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Department of Informatics and Media

The Contribution of Collaborative Tools and Technologies in Facilitating Tacit Healthcare Knowledge Sharing amongst Clinicians

In the Case of

Akadamiska Hospital

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Abstract

Healthcare is a knowledge-intensive field. A significant quantum of extremely vital and viable healthcare knowledge exists in a tacit form, yet due to various operational and technical reasons such healthcare knowledge is not entirely utilized and put into professional practice. The strong increase in expert work and knowledge-intensive fields make examining the topic timely and hypothetically interesting.

The most significant contribution of this study is the increase in understanding, as well as, tacit healthcare knowledge sharing amongst physicians and clinicians with the type of collaborative tools and technologies they have at their disposal. Collaborative tools and technologies help employees of an organization work closely with their colleagues, partner organization and other volunteers as tacit healthcare knowledge sharing among clinicians such as sharing of best practices, tips and tricks, inter professional collaborative networking, clinical experiences and skills are known to have a significant impact on the quality of medical diagnosis and decisions.

This paper posits that collaboration tools and technologies can provide new opportunities for tacit healthcare knowledge sharing amongst health-experts, and demonstrates this by presenting findings from a review of relevant literature and a survey conducted with Medical Doctors who have moderate to high interaction with collaborative tools and technologies in the healthcare industry. Semi-structure interviews were conducted with health-experts (Medical Doctors and clinicians) of Akademiska Hospital, Uppsala, Sweden. Final thematic analysis unveiled six themes as potential contributors of collaborative tools and technologies in facilitating tacit healthcare knowledge sharing among clinicians. The newly developed themes are described and interpreted briefly; extensive literature review has been carried out to relate the emerged themes with the literatures and part of interview participant responses are supported as well. Finally this research suggests further empirical studies shall be conducted to acknowledge this study.

Keywords – Tacit knowledge, Collaborative tools, knowledge sharing, Health-experts, Knowledge Management

For Mom: Not much of a gift by comparison, but the best I can do.

Preface

First off, I would like to thank God! "I can do all things through Christ who strengthened me."

Secondly, my special thanks goes to my tutors Ruth Lochlan and Steve McKeever for the support and valuable guidance, academic advices and the patience you have shown me through the entire process of the writing of this research paper.

Thirdly, I would like to acknowledge Akadamiska Hospital physicians and clinicians who participated in this research. Tomas bjerner, Johan Lindqvist, Per Adolfsson, Goran Angergard, Dessu Doneke for offering me their valuable time and sharing their expertise knowledge for conducting this research paper. Without their willingness to participate, this research would not have been possible to accomplish successfully.

Last but not least, moving off one's home turf carries with it many burdens. I would like to thank my aunt Letai and my sisters for their extensive moral and financial support –despite living far away- they have given me through the entire period of my study in Sweden.

Table of Contents

Chapter One

1. Introduction

This chapter comprises the background of the research topic, problem discussion and the purpose, research questions, scope, limitation and disposition of this research paper. It starts by outlining the background, problem discussion in healthcare industry with respect to collaborative IT tools and technologies through clinical tacit knowledge sharing, followed by the purpose, scope, delimitation, and disposition of the thesis.

1.1 Background

A fundamental question for Information System researchers and practitioners could be how collaborative technologies and tools can be used to share knowledge; by knowledge I mean tacit knowledge – knowledge largely acquired through experiences, and require shared interaction with other people to be imparted from one to another [1]. Collaborative technologies are nothing but integrated sets of IT functionalities that facilitates communication and information sharing among interconnected entities [2]. This thesis dealt with a tacit knowledge sharing through collaborative tools and technologies in clinical settings.

The main focus of this thesis was to assess the contribution of collaborative tools and technologies to facilitate knowledge sharing and diffusion amongst physicians and clinicians who work at the Department of Radiology, Oncology and Radiation Science, Radiology, Medical Physics, Department of Surgical Sciences, Anaesthesiology and Intensive Care and Biomedical Engineer of Uppsala University's Akadamiska Hospital, one of the largest and oldest university hospitals in Sweden.

Clinical knowledge management systems have reached at its turning point, it is less about creating, storing, retrieving and disseminating explicit knowledge it is more about the creation and sharing (new) knowledge that is tacitly held by individuals, advanced search technique for executing complex clinical queries and knowledge repositories.

The uses of Information Communication and Technology (ICT) tools within healthcare industries have historically enabled new forms of communication and collaboration. The emergent of faster communication tools—from two-way audio and video to group video conferencing and instant messaging (IM)—has allowed clinicians and collaborators to close the gap (physical distances) that separate them, offering a faster transfer in information exchange, knowledge sharing and quicker feedback on new ideas and results. Collaboration in distributed system has become a reality of life. Once seen as mere stand-ins for face-to-face meetings, today's collaboration tools and technologies come in number of format and feature such as: text annotation, conference calls, calendars, collaboration suits, extranets, mind mapping tools, social bookmarking, social networking, file sharing and online storage, instant messaging, online meeting, extranets, wikis and other various synchronous tools that allow multiple "hands" to manipulate ideas, objects, and concepts from remote locations

1.2   Literature Review and Prior Research

1.2.1 Collaborative Tools and Technologies

An emerging trend in theories in human learning and cognition is emphasizing collaboration, creative process and the use of new technology [59, 60]. According to Anne Moen et al., (2012), there are numerous changes in modern society which form a basis for the change in learning theories, such as: first, the rapid development and application of new technology which has formed and continues to form qualitative new opportunities for distributed interaction and collaboration and second, the mounting pressure to create, share new knowledge and transform existing practices in varies areas of life and third, the growing complexity of modern society which means that people must come together and combine their expertise to solve often unforeseen complex problems because individuals cannot solve problems alone [3].

Moreover, in the new knowledge economy, a company's competitive edge is intrinsically tied to the ability to quickly collaborate with co-workers, partners and customers. This is evidenced in a recent research conducted by (CXO Media, 2011) in which majority of the respondents confirm that collaboration tools and technologies can accelerate business process and help knowledge workers work better, faster and cheaper. In addition, the supporting knowledge workers and interacting with external audiences was highly important to the majority of the respondents were

one of the key findings of the survey [4]. Profit and non-profit making organizations are investing in collaborative information and communication systems to encourage and facilitate the sharing of information [5]. However, as cited in Jarvenpaa and Staples (2000), Orlikowski et at (1992), argue that technology alone doesn't motivate sharing [6]. Yet few research have sought to understand the important determinants of collaborative technology's use for information sharing [7]. In spite of all the challenges, collaboration technologies present as with genuine, practical opportunities today. As Ziegler and Mindrum (2007) asserted, collaboration (virtual) is all about power; being effective while working collaborating virtually, means retaining as much of the power of a physical interaction as possible [8].

Collaborative tools and technologies are nothing but tools that allow knowledge workers of an organization to explore, share, engage and connect with people and content in meaningful ways that help them learn.

Tools and technology use within healthcare industries have historically enabled new forms of communication and collaboration. The emergent of faster communication tools—from two-way audio and video to group video conferencing and instant messaging (IM)—has allowed clinicians and collaborators to close the gap (physical distances) that separate them, offering a faster transfer in information exchange, knowledge sharing and quicker feedback on new ideas and results. Collaboration in distributed system has become a reality of life. Once seen as mere stand-ins for face-to-face meetings, today's collaboration tools and technologies come in number of format and feature such as: text annotation, conference calls, calendars, collaboration suits, extranets, mind mapping tools, social bookmarking, social networking, file sharing and online storage, instant messaging, online meeting, extranets, wikis and other various synchronous tools that allow multiple "hands" to manipulate ideas, objects, and concepts from remote locations [55].

1.2.2 Features of Collaboration tools and Technologies

Across health care industries, the word collaboration has become synonym with effective quality healthcare, safety and sustainability. Making suitable choices or fulfilling healthcare design, implementation, operation, or healthcare reforms typically require collaboration among the different healthcare divisions. Moreover, It is understandable that healthcare organization ought to have all the information available to them when they need it and where they need it.

Healthcare divisions are asked to demonstrate collaboration in pursuit to make services accessible and encourage behavioral changes for population health improvements and deliver data and data opportunities for varies purposes. According to Intel Healthcare Innovation Summit (HIMSS) Mobile Technology Survey, which was released in February 2012, improved access to view patient information, ability to view/interact with patient data from remote locations and improved access to reference information ranked 80 percent, 71 percent and 69 percent, respectively, were the top three benefits of collaborating through mobile technology for clinicians [9].

But what is effective collaboration when it comes to healthcare?

If we look at Wikipedia, it itself remains one of the largest and most popular online collaborative tool available today, collaboration is "a recursive process where two or more people… work together toward an intersection of common goals... by sharing knowledge, learning and building consensus." [10]. In healthcare settings, "common goal" may refer to the pursuit of good quality health care that is adapted to needs, accessible and effective.

To give a clearer understanding the nuances intended, we can look at varies examples: coordination activities between colleagues of an organization may be collaborative, but are not necessarily so. Sending out information – sharing audio, video and other sharable information on social networking and collaboration networks, for example, posting, twitting, blogging or vblogging – is not the same as working together; bringing together people to analyze or build community around a common set of content is. Writing prescription for patients in order for them to get a prescribed drug from a pharmacy is not; coordinating efforts amongst clinicians or physicians is.

