include hematology, chemistry, immunology, blood bank (Donor and Transfusion Management), surgical pathology, anatomical pathology, flow cytometry and microbiology. LIS commonly supports; patient check in, order entry, specimen processing result(s), entry reporting, patient demographics and physician demographics. In this paper, I included only the services of blood bank (donor and transfusion management).

4.6.5 Gat-Soft and Janus — the local IT systems

In addition many specific local IT systems are also utilized to support the daily activities. For instance, Gat-Soft AS (www.gatsoft.no) is a software module for automatic generation of nurse rosters. A roster plan shows the work schedule for each employee for a given planning period. Moreover, by using good, automatic tools for scheduling, a considerable amount of time is freed for working with patients. This software provides an option to lock pre-filled shifts, thus enabling human interaction in the planning process.

Similarly, one of the most significant benefits of automating the personnel scheduling process is a very considerable time-saving for the administrative staff involved. Also, a long range schedule (work) planning could be drawn, thus minimizing unnecessary cancellations of surgeries; i.e. scarcity of personnel or absence of a nurse(s). Moreover, Janus was another IT system used at the surgery ward. Surgical nurse utilized this system in registrations of protocols after surgeries were done. Firstly, they (nurses) wrote down patients' health status during preoperative¹⁰ stage. This information was then encoded to Janus IT system.

4.6.4 The Health North IKT and SKIS¹¹

Health north IKT is a public owned agency aimed at establishing IT related standards in Norwegian health care. The Health North IKT was established on January 1, 2006 and is serving 11 hospitals in 3 regions; Nordland, Troms and Finnmark. Likewise, SKIS is one of

¹⁰ relating to, occurring in, or being the period around the time of a surgical operation (<http://www.merriam-webster.com/dictionary/perioperative>)

¹¹ Senter for Kliniske IKT Systemer (Center for clinical information technology systems)

the divisions at UNN who is responsible to integrate all the clinical IKT systems within the hospital including DIPS.

4.7 The paper based surgery planning routines

Surgical operation planning involves a highly coordinated task from different work boundaries. Alignment and coordination demands thorough planning, like for instance, from ordering availability of time of operating rooms, forming the surgical team, preparing sterile OR equipments, cleaning the room, ordering of blood, and radiology services if so needed are but one of the many considerations to be focused on.

Before implementing DIPS, ordering of surgeries started from a physician's request done in paper. The requesting physician filled out and signed an order form; surgery order form. See below.

REGIONSYKEHUSET I TROMSØ PERSONOPPLYSNINGER (F.NR., NAVN, ADR.)

OPERASJONSMELDING

Rettledning, se bakside Ambulant Post Sign. rekvt. lege:

Preop.diagnose: Planlagt inngrep:

Ønsket dato: Ev. tidspunkt: Op. dato: Ev. utsettelse skyldtes:

Prioritering 0 1 2 3 4
 Evt. innen kl. (v.ØHJ):

Operatør: Op. startet: Op. avsluttet:

Assistenter: Op. stue: Op. nr.:

Preop.beh./us. operasjonsdagen: Opererende avd./seksjon:

FRYSESNIITT JA/NEI Operatør:

RTG: Assistent:

Gj. lysn. Us.perop:

REN UREN PUSS

LEIJE: Operasjonssykepl.:

AVDEKNING/INSISJON: Utførte inngrep:

SP.UTSTYR:

BLODBANK Behov (antall enh. ev. 0):

er bestilt

Antatt varighet av op.: Post.op.diagn.:

ANESTESI Ønskes/Foreslåes

Narkose/epidural/spinal/ledning/lokal/ingen

ASA I II III IV V

Risikofaktorer: Anestesi startet: Anestesi avsluttet: Anestesi gitt av: Anestesiavd. Opererende avd.

Pas. overført fra op.avd. til: sengepost oppvåkning intensivavd. annen avd.

Kontroll av instrumenter/kompresser: Sign. sykepleier/operatør:

BT	HB	HØYDE	VEKT	TIDLIGERE INFARKT	NÅR
LUNGEFUNKSJON	Normal	TIDLIGERE ANESTESIKOMPLIKASJON	MEDIKASJON	Andre	
Nedsatt p.g.a.		Steroider	Insulin		
		Antikoagula.	ALLERGI	Mot	
HJERTEFUNKSJON	Normal	Manifestasjon			
Nedsatt p.g.a.					

Troms Sykehus, TF 118

Figure 5. Illustrates the paper- based surgery order form.

In some cases, filling out of the form could also be done by a nurse upon request from a surgeon or a physician and later on signed by the requesting physician. The right portion of this surgical order form, under the column Op. dato or operation date (see red arrow on fig 5 above) remains unfilled until the day of surgery was carried out. This implies that the same form was further utilized during the day of surgery, confirmed either by the coordinator nurse's or by a surgeon. Further, as was reflected on this form, detailed information regarding the patient's "surgery time", health care personnel (surgery team) present, type of surgery undergone, the need for anaesthetics or not, who administered the anaesthetics were also reflected on this form. Also reflected on this form were post operation diagnosis and the

patient transition locale (polyclinics, recovery ward, intensive ward or any other ward) after the surgery.

Later, the surgical order form was passed on to the registration office or the receptionist (administrative section at the surgery ward). Upon receipt of the form, the secretary registered the order in a large registry book (needs picture!), showing; the requesting physician's name, the surgeon, name of the patient, diagnoses, necessary sterilized surgical equipment, the clinical history of the patient, etc. Before the end of the day's (approximately 15:00) shift the secretary registered to the computer (janus program¹²) and sorted out the different surgical orders according to which department the patient belonged, for example, neurology, gastro, orthopaedic and other departments. The secretary then printed out these forms and handed over the printed forms to the coordinator nurses (anaesthesia and surgical), on-call nurse (anaesthesia) of the day.

POST	NAVN	FØDT	DIAGNOSE	OPERASJON	OPERATØR	T	STERILSENTRAL	
HJERTE/KAR/NEVRO 00.jan Koord. Anestesi: 0 Avd. sykepl: 0 Koord. Operasjon: 0 Instrumenter: 0 Avløser anestesi: 0 Anestesi spl. 1 vakth. 0 Anestesi spl. 2 0								
00.jan	Spes.elev: Stue 3 (nevro)						A.lege:	
00.jan	Spes.elev: Stue 10 (thorax)						A.lege:	
00.jan	Spes.elev: Stue 11 (hj/kar)						A.lege:	

T=Transfusjon
//=Skille opr.spl og anest.spl

Universitetssykehuset Nord-Norge HF

Figure 6. Depicts the segregation of patients according to OR theatres

¹² Janus, an internal computer program used at surgery and anaesthesia departments

Allocation of surgical time and room was written in a separate form dubbed as pre-surgical operation program (previsittskjema/opr. program) (see appendix A). In addition, in cases where special equipments were needed, requisition was done by the secretary and handed to the sterile central upon receipt of surgical order. (refer to appendix D).

In addition, the written registry then was encoded into a computer program dubbed as Janus before the end of the early shift, that is, from 8:00-15:30. Surgical requests after 15:00 were allocated a day after, except for emergency cases. Printed requests were passed on to the coordinators (surgical and anaesthesia nurse) to be discussed for the following day's surgical plan. In addition to paper based request, the requesting surgeon or physician may take a phone call or talks faced to face with the surgical coordinator (nurse) for further confirmation. Before the start of the early shift, a ten minutes meeting was called, presided by the coordinators (as mentioned earlier, dependent of their posts) of the day.

Likewise, briefing on the day's tasks and distribution of responsibilities are carried on. Necessary information about any recent changes in patients' health condition was discussed, or if any personnel are sick or absent for the day. Surgical theatres or OR are then thoroughly checked ensuring that all necessary surgical equipments and supplies are satisfied. As soon as the patient was rolled into the OR theatre, anaesthesia personnel took over if necessary sedation was required, for instance, epidural¹³ administration, and any other anaesthetic procedures.

Further, personnel planning schedule distributed among dates, OR theatres assignment were posted on a large white board located at the hallway inside the surgery ward, prior to the OR theatres. I noticed that almost every medical or non-medical personnel constantly or usually stopped on this white large blackboard before entering into the OR. The purpose of this large white blackboard was to get a "quick" or updated information as to who was on duty (surgical coordinator nurse and anaesthetic nurse) thereby making it aware among personnel of whom to contact in cases of inquiries and secondly, to prepare themselves (concerned individuals reflected on this whiteboard) of their upcoming responsibilities. At the OR,

¹³ Epidural is an injection of a local anaesthetic into the space outside the dura mater of the spinal cord in the lower back region to produce loss of sensation especially in the abdomen or pelvic region.

anaesthesiologist, anaesthesia nurses and other members of the team, including medical students or student nurses, gathered focusing on each individual task.



Figure 7. The whiteboard

4.8 Background, problem, motivation

The situation at UNN's Surgical Operation Department before the deployment of new DIPS version 4.0, despite the hospital's widespread daily use of DIPS version 3.0 modules, surgical operation planning continued the advanced paper-based system. Typically a normal surgical operation starts with a patients' admission to the hospital and classified according to which ward (s) he belongs, i.e., neurology, gynaecology, etc. The EPR could be updated from results of blood test from the laboratory section, radiology section, i.e. MRI, Ultrasound, CT or any other examinations necessary before the surgical operation. The Physician in-charge "books" the patient for surgical operation.

Likewise, discussions are done among surgeons, anaesthesiologist and physicians for surgical briefing preparation prior to the planned operation. Nurses, assistants and orderlies, sterile central, for necessary surgical equipments, and cleaning personnel must be aware of this plan

to be able to coordinate. In this coordination, time plays a vital role to synchronize the necessary tasks. For instance, even a simple cleaning preparation of a surgical theatre if not synchronized will compromise the whole plan. Various roles have different needs and routines as well which highly demands wide range of coordination across different work boundaries. Dynamic coordination and collaboration between surgeons, physicians, anaesthesiologists, specially trained nurses, other non-medical personnel and resources to carry out these enormous tasks are extremely demanding.

The problem with this paper-based system was these local surgical time plans are not visible for other members of the surgical team (nurses, other physicians, assistants, etc.,) until surgical operation plans are drawn for the next day was produced. Because of these, cancellations, the coordination and integration, pre-operative assessment, ordering of surgical equipments, surgical operation capacity and observation ward capacity are compromised. On the same token, the disadvantage of using the paper based system created doubled tasks within the surgery and anesthesia departments whereby; registrations are done first in paper and later encoded electronically. This implies that the paper based system adds-up to the daily work routines and only escalated redundancy of artefacts.

The interrelated task of actors at UNN's surgical team and the different technical networks linking them together, the scheduling and coordination of surgeries is particularly challenging task. One challenge is to solve the problem to support or coordinate activities that will create new ways of collecting, transforming, representing, sharing, and using information thru an electronic supported tool.

In addition, the heterogeneity of tasks, for instance at UNNs' surgical operating ward, the different health care personnel across surgical planning; job descriptions, areas of responsibilities indicate a high degree of diversity. This diversity and or heterogeneity of responsibilities among actors across different departments are such a complex interwoven tasks that needs coordination. This diversity and or different variables arise due to the different job descriptions played by each health care personnel. The different chains of events delegated by different health care personnel are most often than not repeated systematically.

“Operations theatre scheduling deals with assignment of limited hospital resources (rooms, doctors, nurses, etc.) to jobs (patient treatments, surgery, etc.) over the time in order to perform tasks according to their needs and priorities, and to optimize usage of hospital resources. (Rajpathak, 2001) ”. For automatic meeting scheduling to work efficiently, everyone involved must maintain a personal calendar and be willing to let the computer schedule their free time more often than not. (Ehrlich, 1987).

This implies that all the health care personnel involved in the delivery of services at the surgical operating wards must be aware of information about the ongoing work flow. Tasks could possibly change without due notice when unavoidable circumstances arise, like for instance, emergency cases and or elective patients that need to be prioritized or a surgeon has other tasks. This unexpected circumstance mirrors a real time adjustment of overall plans. Cancellations cost increases due to this unavoidable events and this means a huge increase in health care cost. Keeping abreast of information in a large surgical ward is such a difficult task when paper-based system is being used.

Further, an increasing demand for surgical services has steadily increased through the years both on regular day and late shifts. The increasing capacity of demand is seen larger as what can be offered by the surgery department. In effect of this, integration of plans; pre-operative assessment, ordering of surgery equipments, operating room capacity and recovery ward capacity is difficult or not fully satisfied. Because the daily surgical orders are huge, cancellations also increases. The paper based surgical system seemingly is almost impossible to grasp between the increasing surgical demands which needs a long range planning. The demands of a wide range of resources for coordination of the daily tasks to meet the daily work flow between the departments and avoid increasing cancellations continued to escalate.

The unavailability of a long range plan on surgical operation planning was seen as one of the major problems on this paper based system. Forecasting future plans enhances better health care services, reduction in costs; whereby the change in work practices can be regarded either as an increased or decreased in cost and shift of work flow/tasks, for instance. The core medical personnel in surgical operations are surgeons, anaesthesiologists and physicians, etc. An untimely cancellation of surgical orders, for instance, increases health care costs; where among others, human and none human resources were not maximally utilized.

4.9 The vendor DIPS ASA

The DIPS ASA is one of the dominant players in the Norwegian healthcare sector with the largest customer base in the electronic patient record (EPR) field. Their products have gained a reputation for high quality, and the company expects a high growth rate to continue. As an organisation, DIPS ASA started inside the healthcare sector, and the DIPS-system has been developed through many years of close cooperation with hospitals. Knowledge about healthcare has been very important driving force to deliver excellent systems to the health care system, per se. Physicians, nurses and other healthcare professional constitutes 20% of its staff. Dips' organisation has great expertise in areas such as project management, quality control, implementation and process improvement.

Moreover, DIPS ASA promotes a paperless EPR concept. Paper records are replaced using a unique EPR-scanning and workflow system for physicians, nurses and office clerks. This eHealth development has been a great success for its customers and for DIPS as a company. So far, the DIPS EPR concept has been implemented in more than 30 hospital sites in Norway. They (Dips) claim that similar market penetration by EPR has not been seen anywhere else in the world. Dips further believes that it's products and services will make a great difference to hospital's work by increasing their efficiency, documenting treatment and at the same time increasing its quality.

DIPS have been a pioneer in the work of implementing standardized protocols and interfaces for the DIPS Systems. DIPS have been the first EPR company in Norway to implement support for many system to system protocols, utilizing Edifact¹⁴, XML¹⁵, and HL7¹⁶ standards. (www.dips.no). DIPS EPR supplies 55% among Norwegian hospital and is one of country's biggest fastest growing supplier of EPR. For three years in a row, Dips is one of Norway's fifty biggest technology companies and is among the 500 fastest growing companies in Europe. (www.idg.no/computerworld/article50301.ece).

¹⁴ Electronic Data Interchange for Administration is the international EDI standard developed under the United Nations; it provides set of syntax rules to structure data, an interactive exchange protocol (I-EDI), and standard messages which allow multi-country and multi-industry exchange.

¹⁵ Extensible Markup Language is a general-purpose markup language classified as an extensible language because it allows its users to define their own elements. Its primary purpose is to facilitate the sharing of structured data across different information systems, particularly via the Internet. It is used both to encode documents and serialize data.

¹⁶ Health Level 7 is an all-volunteer, not-for-profit organization involved in development of international healthcare standards. "HL7" is also used to refer to some of the specific standards created by the organization

In addition, DIPS is an open system, and this implies that other suppliers can develop modules integrated to it. In doing so, this integration creates similarity to different subsystems and leads to cost reduction in training users compared to other system. Exchange of data among subsystems can be a threat to security. DIPS have an extensive way of controlling access to users. It is possible to give a restricted number of users access to a patient's journal, making it highly secured. Another feature on security is, once a user has logged-in in one terminal, he/she cannot log in another terminal unless he logged out in the recent logged in terminal, password usage is restricted to only one use at a time. DIPS have access control at both the function level and the data level. Access control is protected down to which bed the new patients are hospitalised and at section level at polyclinic treatments.

4.10 Surgical planning (DIPS) – visions and goals

The challenge to employ a computer-supported coordinated scheduler continued to escalate. Thus, in September 2006, a mandate on utilizing an electronic supported surgical planning was drawn by UNN's management concluding DIPS ASA to be the primary tool. "A well prepared personnel meets a well prepared patient in an effective and predictable operation chain" (Document 1, projectplan operasjonsplanlegging i DIPS) goes UNNs vision in electronic supported surgical operation planning.

Accordingly, the added value of utilizing Dips should result to reduction of cancellation of planned surgeries. Not only but also, increase in quality in relation to patient care, documentation, economical costs, utilization of resources and accessible data in real time are expected from the new module. Nevertheless, UNNs main goal is primarily to utilize an electronic system to support the surgical operation planning. Visibility of physician's timetable should result in an easier coordination and integration of other resources, for instance, allocation planning of OR's. DIPS' new module functionalities allow integration of different tasks, for instance, accessibility of EPR across different coordinating/participating department in one module.

This implies that a user (physician or nurse) need not log in into another system in order to get hold of a patient's EPR; per se. Physicians can access EPR of one and the same person

simultaneously. Simultaneous accessibility is the utmost advantage of EPR reflected in van Bommel's *Handbook in Informatics*, (van Bommel et al., 1997). Simultaneous access to the patient data in the clinical setting also implies that the process of adding new data to the EPR has to be accelerated compared with the paper based. The concept 'simultaneous' also contains expectancy of getting access to the record from everywhere within the hospital and allows the possibility of discussing a case with another physician who might be located in another section of the hospital.

In addition, allocation of surgical time is another vision from the new module whereby surgeons, anaesthesiologist and or "defined"¹⁷ nurses are able to allocate OR suites and time. DIPS' new module contribution to meet this vision has created a special "window" whereby once surgical orders are approved and prioritized, allocation of OR suites and time is done by any defined user and is reflected in the surgical operation plan or *operasjonsplan*.

Not only but also, the possibility of an ordering physician to keep track of an ordered surgical time or plan is reflected by the flexibility feature of this new module. By accessing the same window (refer to fig. 9) and checking the corresponding department or date, a physician was able to browse the status of surgical order/s.

4.11 The implementation processes of DIPS

In this section, firstly I will present the vendor of the new surgical operation planning module (DIPS v.04), a brief background; its role on the Norwegian health care system. Secondly, I will present the implementation process which I followed closely from the pre-implementation phase, which was from mid-February 2007, through the post implementation phase from March 27, 2007 until May 2008.