Likewise, many forms of medical diagnosis procedures are not collaborative, as the Medical Doctor-Nurses relationship is typically hierarchical (a point clearly understood by Akadamiska's nurses interviewed during the research performed in the development of this research). In contrast, research work, participating in an inter-hospital best practice sharing that engages clinicians with other physicians, clinicians, and healthcare professionals, is inherently collaborative.

Similarly, when administrative staffs run reports from the Akademiska Electronic Patient Record System, they are building upon the work of colleagues who process and input that patient information into the database. The flow of work that leads to the availability of the patient data involves many people, all of whom rely on the work of the others; but insofar as the process is essentially routine, or sequential, it is not collaborative. If the user were to work with clinical staff in a pursuit to create new types of clinical reports, that non-routine effort would be considered collaboration. So, too, are those efforts among back-end staffs in which they share techniques, ideas and timelines to solve patient needs or to enhance the healthcare service.

Proposing collaboration promotes innovation [11]. IBM develops perspective where people and virtual data is the future in practice today. "*In the old way of thinking, employees make themselves valuable through what they know. But in the new way, people make themselves valuable by seeking opportunities to work with others and tapping into the expertise that others possess*" [12].

In many cases collaboration tools and technologies are synonymous with tools and devices that facilitate communication. They can be viewed as "generic information technologies that cannot be largely differentiated" [13]. As Sandhawalia and Dalcher (2011) asserted that, collaboration tools have the ability to share knowledge and can facilitate reductions in the frequency team meetings [14].

Most prior research on collaborative tools and technologies has focused on their individual adoption and simple use [67, 68]; this study, though, sees collaboration tools from the perspective of their effective use at the team-collaboration level perspective. This paper basic argument is that in order to take advantage of collaborative tools and technologies (in our case facilitate knowledge sharing), collaborative tools must be collectively adopted by active collaborative teams and be used effectively.

Building up on Pavlou et al (2008), Effective Use of Collaborative IT Tools construct – the ability of group or team work to effectively use their basic set of collaborative tools functionalities such as: workspace sharing, conferencing, file sharing, scheduling, chat and messaging, and email to facilitate team work - for the purpose of this paper, we define collaboration tools and technologies as IT tools designed to help people work together to achieve

common goal and more importantly to facilitate action oriented teams working together - within inside their organization or geographically distributed - by providing functions that aid in sharing information, skill and expertise, collaboration and the process of problem solving [15].

The use of communications and technologies artifacts in collaborative systems and the integration of collaborative systems in organization settings can be seen as a special case of the broader use of communications and artifacts in society [65]. The primary intent of such tools and systems is to transform the way documents and rich media are shared in order to enable more effective team collaboration [16]. As most collaboration tools and technologies advocates suggests, such as IBM, when people can connect and communicate with one another quickly and easily, 'almost anything can happen' [17] such as decreasing the cost associated with process inefficiencies or strengthening customer relationships with excellent service and responsiveness or gaining a competitive edge from the ability to make informed decisions and react quickly. Humans interact in different ways when it comes to online collaboration: Conversation, transaction and collaboration.

Conversation interaction is an exchange or sharing of information between two or more persons where the primary intent of the interaction is building relationships. "There is no central entity around which the interaction revolves but it's a free exchange of information with no defined constraints." Collaboration tools and technologies such as instant messaging (IM), E-mail, and teleconferencing tools are generally sufficient for conversational human interaction.

Transactional interaction involves the exchange of transition entities where a major function of the transition entity is to alter the relationship between participants. The transition entity is in a relatively stable form and constrains or defines the new relationship.

Internet based collaboration tools and technologies often referred to as WEB 2.0, could provide a collaborative environment space where physicians and clinicians be able communicate in a real-time such as that of standard conference call and hold meeting and instant messaging, and do some collaborative processes such as routinely communicate about a specific case with colleagues, managing workflow, producing clinical case documents sharing them with colleague within or outside the hospital, scheduling and receiving internal news and update.

1.3   Problem Discussion

Healthcare systems around the world are facing exceptional challenges due to a number reasons – the need for longer life expectancy, medical and infrastructural cost, rising population, and inconsistent clinical outcomes, multiple treatment options – among different others [18]. According to World Health Organization (WHO) health spending and medical infrastructure statistics by country, the U.S health care expenditure tops the health spending list - equivalent to 17.9% of its gross domestic product (GDP), or $8,362 per person. And that is not all private - government spending is at $4,437 per person. Among the developing countries such as Ethiopia, private spending is all that available for the large population [19]. Moreover, the amount of people who die each year due preventable medical error in Europe and in the US is still soaring [3].

In most countries – such as Sweden and England's NHS - the healthcare system is mainly government funded. Public sector healthcare organizations are a peculiar breed, as they are funded and not driven by increasing profits or competition, and are more concerned by and motivated to address issues of cost, quality, efficiency, and effectiveness. Hence health care organization – both public and private sector - needs to respond to patient's needs, the community's need, stakeholders, government policy and changes in medical and patient care practices [20]. The stakes here are high (!). Some have suggested that responsive organizations – such as healthcare industries - have the ability to create an environment where specialized knowledge, skills and abilities of all employees are leveraged to achieve advancements in service delivery [21]

Pavia, L. (2001) asserted that, healthcare is entering its third era, *the era of knowledge*. This era demands healthcare organization to be more effective at managing and sharing knowledge to enhance the useful knowledge of clinicians, patients and staffs along with using knowledge to reduce costs and deliver quality patient care [22]. Furthermore, healthcare is becoming too complex for a traditional "medical expert" based approach to work. Thus, physicians and clinicians must have the means and access and/or share information (knowledge) to already known 10,000 disease, 3,000 drugs, 1,100 lab tests, 300 radiology procedures, 7,000 current procedural terminology (CPT) codes for physician's services, 1,000 new drugs, and biotechnology medicines in development and 2,000 individual risk factors [3, 7].

J.R Jackson (2000) Postulates that health care is a knowledge-rich domain [23]. Yet, due to various and technical reasons, the various modalities of tacit healthcare knowledge are not entirely harnessed and put into practice. Knowledge, according to Abidi, (2001),

"… is a fluid mix of framed experience, values, contextual information and expert insight that provides a framework for evaluating and incorporate new experiences and information. It originates and is applied in the minds of knower's. In organization, it often becomes embedded not only in documents or repositories but also in organizational routines, processes, practices and norms." [24]

In addition to that, Michael Polanyi on his famous Knowledge Management books entitled "Personal Knowledge" (1958), and "Tacit Dimension" (1966), described human knowledge as explicit knowledge and tacit knowledge. He claims *explicit knowledge* as something that may be expressed in symbol, such as text, graphics and mathematical formulas and other expression of knowledge. Whereas *tacit knowledge* is, that people can realize but it is difficult to explain in words and symbols [25].

It's crucial that health care knowledge both framed experience (tacit knowledge) and contextual information (explicit knowledge) are important and critical for the delivery of quality patient care [26]. Healthcare professional's tacit knowledge is the most valuable source of their framed, experiential know-how acquired in critical situation of patient management [10, 3]. Moreover, the importance of tacit knowledge in healthcare organization is well recognized and documented [27] Thus, tacit healthcare knowledge plays an important role in improving the quality and delivery of healthcares [28] – providing effectively applied and managed. More specifically, the tacit knowledge of healthcare experts can assist clinicians, practitioners and specialists by imparting clinical insights into *what* solutions could work, and *how* to make it work (experiential know-how), than that of *how* things should work (contextual knowledge) [29].

With today's technological advancement and the emergence of new technologies such as WEB 2.0 technologies – individuals have now the opportunities for new ways of interacting, sharing their knowledge with colleagues, playing, working and learning. The role of ICT plays in the tacit knowledge sharing process encompasses different perspectives [30].

Although some study Hansen et al. (1999) argue that ICT can have a disruptive impact with regard to exchanging tacit knowledge; as collaborative tool and most communication technologies often means that employees may email rather than engage in a face-to-face meeting with a coworker. In a direct contrast, (Goh 2005; Tsui, 2005; Hustad, 2004) argue that ICT can have a positive impact [31],[32],[33] even though machines can only process information, whilst knowledge ought to and must be processed by humans [34]. More importantly, IT permits instantaneous, sharing of knowledge, information exchange and communication, between any parties, irrespective of location [35]. From healthcare knowledge management perspective it's important to harness and facilitate tacit knowledge sharing in clinical settings [13].

Organizations are making huge investments in collaborative IT tools with the expectation that these IT investments will facilitate group work and enhance performance. Collaborative IT tools and technologies, such as Groove and Oracle Collaboration Suite are integrated sets of IT functionalities that facilitate communication, information and knowledge sharing among inter-connected entities [2]. Furthermore, collaboration IT tools and technologies have the potential to support collaborative learning processes and can achieve a seamless knowledge flow among collaborative team members [36]. Thus, it's important to create a learning organization culture through taking advantage of collaborative IT tools and technologies and the capabilities of mobile technologies and the emerging web-based standards to share tacit knowledge among clinicians and/or physicians [37].