¹⁷ Defined nurse is a nurse who is allowed to allocate an OR.

4.11.1 Pre-implementation phase

The pre-implementation phase of DIPS v.4.0 started by establishing contact between the IT at UNN, that is, the Health North IKT is the sole supplier IT systems in the entire health north region. The project manager for implementation of Centre for clinical IT system at UNN, dubbed as Senter for Kliniske Ikt-Systemer (SKIS) and the technical support team from DIPS ASA were also one of the core actors of this project.

Since the project encompasses a large groups served by the surgery department, project leaders were created representing various departments ranging from different professional backgrounds, particularly, surgeons, anaesthesiologists, physicians, specially trained nurses, consultants representing from; the section for surgery performed on an out-patient, urology and endocrine, anaesthesia, the surgery department itself, EPJ¹⁸/PAS Helse Nord IKT, gastroenterology and the heart and lungs departments respectively.

On this phase, the project group functioned as an arena for discussion of ideas and suggestions for a better surgical planning coordination and to customize (to some degree) of how DIPS ASA's surgical operation planning module would cater to the heterogeneous IT needs among different work boundaries. In effect of this, broader and wider bases were drawn as to how a planning module would support the daily activities across different departments; their work roles and responsibilities.

In addition, to carry out the secondary objectives of the surgical module, for instance, development of a new surgical order, thorough review and redefining of administrative function in anaesthesia and surgical ward, etc., different working (*arbeidsgrupper*) groups were also sat up. The working group consisted of a leader from SKIS, responsible in conducting meetings in the different departments. Furthermore, responsibilities were delegated to different personnel to carry out, for example, discussions with different department leaders, the surgical and anaesthesia department on designing of surgical operation orders, and definition and consideration of new parameters on cancellation of such orders and the like.

¹⁸ EPJ, *elektronisk pasient journal* is a norwegian language synonym for EPR

Defining accessibility level of different users, system lay out and users' codes, assigning of users' guidance, provision of computer equipments, and others were also extensively discussed by different work groups during this phase. Meanwhile, meetings and close coordination were also done together with the director's team (Director of Health North RHF, medical superintendent of UNN and the Chief-director of clinical departments at UNN), and the leaders of the different participating departments. The general aim of the meetings was primarily to discuss as to how the surgical planning should function and modification of administrative activities, etc., among others.

Further, to facilitate easier adaptations to the new system, super-users were identified representing each department functioning as a "side" technical support among colleagues. These super users should have a fair knowledge in different features of the new module. Super-users were among the first to attend the hands-on training whereby the researcher also participated herself. An approximately 6 hours hands-on training was divided into two sessions, morning and afternoon session respectively.

Stationary computers were sat up at the hands-on training venue (outside the hospital premises). A representative from DIPS ASA presided the hands-on training supported by the project group mentioned earlier. Stepwise access, use and step by step information of the new DIPS module were thoroughly explained to the participants with aided visual aid. Questions raised from the participants were successfully (almost all) satisfied. Brochures or printed guidelines were distributed prior to the start of the hands-on training. Accordingly, an intranet¹⁹ access of the brochure (DIPS ASA's surgical operation module) is also accessible.

In the meantime, laptops and stationary computers were prepared and eventually installed throughout the different departments in preparation for the implementation, March 20, 2007. A technical support line was sat up whereby users of the new system were able to contact for assistance, if so needed. Simultaneously, on February 28, 2007, a meeting was conducted, presided by the project manager of Dips (SKIS), participated by the different heads of the participating department. The general purpose of which was to align some functionalities that needed to be integrated to the new module as perceived by the users so far, this meeting lasted for about 3.5 hours. I took notes as much as I could. My observation was that not much

¹⁹ *An internal IT system accessible to employees at UNN*

was discussed or some members of the team were silent, seemingly due to the unfamiliarity of the new module. However, those who were more advanced in understanding the new module were among those who highlighted few adjustments to suit their needs work tasks.

4.11.2 The adaptation phase

As soon as the development and implementation phase were completed, the surgical planning module ran simultaneously throughout the participating departments. Surgical orders were done electronically thereon (March 27, 2007). Physicians and or nurses who encountered confusions using the module were either assisted by a super-user (colleague) or the technical support. During my field work I observed that laptops were sufficiently supplied and accessible throughout the different locale of the surgery department. For instance, even at the lunch room, stationary computers were also accessible.

In addition, at the post recovery ward, I observed that almost each nurse attending a patient had a laptop nearby. At the nurses' station on this ward, a large flat screened monitor was mounted on the wall. It reflected the real time different activities at the surgery department as it unfolded; different colours reflected as to the progress of the surgery, for instance, a red colour beside the patient's name means surgery in progress and a green, the patient is about to be rolled out of OR theatre, and etc. This entails that the nurses on this ward were able to plan ahead of time accordingly.

4.12 An anaesthesiologist's typical day; the role of planning

To illustrate the importance of planning, I will try to give a brief overview about anaesthesia, anaesthesiologists' goals for administering sedatives and lastly an anaesthesiologists' typical routine day focused on the pre-operative preparation only.

In most cases, the anaesthesiologist induces the patient into an unconscious state prior to surgical operation, maintains that state during the course of the surgery, and then terminates the process at the end. The anaesthesiologist's involvement in a surgical case can be divided into four phases: pre-operative preparation, induction, maintenance and emergence from anaesthesia and handing over to the staff in the recovery room. On the pre-operative phase,

for instance, the need of getting hold of a specific person arises when the information does not satisfy anaesthesiologists' data gathered from the patient. It is, for example, quoting a nurse (nurse 8)

“maybe vital to get in contact with the physician who made an entry in the medical record, in order to get more details of the exact reasoning behind a decision which might be relevant to anaesthesiologist decision in administering anaesthetics” (Nurse 8).

Similarly, there is a need for getting hold of a person (s) who has the latest or updated information ‘in their head’ because it has not been documented and distributed, such as the day’s radiology or blood examination result. A common interruption happens when patients’ conditions change – either for the worse, requiring emergent surgery (e.g., internal bleeding), or for the better, requiring cancellation of the surgery. Finally, the need for a specific person may arise where the highest expertise and authority upon a question is personalised in one individual. For instance as an anaesthetic nurse (nurse 8) lamented in saying:

“Usually the physician or a nurse at the admitting department orders requests for blood analysis prior to surgery, but for some reason, in some cases, they don’t do it, so to be on the safe side, even after implementation of DIPS’ surgical planning module, we send request thru paper-based. (ibid)

Patients with special conditions may react differently to anaesthetic procedures and medications. Therefore, anaesthesiologists and their hands-on providers (the anaesthesia team) need “to anticipate problems and plan ahead”. With difficult cases, anaesthesiologists need to triage and, if necessary, to seek for help from co-workers. Failing to do either can result in delays or mistakes.

Anaesthesiologists commenced preparation for individual surgical case immediately after receiving their case assignments, at which point they are informed of surgical procedure

names, scheduled lengths of surgery, etc. To ensure the patient's recent health status, usually anaesthesiologists have the opportunity to interview the patient and to conduct a brief physical examination before administering anaesthetics. Information regarding sedatives might not have been undergone by the patient before. Either, the patients have had unusual reaction from being sedated before not reflected on EPR. Or in some cases, conduct a pre-surgery dialog with the surgeon or requesting physician to ensure the patient's latest health status not reflected on the surgery order that might hinder or complicate the entire surgical operation later on.

Quite often they also have the opportunity to study the previous medical records of the patient. These medical records are sometimes voluminous being carried around and shared upon different medical personnel, starting from surgeons, physicians, nurses and clerical personnel. Moreover, it is his or her (anaesthesiologist) task to define, or even discover, the intended states during each surgical procedure and record necessary information after each surgical procedure relevant to the surgery. The anaesthesiologist usually has to "re-wire" the system for each case, because monitors, intravenous infusion lines, and ventilators all have to be attached to the patient at the beginning of each operation.

From the aforementioned scenario, this implies the vitality of planning and the role of the different artifacts interconnected, overlapped and is relevant to each and every member of the surgical team dependent on their pre-specified tasks. A missing updated patient's health record or status if unavailable, for instance, will seemingly hamper the information flow.

4.14 The DIPS ASA module in use

The screenshot shows a complex web-based form titled "DIPS ASA" with multiple sections for data entry:

- Diagnose og operasjonskode:** Fields for diagnosis and operation code.
- Operasjonsinformasjon:** Fields for patient name, date of birth, and operation details.
- Opplysninger fra operatør:** A large section for surgeon input, including ASA classification, comorbidities (e.g., heart, lung, kidney), and anesthesia requirements.
- Fylles ut av anestesipersonell:** A section for anesthesiologist input, including ASA classification, planned monitoring, and planned ventilation.
- Andre risikofaktorer:** A section for other risk factors.
- Planlagt anestezi:** Fields for planned anesthesia type and location.
- Axakt (styrking):** Fields for accuracy and reinforcement.
- Behandlingssted:** Field for treatment location.
- Gitt tidspunkt:** Fields for given time points.

an example where a physician must fill out manually

Diagnose og Operasjonstype må fylles ut.



this boxes must be filled out by the surgeon otherwise the order will not be accepted and not be marked as planned.

NB! Hver avdeling finner sine operasjonstyper under prefikset for avdelingene.

- Eksempler:
- A = diverse
 - AN = Anestesi
 - GK = GastroKirurgen
 - HK = HjerteKirurgen
 - KK = KvinneKlinikken
 - NK = NevroKirurgen
 - OR = Ortopeden
 - PL = PlastikKirurgen
 - RE = Reuma
 - UK = UroKirurgen
 - ØN = Øre Nese Hals
 - ØY = Øyeavdelingen

Figure 8. Screenshot of the most used template

The DIPS module was extensively used, seamless information were extensively utilized. Planned surgical operations were visible to defined users across different departments. For instance, a surgeon could update on progress at operating theatre 1 or access his own time plan or other's time plan (work plan). Real time feature of the new module made planning

and carrying out of plans easier such that other personnel or departments (surgical, recovery, polyclinics, sterile central, etc.) who were involved on the surgical operation chain could prepare themselves on their forthcoming activities. Managing and administration of patients, for example at the recovery ward, could be dealt with certain ease. Quoting a nurse at the recovery ward:

“Before the new version was implemented, we always have to ask (personally or by phone) the surgical department about the progress of a patient undergoing surgery, and this makes us uneasy not knowing what was going on at the other side”(nurse 5)

In addition to real time features of the new module, DIPS’ new module included updated registration plan and cancellations. With the new DIPS surgical operation module, a physician could electronically register and browse open time plan on desired specific dates or cancel a planned tasks. In effect of these, surgeons, anesthesiologists nurses, and others could be able to prepare surgical tasks/plans; these plans (surgical) are accessible in days, weeks, and even months in advance. These features were also possible within the polyclinics or in department’s journal.

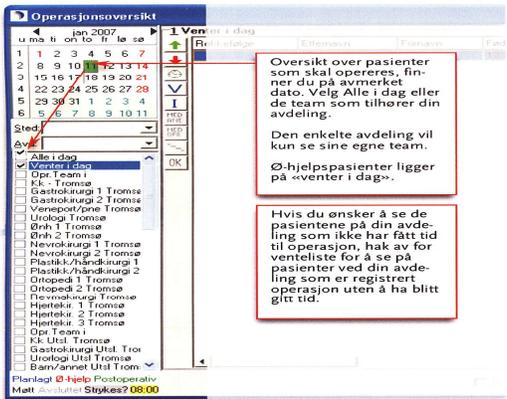
Not only but also allocation of surgical time is another vision from the new module whereby surgeons, anaesthesiologist and or “defined”²⁰ nurses are able to allocate OR suites and time. DIPS’ new module contribution to meet this vision has created a special “window” whereby once surgical orders are approved and prioritized, allocation of OR suites and time is done by any defined user and is reflected in the surgical operation plan (*operasjonsplan*).

²⁰ Defined nurse is a nurse who is allowed to allocate an OR.

Operasjonsoversikt

Åpne Operasjonsoversikten ved å klikke på knappesymbolet for operasjonsplan.

OPR
PLAN



Oversikt over pasienter som skal opereres, finner du på avmerket dato. Velg Alle i dag eller de team som tilhører din avdeling.
Den enkelte avdeling vil kun se sine egne team.
Ø-hjelpspasienter ligger på «venter i dag».

Hvis du ønsker å se de pasientene på din avdeling som ikke har fått tid til operasjon, hak av for venteliste for å se på pasienter ved din avdeling som er registrert operasjon uten å ha blitt gitt tid.

Side 12 av 27.
Dips Rutinebok, Operasjonsplanlegging.
Senter for kliniske Ikt-systemer, UNN.
Kjell Kristoffersen/Hugo Kolstad, Sist endret 14.02.2007.

Figure 9. Depicts the referral order form

Not only but also, the possibility of an ordering physician to keep track of an ordered surgical time or plan is reflected by the flexibility feature of this new module. By accessing the same window (refer to figure above) and checking the corresponding department or date, a physician was able to browse the status of surgical order/s.

Other functions of this new module are:

- Post-operative plan could be easily planned by following the operation plan and developments in the different operation within the hospital.
- After registration of activities was totally phased out.

- The different participating departments can give information to a relative who calls about the surgical developments of their respective relatives. Personnel need not forward calls to post-operative department because they could monitor that patient undergoing surgery is still at the OR suite.
- Participating departments could follow operating plans within their post and prepare patients for the next surgical operation.
- Departments could also follow patients who were at the recovery wards and made plans when patients can be rolled back to their respective departments.

In addition, DIPS' surgical operation plan also was integrated to other DIPS module, like, an infection registration and EPR. Infection registration which has started from September 1, 2006, is expected to be reported to NOIS²¹.

4.13.1 Coexisting local practices and IT systems

Local IT system and paper based system continued to coexist side by side with the new DIPS module. Gat-soft as mentioned earlier continued to play a crucial role in nurse's roster as a normal personnel scheduling practice before the new module was in use. Additionally, no change in paper based system in ordering of blood bank and sterile central services was observed. The role of Gat-soft, like information exchange between nurse's schedules and allocation of specific duties paralleled to surgical operation services were co-dependent, for instance.

4.13.2 Less access but easier work load

With the introduction of the new module, shift of some tasks and workflow has changed within the surgical operation ward. In this regard, I choose to follow a receptionist and a surgical nurse day's task before and after the new implementation of DIPS new module. Generally, secretaries on their normal day's routines are very busy, they register surgical orders, both on paper and then electronically, answer telephones, forward some calls, receive

²¹ NOIS (*Norsk overvåkingssystem for infeksjoner i sykehustjenesten*), Norwegian infection control among hospitals after a patient undergoes surgical operation.

incoming orders, takes messages, follow up inquiries posted from different departments and do printing tasks.

4.13.3 Limited access for receptionists

Before the implementation of the new module, secretaries had a full access to the patients list within the surgery department. One of their main responsibilities was to register incoming paper based surgery orders of the day. As such, these orders were then registered manually to a large registration book, segregated according to the different department, for instance, OR1 is allocated for neurology department, OR 2, heart and lungs, etc. Seemingly, the registration book served as a link between of information flow among other personnel to keep abreast of future plans. The atmosphere at this office was quite chaotic, because people come and go, sometime talking or discussing about their patient, but usually, they didn't stayed long.

Moreover, the receptionist then logs on to an electronic program dubbed Janus, as mentioned earlier on other part of this paper and entered the data reflected both on the paper based surgical order and the registry book. In between these tasks, she received and countersigned incoming orders, like blood plasma needed for next day's operation, and sterile instruments. Before the end of the day's shift, she printed out the surgical order and passed it on to the coordinator nurses. If special surgical instruments were needed, she printed out another form for the central sterile department.

Conversely, with the implementation of the new module, the receptionist' work load changed. The access to the surgical operation plan became limited, for instance, she could no longer cancel a particular patient if so needed. Allocation of OR theatres were automatically generated new module. Receiving and countersigning of blood results, ordering of sterile instruments and other supplies continued as usual.

4.13.4 Structuring the boundaries

The importance of drawing work boundaries between personnel draws a central attention especially in a fast paced surgical ward. The role of each personnel should be fully delineated. Registrations of surgical operations, for example, were restricted to defined users,

like, surgeons, physicians and anaesthesiologists. Each user was assigned with log in names or initials and passwords. A physician for instance, identifies herself/himself before she/he could order surgical time. In addition, on the registration of operation, drop down menus were sometimes flexible but not always. One of the most vital information demanded on this particular electronic registration was filling out or supplying the *recent diagnoses* of the patient and type of surgical operation. The requesting physician must fill this portion out and clicked save before logging out.

Utfylling av «Registrer operasjon» (Operasjonsmeldingen)

Utklippet under her viser hele vinduet «Registrer operasjon» (Operasjonsmeldingen). Feltene fylles ut av ulike grupper personer og i ulik rekkefølge.

Diagnose og Operasjonstype må fylles ut.

NB! Hver avdeling finner sine operasjonstyper under prefikset for avdelingene.

Eksempler:
 A = diverse
 AN = Anestesi
 GK = Gastrokirurgen
 HK = HjerteKirurgen
 KK = KvinneKlinikken
 NK = NevroKirurgen
 OR = Ortopeden
 PL = Plastikkirurgen
 RE = Reuma
 UK = UroKirurgen
 ØN = Øre, Nese, Hals
 ØY = Øyeavdelingen

Figure 10. Illustrates an overview of registration template for surgical operation.

Below was one of the quotes from a surgeon regarding his insights of the DIPS' module functionality.

“This registration request (operasjonmelding) is very cumbersome and not user friendly, it needs a lot of data which cannot be copy pasted from the EPR but supply the necessary data “manually”, not only but also other data that must (måtte) be supplied, there is no drop down to choose from. I am not used to filling out surgery orders by myself previously, but just ask a nurse to fill it out in my behalf; all I did was signing the paper request”. (Physician 1)

The above scenario succinctly reflected the surgeons' irritation and hesitation to using the module. The consequence then of failure to fill out the diagnoses and type of surgical operation is tantamount to rejection of the order and will be reflected later on the planning module. In some cases, the requesting physicians failed to save the request, and just filled out the form and sent it directly. The request then was reflected on the surgical time plan, however, not until it is checked thoroughly by the scheduling personnel; a coordinator nurse or anaesthesia nurse (coordinators) would it revealed that the important data are missing and the order then will not be allocated on the time plan.