1.4   Purpose

The purpose of this thesis was to assess the contribution of collaborative tools and technologies to facilitate knowledge sharing and diffusion amongst physicians and clinicians of Uppsala University Akadamiska Hospital, one of the largest and oldest university hospitals in Sweden. Qualitative research was to accomplish the research goal of the study. Qualitative data obtained from conducting the interview was examined, analyzed and transcribed through the procedures of thematic analysis approach, following the coding guidelines given by QSR International qualitative data analysis software, NVivo 10.

In addition, this study contributes to the emerging literature on the intersection of Healthcare Knowledge Management and Information Systems - particularly by focusing on the potentials and contribution of collaborative IT tools in facilitating tacit knowledge sharing in clinical settings. In addition to that, given the current state of healthcare and the great advantage of sharing   experiences among physicians and clinicians, and the potential of Information technology and tools, is   a tremendous opportunity for IS researchers to contribute their knowledge in bridging the research gaps - and in that, the aim of this thesis is no different.

1.5   Research question

1. Contributions of collaborative tools and technologies in facilitating tacit healthcare knowledge sharing amongst clinicians.

The above explanatory research question calls for findings from a review of relevant existing literatures and conducting a semi-structure interview with five physicians and one clinician at Akadamiska Hospital, Uppsala, Sweden. Although access to clinicians for conducting such a survey - due to many and complex reasons - could probably be the tricky part of conducting the survey. On top of that, the author reckons involving healthcare personnel in a non-medical survey is not that easy.

1.6   Scope

The objective of this study was to investigate the contributions of the collaborative tools and technologies currently used at Akadamiska Hospital in facilitating tacit healthcare knowledge sharing amongst clinicians. The contribution is based on the study of the tacit knowledge sharing process in healthcare settings; issues that has been left until present – we could argue that, little is known in the Clinical Knowledge Management literature about the contribution of collaborative tools and tools technologies in facilitating tacit knowledge sharing among physicians and clinicians. Thus this study aims to provide a basis for further investigation of tacit knowledge sharing in the healthcare industry.

1.7 Limitations

This study has both theoretical and practical limitations. A recurring theme in studies on tacit knowledge sharing is clearly its contextual nature and the interpretation of it along with its transfer requires multiple stakeholders. In this study, target phenomenon was only tacit knowledge that is tacitly held by an individual. Collective or (organizational) knowledge meant to be excluded from the study. However, tacit knowledge is multidimensional – bound to different contexts and time - and ambiguous notion. The distinction between individual and collective knowledge (ontological dimension of knowledge) when it comes to tacit knowledge sharing is not as clear as in the theoretical definition. There were also practical limitations such as getting access to the study participants took much time than the author had hoped it would – which resulted in the submission of this thesis to be submitted beyond its submission deadline set by the department.

Another source of criticism my stem in the decision made during discovery and verification of themes and code selection. Further limitation of this study is the generalisablitly of the results and conclusions may have limited interpretive power since analysis excluded theoretical framework.

Precaution were taken to ensure a representative sample of physicians from Akadamiska Hospital despite the limited access of getting physicians to participate in this study - Five out of the six clinicians who participated in this study are physician by profession.

1.8 Disposition

The disposition provides the content of those chapters as a guideline for the reader. This paper comprises the following sections.

- Chapter I - Introduction
  - o This chapter comprises the background of the research topic, problem discussion, literature review, purpose, research questions, scope, limitation and disposition of this research paper. It starts by outlining the background, problem discussion in healthcare industry with respect to collaborative IT tools and technologies through clinical tacit knowledge sharing, followed by literature review, purpose, scope, delimitation, and disposition of the thesis.

- Chapter II - Methodology
    - This chapter comprises Research Methodology, data analysis and classification of the study, research design, and research approach, most common form of analysis in qualitative research which is thematic analysis, data collection methodology, Interview and its ways of transcribing the data and finally examines the Validity, Reliability and Generalizablity of this research.
- Chapter III – Background of Akadamiska Hospital and its collaborative tools
    - This chapter provides the reader the background of Uppsala University Hospital – Akadamiska Hosptial, and the main collaborative tools they incorporate in order to carry out their daily activities.
- Chapter IV – Data Analysis and Findings
    - This chapter presents the findings of the collected data obtained from semi-structured interview. Final thematic analysis revealed six themes as potential enablers of collaborative tools and technologies to facilitate tacit knowledge sharing amongst physicians of Akadamiska Hospital. Final emerged themes are defined in detail in terms of contribution, aspect, what the collaborative tools offer, and the knowledge that is shared amongst physicians was connected to the existing literature of tacit knowledge sharing and as well as supporting the evidences by putting together sample of the interview manuscripts in an attempt to mine sensible meaning from the gathered data.
- Chapter V - Conclusion.

    This chapter has response for the research question stated in the introduction chapter of this paper. It presents six potential contributors of collaborative tools and technologies that facilitate tacit healthcare knowledge amongst Akadamiska Hopsital physicians. It also comprises Author's selected reviews of few existing literature on the role of tacit knowledge sharing discourse and its use and relationships with Web 2.0 (the Second Generation of Internet based Applications) and its major features such as collaborative tools and technologies and that of social networking

Chapter two

2. Methodology

This chapter comprises Research Methodology, data analysis and classification of the study, research design, research approach, most common form of analysis in qualitative research which is thematic analysis, data collection methodology, Interview and its ways of transcribing the data and finally examines the Validity, Reliability and Generalizablity of this research.

2.1 Research Methodology

Introduction

This chapter comprises the methodology part and provides the reason behind why a specific method or approach was chosen to analyze the data.

Qualitative survey method were used as a methodology to accomplish the research goals for both theoretical and practical reasons: Theoretically, this study is an explorative research – which aims to explore in an area where little is known and to investigate the possibilities of undertaking a particular research study - which focuses on the role of collaborative IT tools and technologies in supporting tacit knowledge sharing among healthcare personnel, while attempting to clarify a few relevant 'what' and 'how' questions.

A qualitative survey methods is a survey method that is suitable for developing explanations of social phenomena such as, opinions, experiences and feelings of individuals [38]. Moreover, qualitative methods attempt to gain an understanding of the underlying reasons and motivations for actions and establish how people interpret their experiences and the world around them [39].

Information Systems (IS) is an applied research discipline, in the sense that we frequently apply theory from other disciplines, such as economics, computer science, and the social sciences, to solve problems at the intersection of information technology (IT) and organizations. In addition, the dominant research paradigm that we use to produce and publish research for our most respected outlets largely continue to be those of traditional descriptive research borrowed from the social and natural sciences [40]. Information Systems (IS) research aims to empirically

investigate a variety of phenomena concerning IS through qualitative data from a variety of sources, such as interviews, observations, design efforts, interventions, and archival materials [41].

2.2   Data Analysis

Approaches to qualitative data collection and analysis are numerous, representing a diverse range of theoretical and disciplinary perspectives [42]. Qualitative data obtained from interviewing participants was analyzed using the thematic analysis approach. Thematic analysis is the most common form of qualitative research [43]. On this data collection and analysis phase, a computer aided qualitative data analysis software package (some possible examples: NVivo 10) was used as a way of capturing the main attributes of the interview for generating and developing themes, coding and for text interpretation.

Here is how it was used in this project: First, an initial code list was generated following the some coding approach through reading and re-reading the interview transcripts several times. This also helps understand what the data entails and paying specific attention for patterns that occur frequently. Next, broad data categories were established by combining concepts with similar features and to consider the significance and relevancy of the concepts to the research question outlined in the introductory part of this study. Finally, the themes are initially defined and a 'thick description' of the results were reported here as findings of the research.

2.3   Thematic Analysis

This section describes the specific techniques of thematic analysis. Explaining the techniques in detail is important to understand, and considering it is the method of choice for both the data gathering and the analytical procedure.

Thematic analysis is the most common form of qualitative analysis [24]. Scholars and researchers from many fields use thematic analysis such as in the analysis of target market segment in marketing, participatory observation studies of patients in medical settings, and the analysis of many more fields. According to Boyatzis (1995) definition,

"Thematic analysis is the process of encoding qualitative information. The encoding requires an explicit 'code.' This may be specific themes; a complex model with themes, indicators and qualifications that are casually related, or something in between these two forms."[44]

One of the benefits of thematic analysis is its flexibility and a useful method for working within participatory research paradigm, with participants as collaborators [45]. Although some argue that thematic analysis can be seen as a poorly 'branded' method, in that it does not appear to exist as a 'named' analysis in the same way that others methods such as grounded theory [46], narrative analysis [47], or discourse analysis[48] do [49]. Grounded theory seeks patterns in the data, but is theoretically bounded [50]. However, thematic analysis differs from other analytic methods in that it seek to describe patterns across qualitative data – such as 'thematic' discourse analysis, thematic decomposition analysis, and grounded theory [51]. Braun and Clarke (2006) described and outline six phases to doing thematic analysis, these are as follows,

Thematic analysis was chosen as a method for analysis. This is because the author was convinced the method best fits the qualitative nature of this research and to reflect reality and unravel the surface of reality.

Thematic analysis involves a number of choices which are often not made explicit, but which need explicitly to be considered and discussed [32]. As the initial phase describes, data collection and analysis are iterative and simultaneous procedures that both run can from the beginning. At the initial phase of a thematic analysis process, it is important to read and re-read the interview transcripts in order for the researcher not only to familiarize him/her with the data but also to aid the researcher identify possible themes and patterns.