Further, I observed during one of my participant observations that requests order were enormously huge spanning weeks and or months before planned surgeries. As such, unfulfilled requests are not easily visible unless thoroughly checked. Filtering of this unfulfilled requests were not possible on this new module. Although colour codings were visible on the time plan, like for instance, an approved planned order reflects a green color or an emergency is red, still are some cases are overlooked.

“We have to closely check each and every requests if all the necessary information are reflected on the requests, otherwise, we have to call (by phone) or talk face to face the requesting physician and this demands a lot of work and time delays. This department is highly busy; we expected that the new module would have able to sort out or filter these deficient requests” (Nurse 8)



Figure 11. Checking the surgical orders/referrals

4.13.5 Training needs

Accordingly, there are prevalent complains that the new module highly demanded a detailed knowledge in using computers. Browsing and getting access to a new window demands a better know how of the right “button” to poke.

*“We are working in a high paced OR theatres, we don’t have time to slow down when the patient is on the table, learning, getting used to the module and simultaneously on the job is not attractive at all”
(Nurse 4).*

This was a comment received from nurses (some) at the OR. She continued in saying (ibid, more details); only few nurses were solely trained getting used to

the system; others were just trained by colleagues while they were working. These prevalent bottlenecks were also reported to SKIS, to quote:

“Detailed knowledge of using a complicated module is predominantly a constant complains” (Nurse 2).

An illustrative scenario could be a physician at the emergency ward received an emergency patient referred from a GP²². The emergency physician then categorizes which department the patient should be admitted in (i.e. Gynaecology Department) and fills out a surgery request (emergency request). On this request (electronic), much information is needed to be correctly supplied otherwise the patient will not be allocated as an emergency case. See for example on fig Boxes A, B, and C, if information on this box were omitted, the surgical order will be considered deficient or incomplete. The detailed knowledge or awareness of right information to be supplied then was crucial on this surgical form.

²² *General Practitioner (physician) serving primary care service at community level.*

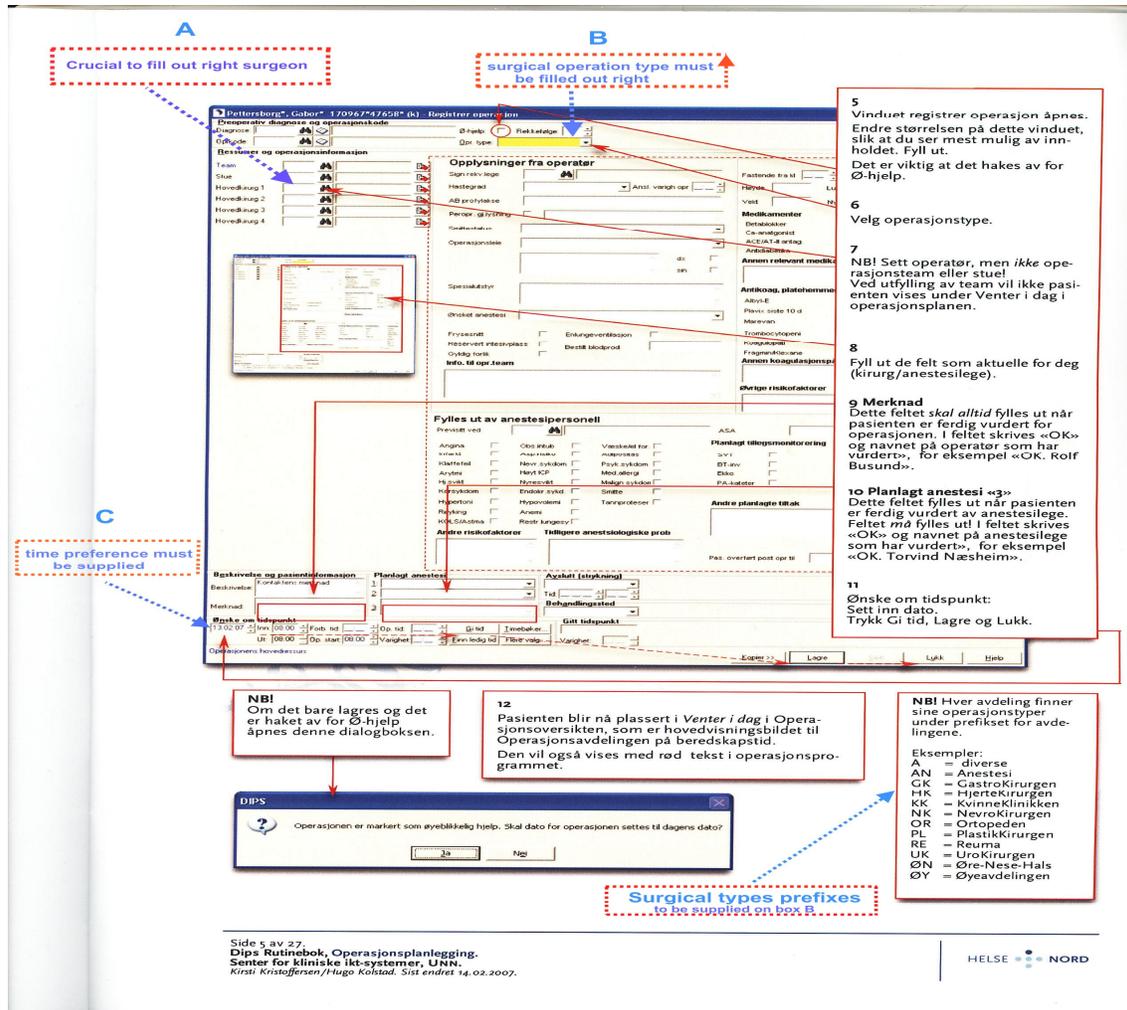


Figure 12. The referral form

Moreover, in one of my participant observations, I noticed that a nurse forgot to punch the right password and repeatedly tried a number of times; she got uneasy and gave up logging on again. Therefore, she asked assistance from a super user (surgery nurse), it took awhile for the super user to find and solve the problem, maybe approximately 15 minutes but to no avail, she (super-user) then phoned the technical support and was given assistance to solve the problem. The technical assistant and the user solved the problem remotely while both of them were logged in to the new module. Quoting nurse 6:

“This is the problem in electronic stuff, we need to log-in, and if we forgot the right password accessibility is denied, and this create problems and delays if we urgently need information. Unlike the paper based it was easier and accessible anytime.”

From this premise, I observed during this early phase that frustrations started to build up, comparing the paper based whenever they got entangled with the new module. Also in one of my field research data collection, one nurse commented that she tried to avoid accessing the new module in fear of making mistakes and that she might be seen as a slow learner among her colleagues.

Moreover, the insecure expression of her face clearly showed of not being able to adopt and use the new module, despite being a specially trained nurse. “It feels like being pierced on the breast not able to use this module” she lamentedly said; she is in her early fifties. Conversely, there were also users (nurses) of varied age groups who were more enthusiastic and comfortable using the new module. It is not my position on this regard to conclude that age bracket played a significant role regarding the usage of this new module.

4.13.6 DIPS limitations

Almost every IS has its own limitations in many ways and may often not be observed until used in practice. Although profound intentions and planning were done, more often than not, limitations are inevitable. DIPS have its own limitations too in this context. During my participant observation at the field, looking closely at the module, excessive amount of data are being demanded for filling out (electronically) different forms. Work practices before, the paper based, more so relied on surgical ordering (not always, but possible) from the nurses “handed down” or requested from physicians.

This specific work practice was altered- the ordering physician was no longer allowed to request a nurse (s) to order surgical slot in the physician’s behalf. The purpose of channelling back this task was to make sure that those responsibilities (requesting surgical slot) lied directly on the physician himself/herself.

In addition, in cases of incomplete surgical requests, unless otherwise physician checked the status of surgical order electronically, or ask (verbally) the coordinator nurse can then the physician be aware of surgical status. The consequences then would neither the request be cancelled nor be followed up by the waiting list personnel by calling the attention of concerned physician. However, many physicians who were ordering requests outweigh the number of non-compliant though.

“Quite a few are non-compliant (verstinger) most of these requests are for minor surgeries though, however they should at least follow what is needed (information) from them. There are a lot of good stuff in DIPS, no doubt about it, oh yes there are! (nurse 8)

Moreover, there are instances that planned surgeries are cancelled because patients (minor cases) are on vacation, or important recent diagnoses are not reflected on the registration form, or lack of sterile surgical instruments, and or sick personnel, for instance. Thus, the need to cancel this scheduled surgery should be executed. As such, drawing up a new surgery schedule could be cumbersome. For example, information entered manually on the cancelled order (for the same patient) could not be copy pasted to the new surgery request. Accordingly, considering the number of surgeries for each single day and the percentage of cancellations could seemingly create double tasks.

“It should have been easier if physicians could just have copy pasted all the information from cancelled request, but the module does not allow it, some physicians complained about these limitations”
(nurse 2)

Further, identification to which contact could be confusing, and this was a constant bottleneck on the new module, refer an example below:

Henvisning – registrering av elektive pasienter i operasjonsoversikten (oppstart ved ventelisteansvarlige)

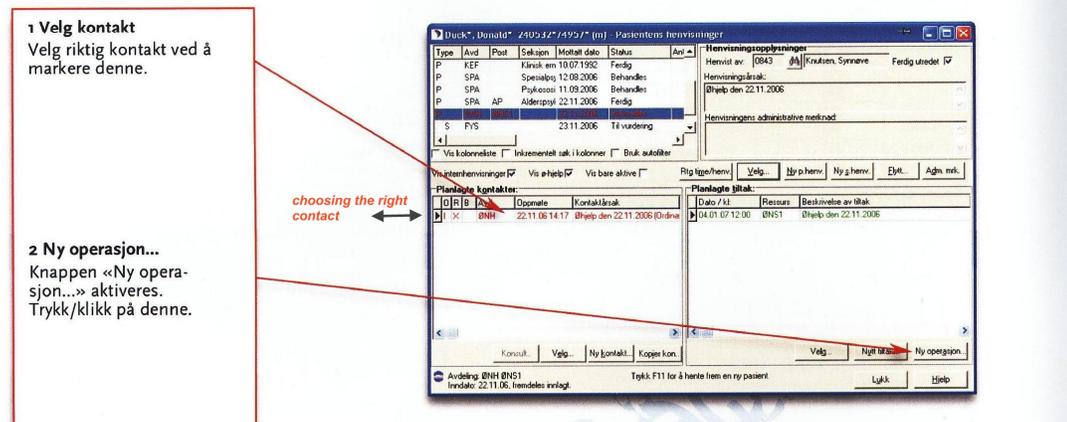


Figure 13. Choosing the right code or contact

Accordingly, for example, a patient had cancer on the stomach and was admitted to the oncology department (*kreft avdeling*, in norwegian language), the right contact then to register would be gastro surgery, however, supplying wrong type of surgical code which is a must, leads to incomplete or rejected order on the planning book (*timebok*). As mentioned earlier, filling a new order demands lots of time and wrong types of codes (*operasjonstyper refer fig . .*) adds-up to the physicians', nurses' and waiting list responsible tasks as well.

“We encounter this kind of surgical order almost every single day and there are not only one or two case, but many of them, these increases to the daily tasks, sorting out and meticulously checking each surgical order”. (nurse 1)

4.13.7 The refresher's course

Accordingly, it was seen that the constant bottle neck increases regarding the use of DIPS; the incomplete information on surgical referrals, wrong codes used, difficulty to find the right templates, among others. This implies that some end users were not fully utilizing the module. Thus, to harness users' ability in utilizing the module, approximately six months after the implementation of the module, SKIS conducted a 30-45 minutes refresher course at each and every participating department.

4.13.8 Duplication of tasks

Periopertaive (relating to, occurring in, or being the period around the time of a surgical operation) registration plays a big role when patients are on the surgical table. Exact time registration of sedative is crucial especially in cases when unexpected problems surfaced, i.e., changes in respiration, changes in gastro, lever or kidney function, etc. Future assessment would be easier to trace back when the exact time has the health status changed.

However, accordingly, this template in DIPS module could not be activated until the surgery is done.

“We make the best out of it. This is not quite good because registration is supposed to be done in real time. The module only accepts registration of activities when surgery is finished, thus, we do register information after the surgery, which should not be the right way” (nurse 8)

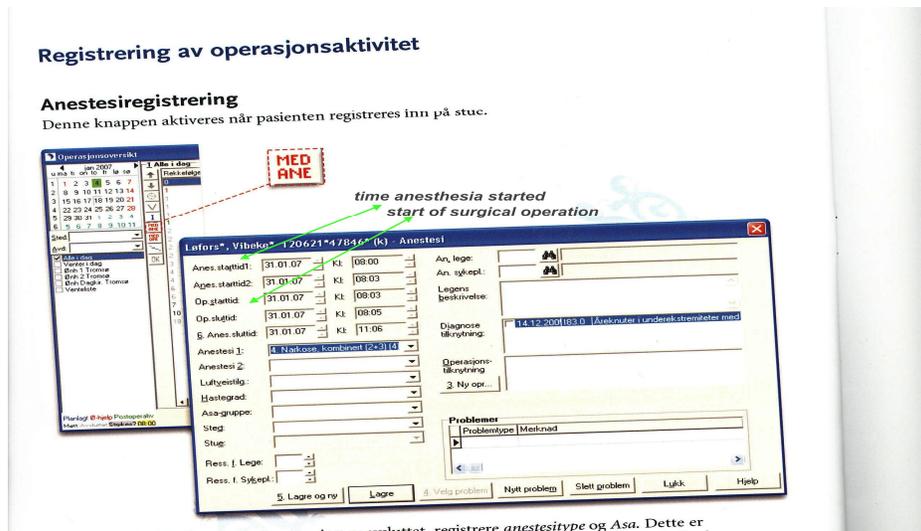


Figure 14. Depicts tasks within anaesthesia team registration of activities

This implies double tasks. First, taking note thru paper based and supplying this data to the DIPS module after the patient is rolled out of the OR theatre.

Further, a quarterly report on the number of patients who have been administered with sedative of any kind, i.e. total intravenous, local, spinal, epidural, etc. is a mandatory imposed by UNN. Accordingly, on the first quarterly report after implementation of DIPS (approximately July 2007) many patients who have been administered with sedative were not reflected on DIPS' data base. For instance, if a patient was referred to be administered with central venous catheter²³ and the anaesthesia team registered the patient in the module with operation code; i.e., AN CVK (*central venøs kateter, Norwegian language term for central venous catheter*). Quoting anaesthetic nurse:

²³ A catheter passed through a peripheral vein and ending in the thoracic vena cava; it is used to measure venous pressure or to infuse concentrated solutions. <http://medical.dictionnaire.thefreedictionary.com>

“We had to go back weeks and months scanning all the records identifying who among those patients were administered with sedatives, this was very cumbersome and requires a lot of human resources, it’s frustrating for such a highly advanced electronic stuff to oversee this” (nurse 8)

5 DISCUSSION

In this section I will discuss the introduction of information infrastructure (DIPS) to a heterogeneous user its implication and changes in work practices, in what ways DIPS has contributed to a better workflow and the consequence it entails to such changes in work practices. Further, discussions on how the actors/stakeholders were enrolled, the different work practices that influenced their behaviour in use of the module.

5.1 Establishing clear cut boundaries between nurses' and physicians' tasks

The health care delivery system is unique in several respects, all of which have a direct impact on the ability of the organization and its individual members to absorb information technology and utilize it in delivery of health care. These characteristics include the unique knowledge-skill relationship within the health care system itself, the long training time and resultant knowledge fixation of physicians, and the relatively fixed hierarchy within the health care delivery system.

Conducting surgeries and coordination of tasks in healthcare/large heterogeneous organizations is by no doubt a key to successful patient care. Implementing technology in organizations embodies a vision of health care premised on speed, innovations, and precise surveillance of and accounting for care and health care professionals. Bowker et al., argues (1999):

“One goal of such technologies is to expose the intricacies of patient care, to make concrete the intangible”

However, a lot of work requires much coordination of work between nurses and physicians are done in informal, ad-hoc-ways. For instance, in cases where referrals are not satisfactorily filled out, the coordinator nurse have to contact the concerned physician either by telephone or through face to face conversion.

One of the major challenges by implementing DIPS is that it makes the boundaries between nurses' and physicians' work clear-cut. For example, thru coding system whereby physicians were assigned codes such that only those physicians authorized to send electronic referrals were able to access the template (refer to figure 9).

Comparing the paper based surgical referral form to that of the electronic referral module (DIPS), the context of the latter is drawn from the former in some ways. For instance, to make the electronic referral more legally laden, it (DIPS ASA) constrained other medical (nurses) or administrative personnel (secretaries) to fill out surgical referrals as were possible on the paper based.

This feature of the electronic referral laid down the core responsibility or re-delegated the responsibilities to the physicians in referring surgeries. As such, the demarcation line between the work tasks of the physicians and nurses were now being made clear cut. DIPS ASA's surgical module became a focal point, a common resource for the coordination among the surgical team. The surgical module as an artefact — a mediator, that mediates or articulates tasks thru the coordinator nurse (s) to easily manage or administer the surgical referrals and at the same time easily coordinate with the anaesthesia team and the non-medical team. Berg (1999) underscores:

“information technologies are tools that receive input, transform that input, and produce output, and they are thus intimately connected with the practices that read and write these inscriptions.”

5.1.1 Enrolling actors

The project managed to enrol nurses, but not physicians. Nevertheless, it should have been physicians who were needed to enrol, however, physicians were not as enthusiastic as the nurses, and one reason for this might be that the physicians were not directly benefited, i.e. on their clinical tasks. On the contrary, the nurses were more interested because DIPS supported the administrative tasks. Grudin (1988) argues that:

“in implementing electronically supported calendar system in large organizations, it is crucial to draw who gets the benefit for such technologies”

A crucial question to ask then is how these inscriptions were brought into existence.

In ANT term, transcriptions are the actors' visions, wishes, and goals among others that were aligned, meshed together and formed a network thereby a template or model are based on, (Latour, 1987). The vitality lies on how, who were the enrolled actors in such a network to exist. Looking at the list of team members who initiated the design or transcription process, I foresaw that almost ninety-five percent of the team members were populated by nurses, except one anaesthesiologist. When I asked an informant why this was so?

“we conducted meetings with them (physicians at the different participating departments) negotiating what they wanted from the module” (nurse 2)

This means that prior to enrolment of actors it is presumed that problematization and intressement (Callon, 1986) has been satisfied. This presumption might be partly true because after almost a year after implementation, I went back and asked the same informant on how the physicians were adapting DIPS surgery module.