Another important phase in thematic analysis is generating initial codes from the data set that have reoccurring patterns.

A code in qualitative inquiry is most often a word or short phrase that symbolically assigns a summative, salient, essence-capturing, and/or evocative attribute for a portion of language-based or visual data. The data can consist of interview transcripts, participant observation field notes, journals, documents, literature, artifacts, photographs, video, websites, e-mail correspondence, and so on [52]. According to Braun and Clarke (2008), a systematic way of organizing and gaining meaningful parts of data as it relates to the research question is called coding [53]. The

15

above Table 2.2 shows us the coding process in inductive analysis which pretty much resembles the coding process in the thematic analysis.

Another core procedure of thematic analysis is the identification and development of a theme. A theme captures something important about the data in relation to the research question, and represents some level of patterned response or meaning within the data set. A theme might be given considerable space in some data items, little or none in others, or it might appear in a relatively little of the data set [40, 42]. So, researcher judgment is crucial in determining what a theme is – as Braun and Clarke (2008) suggest, retaining some flexibility and rigid rule really don't always work [40]. Furthermore, the 'keyness' of a theme is not necessarily is not dependent on quantifiable measures – but rather whether it captures something important in relation to the overall research question [42].

After the final themes have been reviewed, defined and named, researchers can begin the process of writing the final report. The task of writing up of a thematic analysis is to tell the complicated story of the data in a way that convinces the audience and the validity of the analysis [54]. Moreover, the write-up must provide sufficient evidence of the themes within the data [40]. In this precaution were taken to ensure a representative of sample physicians and clinicians from Uppsala University Hospital, Akadamiska. The number of response I got from Akadamiska Hospital physicians was relatively enough and in line with research paper that study the intersection of ICT and physicians. However, the author thoughts participating six physicians was not 'ideal' representative as one would like, anyway.

Following data collected from six interview participants the interview transcripts were entered into the QSR Nvivo 10 data management software program and a comprehensive process of data coding and identification of 'themes' was verified and developed for further development of the codes.

2.4   Interview

Interviewing participants is probably the most widely employed method in qualitative research. Extensive in-depth interviewing is what most qualitative researchers rely on. It may be one of the overall strategy or only one several methods employed [48]. There are two major types of

interview in qualitative research – semi structured interview and unstructured interview. In the unstructured interview – it tends much like a conversation; the researcher uses at most an *aide mémoire* as a brief set of prompts to the researcher himself/herself to deal with a certain range of topics. According to Burges (1984) there may be just a single question that the interviewer asks and the interviewee is then allowed to respond freely, with the interviewer simply responding to points that seem worthy of being followed up, whereas in the semi-structure interview, the researcher has list of question or fairly specific topics to be covered, but the interview participants have a great deal of space in how to reply [55].

The approach used in this study can be described as semi-structured interview with much emphasis given to not only to the link with the research question stated in the first chapter of this study but also how the interviewee frames and understands issues and events. Since the interview was conducted with mostly physicians and clinicians, both tacit knowledge and collaborative tools terms were apparently a little bit technical for them. A brief description of collaborative tools and technologies and a concept of tacit knowledge were given to participants before starting the interview [See: Appendix 1]. Open ended questions were used during the interview session since open ended questions tend to be less leading and more objective. Moreover, it is designed to encourage participants to open up more freely spontaneously in telling the stories about the specific and general knowledge they acquire. Thus, it is advantages for the researcher in gathering broad and meaningful information about the subject being studied.

2.5   Conducting the interview

Five medical doctors and one more clinician from Akademiska Hosptial were willing to participate in this study and that was sufficient - if not ideal - amount of respondents to gather the data considering the hectic schedule of medical doctors and clinicians and the author of this paper himself have not been living in Sweden for long by itself was a challenge in finding active participants - like that of physicians. Almost all of them have moderate to high level of usage and interaction of the collaborative technologies at Akademisaka Hospital. When it comes to approaching tacit knowledge and conducting an interview with naïve respondents such as that of clinicians' and physicians', (almost all participants during the interview have said that they

hardly heard of the term 'tacit' and 'explicit' knowledge before the day of conducting the interview), the author believed that, a distinction had to be made first to clear the air between tacit and explicit knowledge and as well as individual and collective knowledge.

The intent of this research is to focus on the contributions of collaborative tools and technologies in facilitating tacit health care knowledge sharing among clinicians and hence choosing experienced professionals, who actively use collaborative tools in their daily activities, to conduct the interview would make sense and suits in achieving the research objective.

Before conducting the interview, the author first approached Mr. Joan Lindqvist, the head of Information Technology department and he himself is a Doctoral student Department of Neuroscience, Clinical Neurophysiology, and Per Adolfsson, Verksamhetschef officer (Operations and IT). With the help of both of the above mentioned employees of Akademiska, respondents were selected and approached via email describing briefly about the research topic and the type of question they were going to respond. Then author contacted interested and willing participants to explain about the research topic, discuss further appointment dates and on how to conduct the interview session.

2.6   Transcribing Recorded Data

There are numerous ways of transcribing or processing audio-recorded qualitative data. One straightforward way could be to use qualitative data analysis software such as that of NVivo, and/or another way could be through one of the desktop media players out there such as Quick time. NVivo 10 was chosen for this study to transcribe the recordings and applied all the thematic analysis procedures for verifying and developing the codes and to develop the initial and final themes as well.

2.7   Applying Nvivo 10 Software

Nvivo 10 is software, a flagship by QSR international, based in Melbourne, Australia, that supports qualitative and mixed method research. It is designed to handle unstructured and semi-structured data such as open-ended interviews, literature reviews and other.   One biggest advantage working with Nvivo is that it doesn't favor particular methodology – so it best suits

for achieving the research goals of this research. Regardless of the method you use, there is one thing that is for certain when handling qualitative data – if you don't use software, the work will likely be more time consuming and the task gets burdensome, challenging to organize and manage and hard to navigate. Furthermore working manually can also make it very hard to discover subtle connections in the data particularly if the data is of large volume. Nvivo helps this paper to easily import a whole range of data – retrieve a query such what words physicians used most frequently, taking a stock of what the physicians were saying about collaborative tools and technologies or bunch of other keywords in one place. In addition we Nvivo lets a researcher produce a report or presentation. As a result Nvivo was chosen to accomplish the research goals this paper in facilitating the author work more efficiently, save time, produce a quality picture of the survey data and build a body of evidence in answering the research question of this paper.

2.8   Generalization of results

According to David Silverman (1999:248), Generalizability is a standard aim in quantitative research and is normally achieved by statistical sampling procedures. Such sampling has two functions: First, it allows the researcher to feel confident about the representativeness of his/her sample [56] meaning 'if the population characteristics are known, the degree of representativeness can be checked' [46]. Second, such representativeness allows the researcher to make broader inferences. Such sampling procedures, though, are usually unavailable in qualitative research. However, as most qualitative researchers argue that, quantitative measures are not the only way to test the validity of a qualitative research propositions. Furthermore, theoretical sampling and analytic induction, based upon deviant-case analysis and the constant comparative method, offer powerful tools through which to overcome the danger of purely 'anecdotal' quantitative research [57], The author believes and shares writers of most qualitative researchers stand, in that, we have to show the ways in which qualitative research can be every bit as credible as the best quantitative work.

The author does understand that adequate sociological description of a phenomenon needs to look beyond purely qualitative methods. Moreover, as Jennifer Mason (1996:6) rightly put it, "*qualitative researchers should produce explanations which are generalizable in some way, or which have a wider resonance*" [58]. Consequently, some generalizability features can be identified in which collaboration tools and technologies can play a role in facilitating in tacit

healthcare knowledge sharing in clinical settings. To examine and create the notion of acknowledgment of the contributions of collaborative tools and technologies in tacit healthcare knowledge sharing amongst clinicians has been the main purpose of this research.

Chapter Three

3. Background: Akadamiska Hosptial and the Main Collaborative Tools

This chapter provides the reader the background of Uppsala University Hospital – Akadamiska Hosptial, and the main collaborative tools they incorporate in order to carry out their daily activities.

This research is based on Uppsala University Hosptial - Akadamiska Hospital. This section presents the background of Akadamiska hospital using data from secondary sources.

3.1 Akadamiska Hosptial

Based in Uppsala, Sweden, Uppsala University Hospital founded in 1708 as the first clinic with the specific intention of facilitating the practical education of medical students of Uppsala University. The present Akadamiska Hospital (*Akademiska Sjukhuset – in Swedish*) was established in 1850 as an organizational merger of the Uppsala county hospital and the university clinic, and a new building was inaugurated in 1867. From this building, which is still in use, the present hospital complex has grown. The university hospital is known for its characteristic to look for new and innovative solutions. It makes the best use of new technology, new scientific findings and new ways of working in order to solve medical problems and to continuously improve the diagnosis, treatment and prognosis processes of taking care of patients.

According to its website 'About Us' page, today the university hospital is one of Sweden largest and a full-scale university hospital with 8,000 employees and 1,100 beds. Each year there are 58,000 admission of students, 330,000 physician encounters and 420,000 out-patient treatments.