“We have many reports from the physicians that the module is cumbersome; they need many “clicks” before they can find the actual window or template needed” (nurse 2).

The same comment was supported by a physician. Does this mean that the enrolment of actors was not adequately met? Or could it be that during problematization and intressement stages (translation) was poorly represented by physicians?

5.2 Support for the administrative tasks versus support for clinical tasks

The physician (*physician 1*) complained about the user friendliness of the module. Accordingly, it is not easy to find the right template one is looking for, sometimes there are even no alternatives to choose or no drop down menus such that they get entangled and must manually write information, refer screen shot below:

Slik vises vinduet «Registrer operasjon» - Anestesi uten operatør

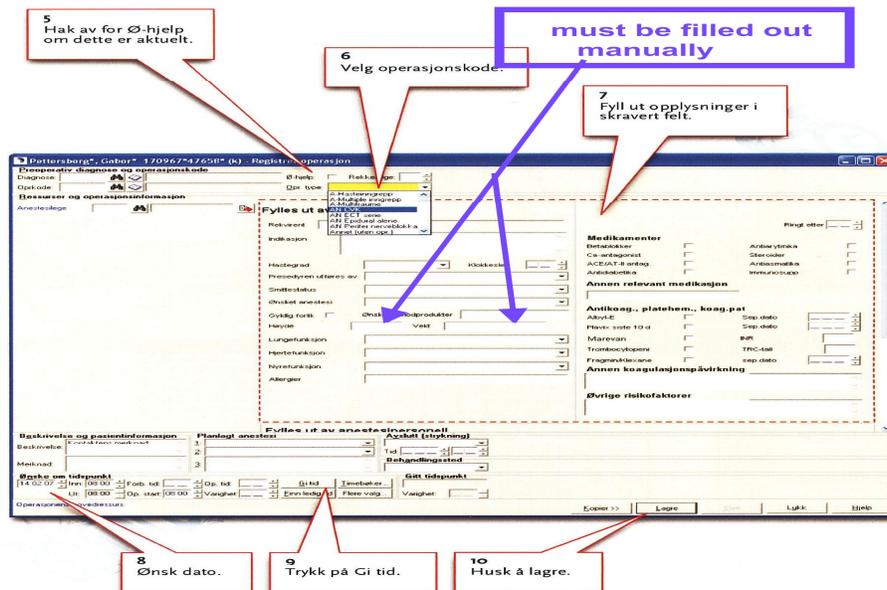


Figure 15. Screen shot of electronic referral

Although, it seems an easy task to fill out manually the information on the screenshot above for instance, to an inexperienced user/actor this was cumbersome.

“DIPS design should be “overhauled” (ta et godt runde), this looks like a tool for people with advance knowledge in computing, we do not have enough time going in and out of different templates, we are busy attending different clinical tasks”(physician 1)

From this quote (and others) we might conclude that the module didn't support surgery planning. However, an alternative explanation maybe that clinical task is very complex. For instance, a typical scenario would be when a patient suddenly raises his/her blood sugar after a surgery has been referred, or might be that radiology results are not ready yet because radiographic machines are not executing well enough, among other grounds.

In the case of raised blood sugar mentioned above, a physician's main priority must to stabilize first the patients' health status which results to unplanned cancellation of referred surgeries. Furthermore, because of this fluidity of patients' health condition this has to be dealt with by physicians and at most times formidable when drastic changes occurs.

Thus, it is really difficult to capture all the idiosyncrasies of clinical work. Therefore, designers end up building systems for administrative tasks.

Planning and coordination of tasks which is seen as an administrative responsibility, likely seem to be supported by the module in a general setting. However, clinical tasks which are perceived by physicians to be taken more focus into than spending more time on administrative tasks. Similarly, it even becomes more complex when we try to merge administrative and clinical tasks into one surgery planning system.

5.3 DIPS coding strategies; consequences on workflow

In surgical planning, due to the fact that physicians hold the central role in surgical tasks, in most cases, the success or failures in planning and coordination also holds true within this specific group.

For instance, coordination commenced from referrals (*henvisninger*) which are the starting and critical point in carrying coordination process, critical in a sense that when referrals are not fully and rightly filled out by a physician the coordination process is impinged.

Moreover, coordination of workflow demands precisions to avoid bottlenecks or breakdowns in the chain of tasks, i.e. planning and to support easier allocation of resources. For instance, (refer to figure below), by supplying the right code for the surgery type, this further articulate allocations of OR time slots, allocation of number of surgeries for a particular department in a target time frame and or rostering of specially trained nurses, among others.

AN = Anaesthesia
 GK = Gastric surgery
 KK = Gynecologic Surgery
 ØN = Eye, Ear, Throat surgery
 and many other codes

the different codes

5
 Vinduet registrer operasjon åpnes
 Endre størrelsen på dette vinduet,
 slik at du ser mest mulig av inn-
 holdet. Fyll ut.
 Det er viktig at det hakes av for
 Ø-hjelp.

6
 Velg operasjonstype.

7
 NB! Sett operatør, men ikke ope-
 rasjonsteam eller stue!
 Ved utfylling av team vil ikke pasi-
 enten vises under Venter i dag i
 operasjonsplanen.

Figure 16. The different codes to identify types of surgery

Similarly, OR theatre allocation, special surgical instrument (s), the need for blood examination (plasma) are also among other attributes that emanates from this codes. Not only

but also, it allows easier renegotiations among affected personnel and other resources in cases where a plan deviates because of contingencies and or emergencies, hence supporting UNNs' visions:

“planned surgeries become visible to all personnel who have the right access to the DIPS module. Other involved personnel can then prepare themselves and serve the patient in a well-prepared fashion.”

In addition, one of the benefits among physicians of utilizing DIPS ASA's surgical module is it allows physicians to check on status of referred surgeries without contacting a nurse or a secretary. Nevertheless, despite that the majority of physicians filled out the referrals in an “acceptable” manner, hence increased in better administration of surgical plans and better workflow; there are still some who does need more training and mastery in filling out the referrals.

Consequently, it created a loophole or bottleneck in the surgery planning. Even though these referrals are “temporarily” accepted by the DIPS' surgical module, if not meticulously checked by a coordinator nurse or by the ordering physician themselves would it reveal the status of it (referral). This entailed double work for both clinicians and nurses. A quote from a coordinator nurse and nurse (nurse 2 & 8) goes to say:

“Despite a year has gone since implementation of the module still is many physicians are difficult to change when it comes to requesting surgeries, we need to check them (referrals) every single day and do some follow ups, otherwise if overlooked it'll stay stagnated on the module, horrifying/forferdelig (forferdelig, a norwegian term)

In social organizations, commitments to carry out task by each individual are interdependent. Hence, manual work arounds in the form of contacting the physician with unfulfilled surgical referrals has to be done by the coordinator nurse. These fixes are problematic because they caused extra work among coordinator nurse (s). However, Gasser (1986) argues that it is necessary when task assignments break down, additional work must ensure to reinstate them (tasks) to accommodate the new arrangements.

5.4 Replacement or extension; paper and electronic co-exist

The surgical module purportedly should have eliminated the paper based requisitions. On the contrary still the requisition for surgery equipments are done in paper. The secretary should go through all the patients who needed special surgical equipments jot down in a special form (refer figure below) and handed over this lists to the sterile central, the same routine exist as were before the new module was implemented.

Operasjonsprogram til sterilsentralen		23.01.2008
		Innslusa/generell seksj.
Koord.opr tlf. [redacted]	Instr.ass stue 1-6: [redacted]	
Opr.spl. hjerte tlf. [redacted]	Instr.ass stue 7-12: [redacted]	

stue 1(gyn)		
Nr	Født år	Prosedyre fra sterilsentralen/ + evt. Brikke
1		STOR LAPAROTOMI
2		STOR LAPAROTOMI
3		
4		

OR theatre number → stue 8 (gastro)		
Nr	Født år	Prosedyre fra sterilsentralen/ + evt. Brikke
1		LAPAROTOMI
2		
3		
4		

stue 9 (uro)			
Nr	Født år	Grunnpakke	Brikke
1		STOR	STOR LAP GASTRO
2		STOR	STOR LAP GASTRO
3			
4			

Figure 17. The paper based order for the central sterile section

Not only requisition to the sterile central which needed a paper based requisition but also requisition of blood analysis to the blood bank. The coordinator nurse (s) have to go through patients who were going to undergo surgeries, made a list and handed it to the blood bank, this was done the day before surgery. The underlying reason might be that it is difficult to integrate the blood bank and sterile central program to the new module.

The crucial question here is; how will DIPS accommodate such change of program? In ANT terminology, will this black box be pried to open such that changes will occur? Callon (1986) underscores that translations is a process, never a completed accomplishment and it may fail.

Did the translations (ibid) regarding sterile central and blood bank as actors strong enough to gain power within the network; is there a need to open the black box? Studies by Lærum et al., (Lærum, 2003) concluded that scanning and eliminating the paper-based record (EPR) was feasible, but that the initial benefits were mainly obtained by the medical secretaries, however in this study, the secretaries are still following the paper based system despite the DIPS surgical module, in some ways they are not seen as gaining the benefits on this regard.

5.5 On the boundaries of a surgery planning system

As mentioned earlier, planning surgical operations schedules are highly interdependent. This interdependency demands articulation of tasks. Although DIPS surgical module is widely used, it is difficult to integrate smaller systems, like ordering of surgical equipments and blood examination requests. The underlying reason might be that this stand alone systems had already have defined inscriptions before the implementation of DIPS' planning module.