3.2 Collaborative Tools at Akadamiska Hospital

3.2.1 Tandberg (Movi) version 1.0

Web conferencing software helps teams meet anywhere at any time, and you can experience meaningful face-to-face interactions by sharing your screen and seeing others on video [59]. Tandberg Movi is a video conferencing software client developed by Tandberg Norway. [60].

Movi is a new addition to the TANDBERG product line, providing a soft SIP client that is both easily deployed and can be centrally managed. The connectivity provided by Movi allows video communications that would otherwise not be possible [61]. Below is a statement taken from the interview transcript (M.D Thomas) reflecting on the current use of Tandberg Movi at the oncology department, Akadamiska Hospital:

*"Often we have regular multi-disciplinary video-conference meeting with other small and bigger hospitals clinicians and representatives in the Uppsala region to discuss, share tricky clinical cases and the majority of the sharing are done by **Tandberg video-conference systems** and (at times we use secure **skype**) where we have connectivity to other hospitals and share different clinical cases (Oncology cases, prostate cancer cases, cancer pathology data) and the collaborative tool we have supports and is pretty much adaptable to relay the information."*

Limitation:

However Tandberg Movi has one main limitation. It is only supported on Microsoft Windows XP or later operating system in conjunction with Microsoft IE version 6.0 or later.

3.2.2 Citrix Collaboration Tool

A server solution that uses Microsoft Terminal Services to deliver Windows applications to PCs, Apple Macintosh computers, X terminals and UNIX workstations. This enables users of those systems to access and use those programs which are available to those using the Windows operating system. Citrix servers use two technologies; WinFrame and Independent Computing Architecture. Moreover, Citrix collaboration solutions allow users to connect with people, files and workflow tools from anywhere – allows users can do their best work, whenever and wherever inspiration strikes [62].

It also allows agile teams to keep track of all their conversations, content and processes in one place. Hence provides great visibility. Recalling this statement:

"as work becomes more distributed and as you know the healthcare organization especially hospitals like that of us, Akadamiska Hosptial, demands 24 hours of cycle of work and fitting in life into work for individuals and clinicians is more challenging, and

we believe is that having such a collaborative tool will make far more productive and feel more engaged and connected."

3.2.3 IBM Notes Domino

Provides business collaboration functionality, including email, calendars, to do lists, contacts management team-rooms, discussion forums, file sharing, micro blogging, instant messaging, blogs, and user directories. It also enables groups of users to work together in real time by sharing information and processes with unified communications software [63]. In addition, it provides users with web access to critical information and applications that are personalized to their needs. [64].

3.2.4 Cisco Jabber

Cisco Jabber is a unified communications application for PC, Mac, Tablet and Smartphone. Cisco Jabber client applications provide presence, instant messaging, voice and video, voice messaging, desktop sharing and conferencing capabilities. It can be used with either on premise or cloud based unified communications services [65].

3.2.5 Skype

Is a free Voice-Over-IP (VoIP) and instant messaging client, currently developed by Microsoft Skype Division. It allows registered users to communicate with their colleagues through voice, video and instant messaging over the Internet [66].

Skype has also become popular for its additional features, including file transfer and videoconferencing between its registered users.

3.2.6 Research Participants

Almost all of the research participants are male in gender and between 35 to 58 years of age.

Participant (Physicians)	Role	E-mail	Hospital
Tomas bjerner	Chief Physician at the Department of Radiology, Oncology and	Tomas.bjerner@akademiska.se	Akadamiska Hospital

	Radiation Science, Radiology -		
Johan Lindqvist	Doctoral student at Department of Neuroscience, Clinical Neurophysiology	Johan.Lindqvist@neuro.uu.se	Akadamiska Hospital
Per Adolfsson	Per Adolfsson Chief Operations Biomedical engineering, medical physics (MSI)	per.adolfsson@akademiska.se	Akadamiska Hosptial
Goran.angergard	Chief physician at Department of Surgical Sciences, *Anaesthesiology and Intensive Care*	goran.angergard@akademiska.se	Akadamiska Hospital
Lars Westman	Lars Westman Avdelningschef Ambulansen	lars.westman@akademiska.se	Akadamiska Hosptial
Dessu Doneke	Biomedical Engineer at Uppsala University Hospital	dessu.amin@yahoo.com	Akadamiska Hosptial

Chapter four

4. Data Analysis and Findings

This chapter presents the findings of the collected data obtained from semi-structured interview. Final thematic analysis revealed six themes as potential enablers of collaborative tools and technologies to facilitate tacit knowledge sharing amongst physicians of Akadamiska Hospital. Final emerged themes are defined in detail in terms of contribution, aspect, what the collaborative tools offer, and the knowledge that is shared amongst physicians was connected to the existing literature of tacit knowledge sharing and as well as supporting the evidences by putting together sample of the interview manuscripts in an attempt to mine sensible meaning from the gathered data.

4.1 Analysis

Analysis of data in qualitative research involves summarizing the interview transcripts conducted during the data collection phase of the project and presenting the results in a way that communicates the most important attributes. In qualitative research analysis involves things like the frequencies of variables, differences between variables, statistical tests design to estimate the significance of the results and the probability that they did not occur by chance [67].

 All the above processes are done basically by counting how something often appears in the data and comparing one measurement with others. At the end of the analysis, not only does the author have a mass of results but he/she also has the major findings.

Qualitative data obtained from conducting the interview were examined, analyzed and transcribed through the procedures of thematic analysis approach, following the coding guidelines given by QSR International qualitative data analysis software, NVivo 10.

First and foremost, interview transcripts were read and read in order to become familiar with what the corpus entails and the patterns that frequently occur in the mass.

Secondly, the initial codes were generated by data reduction technique and document where the patterns occur and what the codes mean.

Thirdly, list of candidate emergent themes, which accurately depict the data, were developed for further analysis. Moreover the themes developed at this stage were carefully defined and linked to the literature in a pursuit to answer the research question. Finally, a thick description of the findings was documented. In addition, instances of the transcript were used as to support the emergent themes to link with the existing literature.

4.2 Collaboration Tools and Technologies used at Akadamiska Hospital

Before exploring the contribution of collaborative tools and technologies in facilitating tacit knowledge sharing, the data was reviewed to see what kind of collaborative tools and technologies clinicians at Akadamiska Hospital use most. According to the interview participants (physicians and clinicians from Akadamiska Hospital) who were interviewed in this research Tandberg MOVI, Citrix, IBM Notes and Domino, Cisco Jabber, Electronic Patient Record System (EPR), and Skype were the main collaborative tools and technologies were used regularly, ipad apps, social networking sites such as YouTube and Vimeo

Tools	Regularly	Occasionally
TANDBERG MOVI (videoconference Tool)	5	1
Citrix Collaboration Tool	4	3
Cisco Jabber (instant messaging (IM), voice, video, voice messaging, desktop sharing, and conferencing tool)	4	2
Skype	6	0
Elecronic Patient Record System (EPR)	6	0

IBM Notes Domino (provides business collaboration functionality, including email, calendars, to do lists, contacts management team-rooms, discussion forums, file sharing, micro blogging, instant messaging, blogs, and user directories.[68]	3	3
Others	2	4

Table 1 Type of Collaborative used by participant physicians of Akadamiska Hospital

4.3 Type of Tacit knowledge Shared Between Participant Physicians at Akadamiska Hospital

Next the data was reviewed to determine the type of information and knowledge clinicians at Akadamiska Hospital usually share through collaborative tools and technologies, and if there are instances of tacit knowledge sharing. Based on the responses from the interview participants of the study, clinicians do share varies types of knowledge (individual and collective, explicit and tacit) through their collaborative tools and technologies currently used at the hospital.

They share contents such as different clinical tricky cases, pathological data, oncological cases, research papers, best practice, and engage in conversation as well. Since tacit knowledge is created in social interaction amongst individuals, clinicians share a lot of tacit knowledge through collaborative tools and technologies in the form best practice, hints and tricks, engaging in a conversation on different clinical cases, when diagnosing an illness, surfacing new thoughts.

The following table shows a summary of these codes associated with the types of tacit knowledge shared among clinicians of Akadamiska Hospital through their collaborative tools and technologies listed in table. Coding sources (CS) and Coding references (CR) show the number of interview respondents and how many times they talked about each type of information they share through collaborative tools and technologies. Here the numbers indicate the types of tacit knowledge shared amongst clinicians.

Forms of Tacit knowledge shared	CR*	CS**
Best practice sharing	10	6
Rule of thumb (hints and tricks)	9	5
Engaging in conversation	12	6
Telling about diagnosing an illness	8	3
Surfacing new thoughts	6	2
Skill demo via video conferencing	7	3
Problem solving in proactive and novel situations	3	5

Table 2 Types of Tacit Knowledge shared amongst participant of this study - Physicians of Akadamiska Hospital

*CR: Coding Reference **CS: Coding Sources

It is important to note here that this study considered the different types and forms of tacit knowledge ranging from easily codified tacit knowledge to the notoriously complex and difficult to express in words, such as social skills, intuition, ideas, values perception, subjective views and aesthetic sense [nonak and takuechi 1995, Virtainlahti 2006] and individual and collective knowledge as well. As stated by Philippe Baumard (2004), "*tacit knowledge is personal, and has profound meaning only for the individual who has lived the experience. This non-scientific, practical, contextual knowledge is generated in the intimacy of lived experience. It is the acquired by trial and error, through organizational and environmental learning*".

Furthermore, According Polanyi (1958; 1966) all knowledge is either tacit or based on tacit knowledge. Tacit knowledge is necessary background knowledge so that we can handle and develop explicit knowledge [69]. Polanyi states that all knowledge has a tacit component. In other words Polanyi never intended tacit knowledge to be a separate component of knowledge, but rather to be an integral part of all knowing [67]. As a result, it is with the help of tacit knowledge that we can know when to trust in an explicit knowledge. Thus, a piece of document or video, holding explicit knowledge has also a dimension of tacit knowledge because it is

dependent on the cultures, languages and understanding of the reader and writer. This Polanyi's theoretical orientation was constantly applied as a guide at each and every phase of the coding process.

Moreover Halding-Herrgård (2004) concludes that although tacit knowledge is personal and abstract, it is possible to share it among people nonverbally through practice and experience [70]. Accordingly, the data is refined and revised and developed into main themes to see if, in fact, collaborative tools have the roles in facilitating tacit knowledge sharing amongst physicians. Thematic data analysis revealed number of patterns or themes from across the data sets which are closely associated with the first research question of this study. Six themes were selected among others based on their closeness to the first research question. Finally the emergent themes are defined below, connected with the literature and backed by selected responses from the interview transcripts in an attempt to see if, in fact, collaborative tools and technologies can have the potential in facilitating tacit knowledge sharing.

Thematic analysis method as mentioned above was employed and played a crucial role in extrapolating and identifying the main ideas from the rich description of the data set. During developing code from the data set, analysis goes beyond just simply counting phrases or words in a text and much emphasis were given in identifying important phenomenon in the data and thus are encoded prior to their interpretation. In addition to that, with the help of qualitative data analysis software NVivo 10, codes are interpreted by comparing theme occurrence and their frequencies in order to capture the intricacies of meaning within the data set.

Brief description of each theme is provided below. In addition, to support assertion and theories, each emerged theme was connected with the tacit knowledge literature and then supported by piece of statements selected from the interview transcript.

4.4   Findings

The following five figures depict a comprehensive analysis of what the theme contribute to understand the corpus (data). Moreover, from each figure we can see the relationships between the **nodes** (combined codes) and the final emerged **themes** of this research.

A **node** is a collection of reference about a specific theme, place, person, or other area of interest. Qualitative researchers gather the references by 'coding' sources such as interviews, focus survey etc.

Figure 4.1 Showing final emerged theme developed from the frequently occurred (from the corpus) codes.