Hence, merging these systems to already complex infrastructure (DIPS ASA) will likely be problematic. The point is really that one system alone cannot take care of surgery planning, but depends on a lot of other ... so it is maybe a network of people and artefacts intertwined together.

5.6 Strategies in changes of work practices

Changes in work routines no doubt occur when technology is introduced into a large heterogeneous work group like in conducting surgeries. In some cases, these changes are difficult to overcome, hence strategies are drawn. One such strategy was letting the physicians report to SKIS on their experienced difficulties in using the module. SKIS had thus gathered all these reports (complains) and collaborated with DIPS' management to find strategies or solutions regarding.

Accordingly, the compiled complains are prioritized and some measures (technical) will be gathered to solve the problem later. The issue of identifying who among the users (physicians) are largely affected by the change of ways in referring surgeries is critical, identifying of what they really mean. Here, it is obvious that as long as the module is not stabilized, actors will likely contests DIPS' module function.

Similarly, the refresher course conducted at the different departments as well mirrors the strategy of bringing the actors – physicians into alignment with the network, hence strengthening the network itself. It opens up possibilities of understanding the coordination role of the technology in use or in practical setting. Here, it becomes an arena for both the physicians and SKIS' role (as the administration's technical "watchdog") to discuss different aspects of the technology which seemingly creates bottlenecks in the coordination processes.

Tellingly, a project leader (nurse 2) commented:

"It is not an easy task to identify what has to be change, we receive complains every now and then about the cumbersomeness of the module, nevertheless we should concretely identify them first before doing any moves, and this cannot be accomplished overnight though, but generally, majority of these physicians are adapting the module without much ado."

Nonetheless, based on the quote above we might have a reason to believe that majority of this physicians are utilizing the system, secondly, there is still a leeway for renegotiations, until the module is not anymore contested thereby reaching stability

5.7 Re-focusing of approach

The dynamic interplay of tasks in surgical planning demands a great deal of collaborative and coordinative process. As such, the role of the paper based artefact when taking the lens of CSCW, material artefacts are publicly accessible, and their state can be inspected by other members. Where they are located can be observed by and made sense by members. What

others are doing to an artefact can be noted and made sensed of. In addition, they for instance, provide a collective or individual space for experimentation and change, (Bardram, 1997).

Moreover, artefacts can be seen as links that joints various processes (Hanseth et al., 1999), as they articulate work activities and support coordination. Such was the case of the paper based planning before DIPS new surgical planning module. Yet, following only this activity oriented concept in CSCW neglects the vitality of the installed base in information infrastructure. An information infrastructure is large and tightly interconnected network, constituted of heterogeneous socio-technical elements or components.

Gradually an infrastructure has to evolve through the extension and improvements, in order to meet the requirements of various actors; surgical planning. The expanding infrastructure accumulates pressures for making change, and this has to be negotiated and balanced against the conservative influence of the existing installed based. Berg (1997) argues on selection of computer-based decision tools in medicine:

"implementation of computer based decision support tools always results in a transformation of medical practices and, further, that getting such tools to work requires continuous negotiations with all the various elements that constitute that practice— nurses, physicians and patients, among others."

In addition, many decision support tools appear to work in only one specific medical practice and that understanding the complexity of issues related to their use will require a focus on the heterogeneous networks surrounding the production and use of technical systems in medicine (ibid). The increasingly complex relationship between local communities and global actor networks makes effective political action extremely difficult, (Wagner, 1995). Nevertheless, due to serious inherent limitations of coordination mechanisms based on paper artefacts, by initially taking the perspective of CSCW offered me a perspective of zooming in to a deeper level of understanding and unpacking the micro-elements of the different actors and their work practices.

Finally, the author has seen that by using CSCW, intricacy of surgical planning and coordination was easier to identify among each group; i.e. surgeons/physician, coordinator nurses, among others, came into focus. However, considering the heterogeneity of the surgical team, a CSCW lens was not feasible enough. Hence, by using the lenses of ANT, grounding in into a large, heterogeneous group it was seen that pre-existing networks should be reconsidered because they function as a strong obligatory point of passage. In addition, ANT acted as a framework to delineate the social and technical interaction involve in the utilization of DIPS ASA surgical module.

6 CONCLUSION

The objectives this study set out aims on answering on how can DIPS surgical module shapes work practices, in what ways it (DIPS) contribute to better work flow and the consequences to changes in work practices. It is inevitable that when a new technology like DIPS or any technology is introduced to heterogeneous actors/users, changes in doing tasks occurs. More so that work tasks needs to be coordinated temporally and spatially. In surgical planning, contingencies arise, i.e. emergency cases have to be prioritized, or a planned surgery took longer time than was planned, among others, are but crucial points to consider. Hence, to avoid over booking of a day's surgical plan, it is crucial that plans should be visible; resulting to a better preparedness of every involved personnel (medical and non-medical) as tasks unfolds.

Further, it showed that in large organization, visions, goals and expectations from IT could be realized provided that actors or stakeholders have one common ground, i.e. it is crucial that benefits of IT are clearly drawn before the onset of a technology, for instance, is the technology chosen to serve an administrative task or clinical tasks? However, studies have shown that identifying the core role of IT seemingly has been a problem in large organization and was also seen in this study. A traditional method to cope such problems might be to “redesign” existing jobs or to require other personnel to do additional jobs, thus organizational change.

Nevertheless, in such heterogeneous actors or stakeholder, we can assume that hierarchy of power is no doubt exist, it is but natural to enrol adequate representatives of those who has the power, as in ANT term, recruit them into the network, to win their clout. We must acknowledge that pre-existing practices are formidable at most times, drastically changing these work task practices can result to “passive” resistance.

In this study I have shown how coordination of tasks across different work boundaries was linked together through the use of DIPS module in order to accomplish certain tasks. Nevertheless, coordination between these different works boundaries is highly intricate, complex and or heterogeneous, thus, a need to meticulously map out the different roles interweaving between them should be given more focus. We might start by examining into

the pre-existing practices, for instance, among the surgeons and physicians who has the tacit knowledge with regards to the intricacies of their work tasks. One strategy might be to refocus on the translation of interests among the ultimate users of a technology, ANT guide us toward the formation of consensus. However, the main challenge here is; how we can integrate work practices in a heterogeneous organization into one common technology serving varied interests, vision and goals? Thus, this calls as a ground for further future studies.

7 APPENDIX

NR.		PREVISITTSKJEMA-/OPR.-PROGRAM /			AVD/SEKSJON.....		SIGN.....		
NAVN	DIAGNOSE	INNGREP	OPERATOR/ ASSISTENT	SPECIAL- UTESTYR	IN- TEN- SIV?	ØNKE- PAS- PAS- SAMT	OPPLYSNINGER (av betydning for ane- st.)	ANE- STESI OG MONIT	ASA

A: paper based form used before patient undergoes surgery

Jeg er gjort oppmerksom på de regler som gjelder og har fått informasjonen i Hovedinngangen, Personal service, eller Driftscentralen i B3-506 på UNN HF. Jeg kan også forlange å få kvittering fra Driftscentralen, Personal service, eller Informasjonen når jeg leverer tilbake ID-/nøkkelkortet. Kvitteringen for innlevert kort må oppbevares i 6 måneder.
Jeg er klar over at jeg må betale kr 500,- for kortet hvis jeg mister det eller ikke leverer det tilbake innen vilkår angitt ovenfor.

Utfulles av Utsteder:
Kort NR: 12222 Legitimasjon: OK Utleveringsdato: 13.04.07
Kortet leveres tilbake senest dato: 13.07.04 eller ved sluttdato
(Gjelder lånekort) (Gjelder ID-kort med bilde)
Kortmottakers etternavn, fornavn: **Født dato:** XXXXXXXXXX **Sign av utsteder:** E. G.
Øneuland - Aas, Glorvica
 Utfulles av kortmottaker:
Glørve tufsen - K.
 Kortmottakers signatur

Henverdeler angående ID-/nøkkelkort gjøres til Driftscentralen, UNN HF på tlf. 77 62 61 70

REV: 4
 Hvit del beholdes av kortmottaker.
 Gul gjenpart beholdes av utleverende avdeling.

09.2005 - LUNDBLAD MEDIA AS, TROMSØ



29590

B: The agreement form to gain access to the surgical department at UNN



C: The electronic ID for entry to the surgical department at UNN

Operasjonsprogram til sterilsentralen	23.01.2008
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Innslusa/generell seksj.

Koord.opr tlf. [REDACTED]	Instr.ass stue 1-6: [REDACTED]
Opr.spl. hjerte tlf. [REDACTED]	Instr.ass stue 7-12: [REDACTED]

stue 1(gyn)		
Nr	Født år	Prosedyre fra sterilsentralen/ + evt. Brikke
1		STOR LAPAROTOMI
2		STOR LAPAROTOMI
3		
4		

OR theatre number → stue 8 (gastro)		
Nr	Født år	Prosedyre fra sterilsentralen/ + evt. Brikke
1		LAPAROTOMI
2		
3		
4		

stue 9 (uro)			
Nr	Født år	Grunnpakke	Brikke
1		STOR	STOR LAP GASTRO
2		STOR	STOR LAP GASTRO
3			
4			

D: The paper based form used for the central sterile section.

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