Figure 4.2 Showing final emerged theme developed from the frequently occurred (from the corpus) codes.
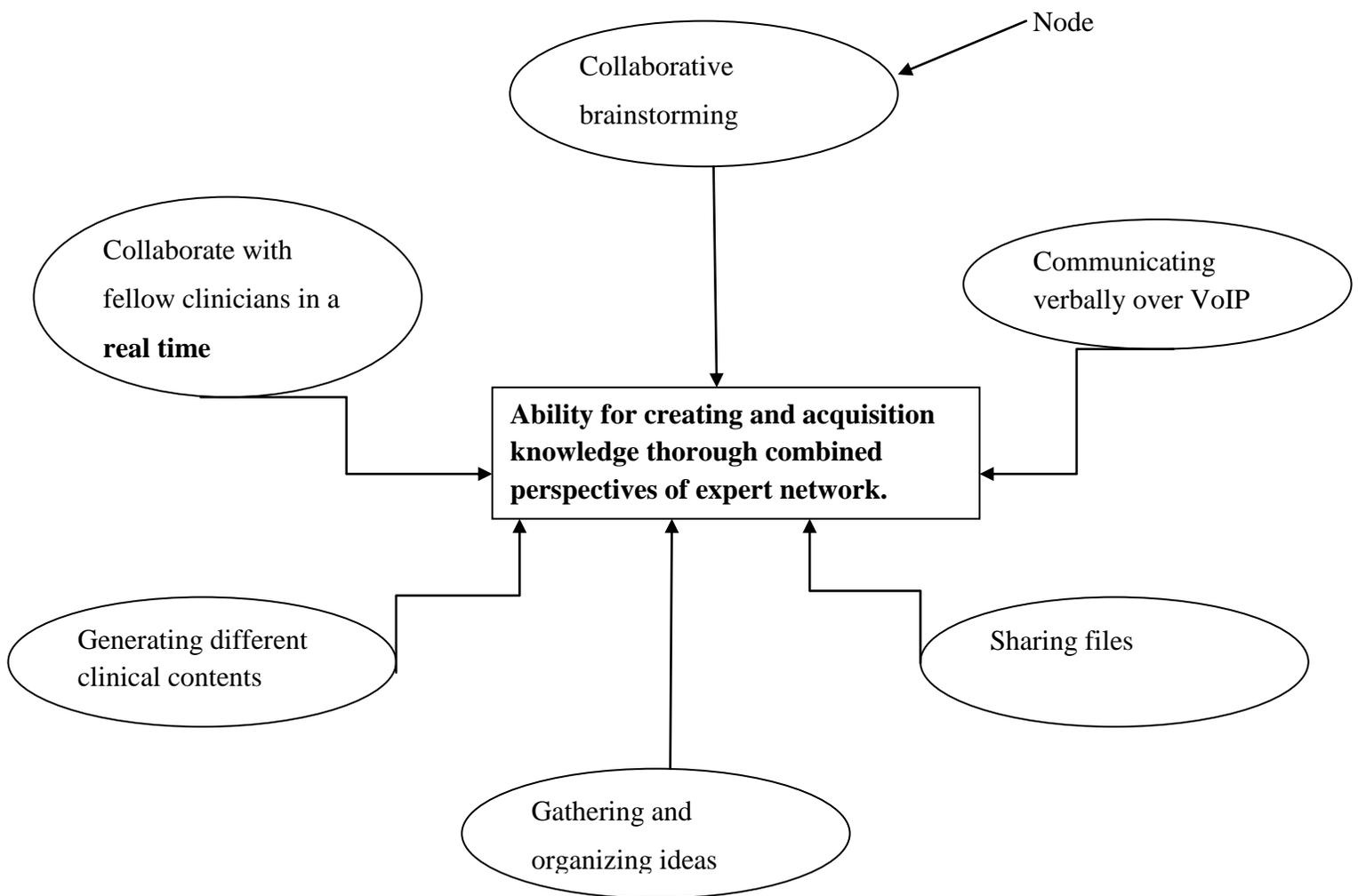
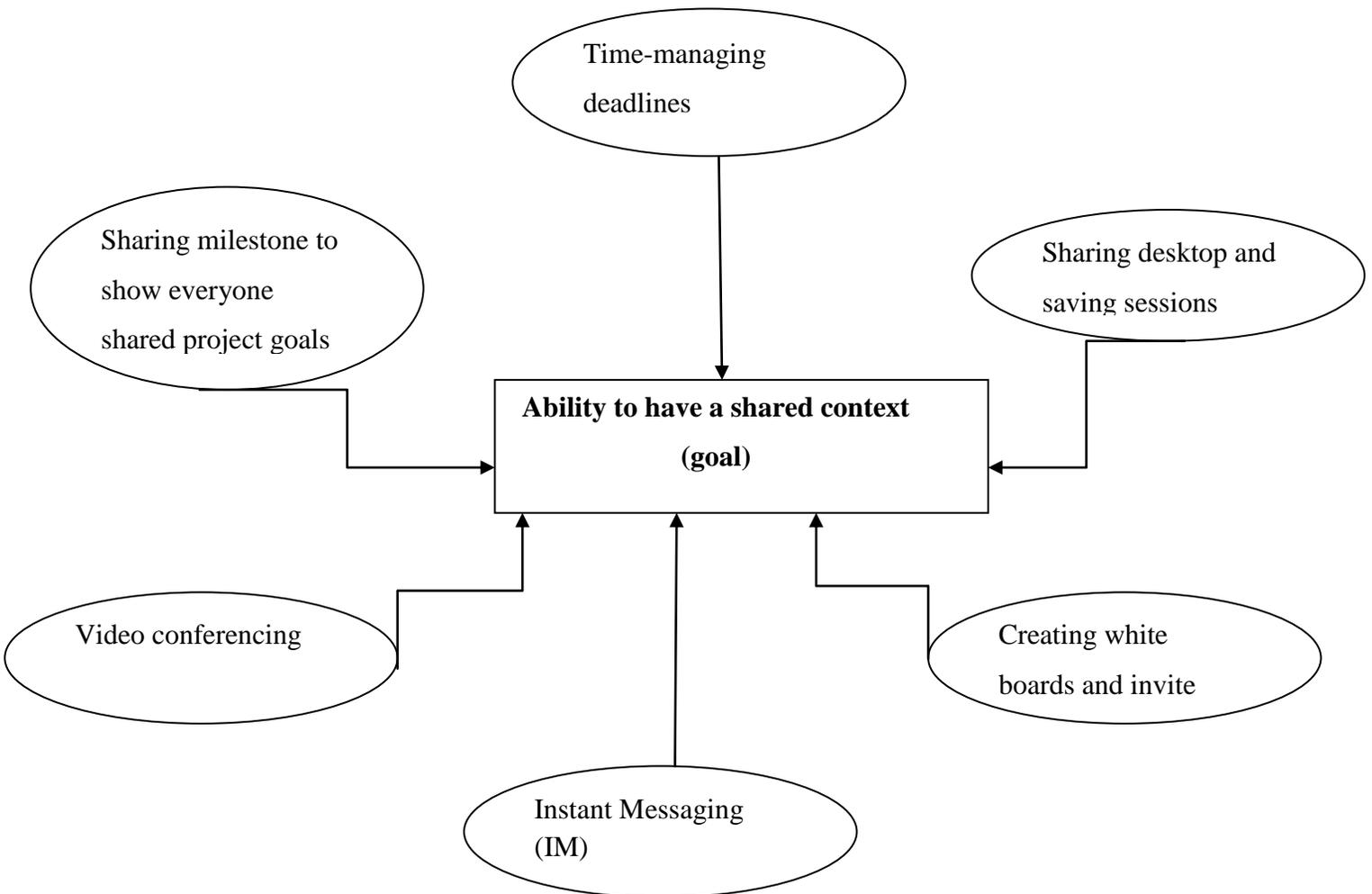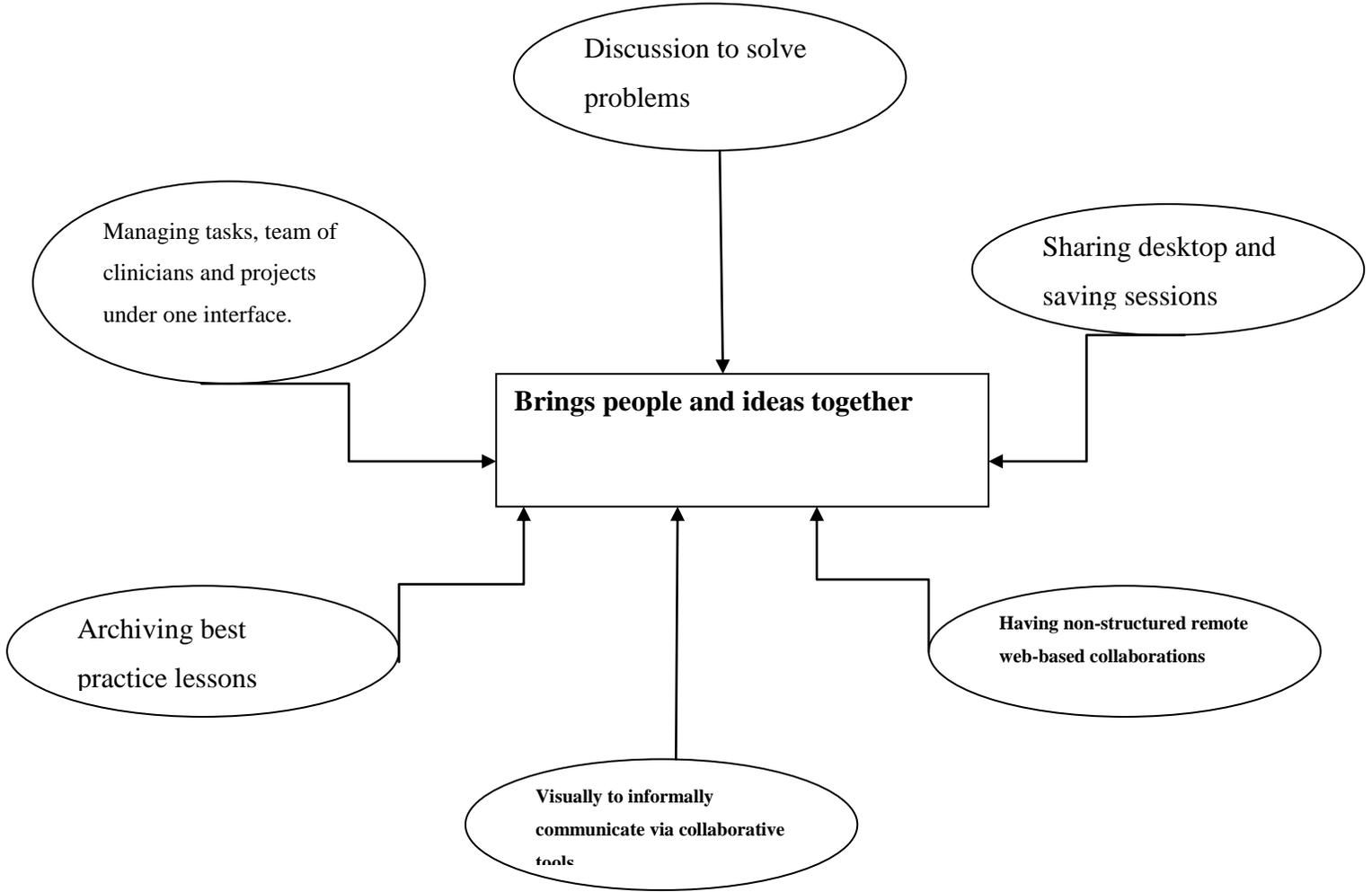Figure 4.3 Showing final emerged theme developed from the frequently occurred (from the corpus) codes.
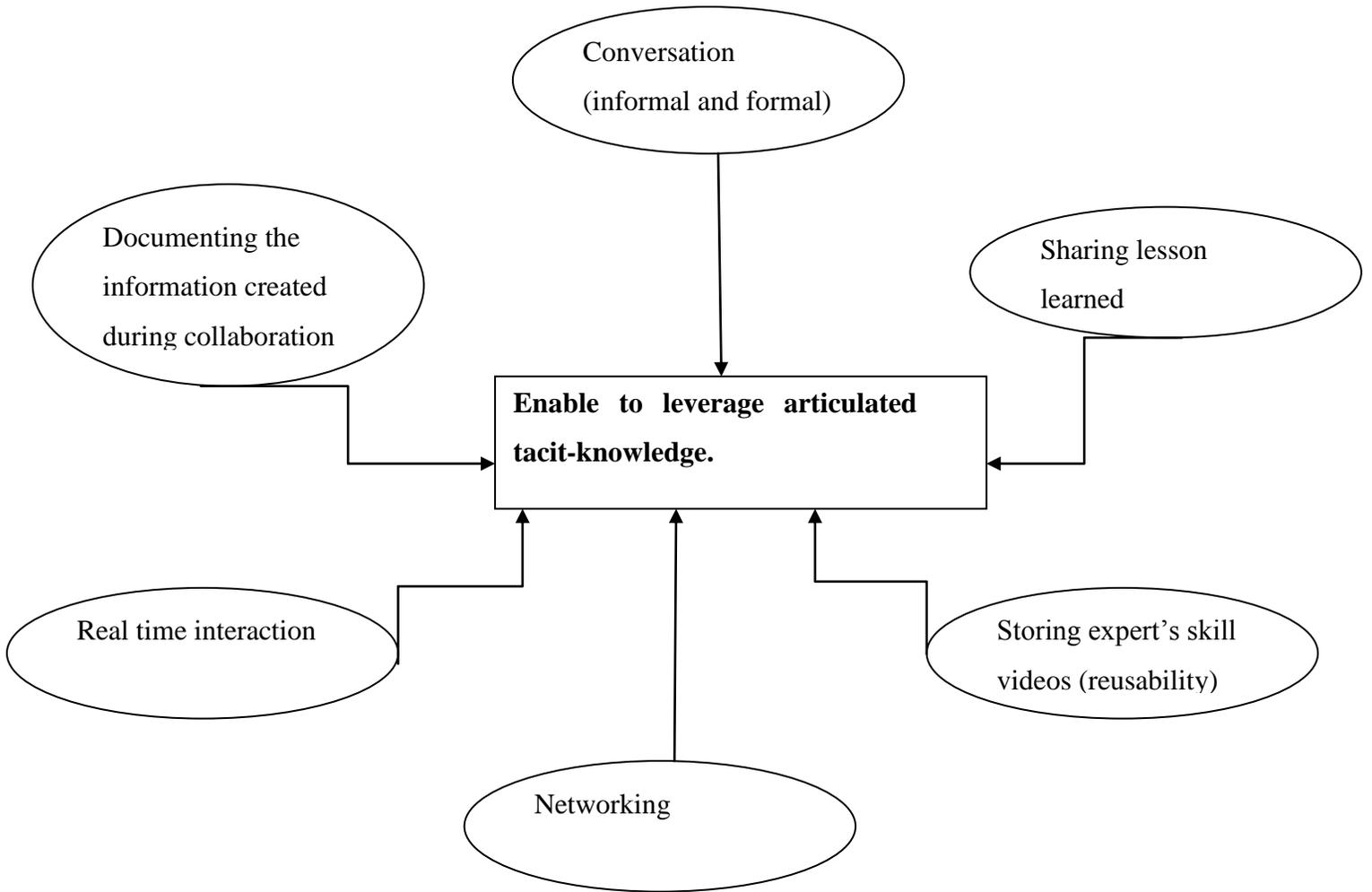
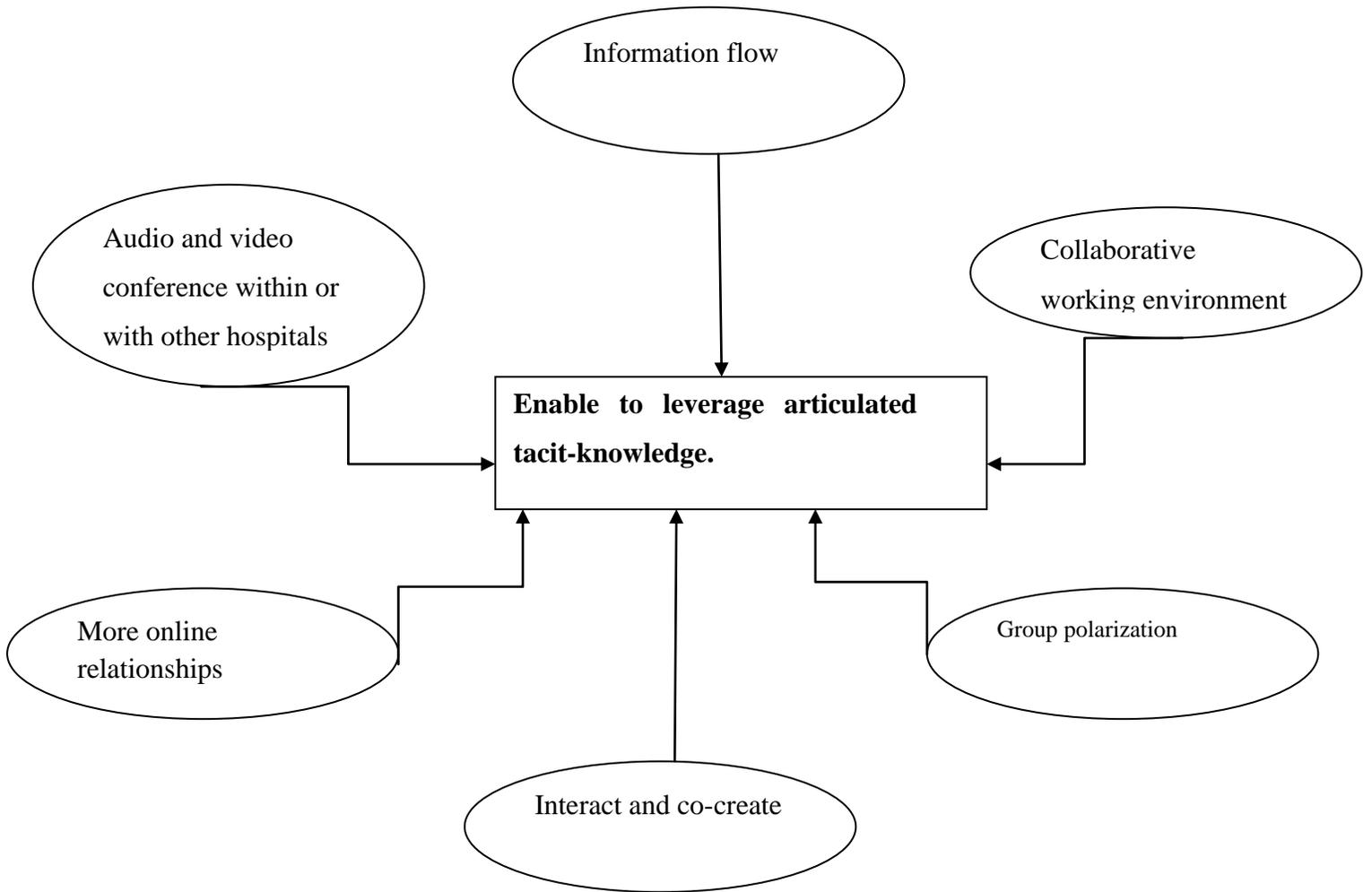Figure 4.4 Showing final emerged theme developed from the frequently occurred (from the corpus) codes.

Figure 4.5 Showing final emerged theme developed from the frequently occurred (from the corpus) codes.

4.5   Final Six Emerged Themes with their detail definition

Contribution	Aspects	What the collaboration tools offer :	*CR	*CS
Ability for creating and acquisition knowledge thorough combined perspectives of expert network.	• Supporting shared goals • Operational Coordination • Innovation through ideas • Spawn innovation • Creating Values • Contributions are available for re-use or re-purpose	• Collaborative brainstorming • Collaborate with fellow clinicians in a real time • Generating different clinical contents and inviting clinicians to have their say and collaborate • Gathering and organizing ideas remotely • Communicating verbally over VoIP	29	6
Ability to have a shared context (goal):	• Shared benefits • Work together • Building collaborative culture	• Time-managing deadlines • Sharing milestone to show everyone shared project goals • File sharing • Sharing desktop and saving sessions • Creating white	13	6

		boards and invite clinician(s) to join and to update, change in a real-time • Video conferencing • Instant Messaging (IM)		
Give boost for the creation of new explicit knowledge from tacit knowledge	• Quickly Communicate • Learning from others • Informal communication • Story telling	• Discussion to solve problems • Archiving best practice lessons • Managing tasks, team of clinicians and projects under one interface. • Visually to informally communicate via collaborative tools • Having non-structured remote web-based collaborations • Telephone calls	15	6
Brings people and ideas together	• Connectedness • More interaction automatically and directly	• Conversation (informal and formal) • Networking	12	4

	• building community • Ability to network • doing tasks in group and more closely • Staying on top	• Real time interaction • Engaging to collaborate		
Enable to leverage articulated tacit-knowledge.	• Shared Benefit, values • Reusing articulated experience when in need • Harnessing tacit knowledge to achieve quality of healthcare interventions • Intellectual capital	• Documenting the information created during collaboration • Sharing lesson learned • Sharing best practices • Storing expert's skill videos (reusability)	10	5
Enables collaborative group-decision making on a tacit basis	• e-professional • collaborative working environment • discussing problem solving • Information flow • Deliver great content and value • Group polarization • Synergy	• Email • Instant Messaging • Audio and video conference within or with other hospitals • More online relationships	13	5

Table 3 Brief Description of the emerged theme with their detail descriptions

4.6 Emerged Themes Are Linked with Existing Literature

4.6.1 Ability for creating and acquisition knowledge thorough combined perspectives of expert network

Organization work intensely to create, preserve and protect their knowledge. Knowledge is the genome of an organization [13]. Organizational learning depends on the business ability to generate new ideas and its adeptness at generalizing ideas through horizontal and vertical knowledge transfer (Korac-Kakabadse and Korac-Kakabadse, 1999). Unlike the transfer of explicit knowledge, the transfer of tacit knowledge requires close interaction and the buildup of shared understanding and trust among them. There are, however, a few issues that are important for transferring any kind of knowledge that is tacitly held by individuals. One is by experience; people learn by watching others and seeing what and how they do it. Abidi and Curran (2005) argue that a healthcare experts' tacit knowledge can be captured within the set of actions events that manifests by clinicians problem solving decisions and actions [xi]. Moreover, Nonaka's knowledge creation spiral model so called 'socialization' includes that the shared information and communication of tacit knowledge between people, for example in this case, in video-conference meetings or engaging in a discussion of tricky clinical cases. Davenport and Prusak (1998) Knowledge sharing is often done without ever producing explicit knowledge and, to be most effective, should take place between people who have a common culture and can work together effectively [lxi].

With respect to the above arguments, Nanoka and takeuchi observed that Socialization boosts the ability to create new knowledge through combined perspective [12]. Collaborative tools and technologies create such a space for clinicians to share their experiential healthcare knowledge with their colleagues. Hence, learning from experiences, reflecting unlearning and doing by learning have significance positive influence on tacit healthcare knowledge acquisition and creation, which also have been proved to better the performance of an organization by some scholars (evitt & March, 1988; Luo & Peng, 1999; Slocum & McGill , 1993; Nonaka, 2000; Huber, 1991; RuiMingjie, 2002). The following statements taken from the interview transcript (M.D Thomas) reflect some of the above arguments:

*"Often we have regular multi-disciplinary video-conference meeting with other small and bigger hospitals clinicians and representatives in the Uppsala region to discuss, share tricky clinical cases and the majority of the sharing are done by **Tandberg video-conference systems** and (at times we use secure **skype**) where we have connectivity to other hospitals and share different clinical cases (Oncology cases, prostate cancer cases, cancer pathology data) and the collaborative tool we have supports and is pretty much adaptable to relay the information."*

"This kind of meeting are discussion of oncology cases that are between different cancer research groups representative organized by the regional cancer center here in Uppsala, which have different diagnosis groups such as prostate cancer research groups and common cancer group, and these group meet online via Tandberg systems to discuss and share different clinical cases such as what is the best way, how should we work with such tricky cases and try to come up with the solutions and of course we converse and chat about unusual radiological images for diagnosis and treatment."

Health industries can be successful because of their skills and expertise at "organizational knowledge creation". By organizational knowledge creation according to Nanoka and Takeuchi it is the capability of a company as a whole to create new knowledge, disseminate it throughout the organization, and embody it in products, services, and systems. Thus, it's understandable that engaging in such social arrangements and community networks between different clinicians from different small and big hospitals will create and maintain a generative environment over time where synergetic relations between them are nourished, leading to new ideas and their application. According to Nonaka "the key to knowledge creation lies in the mobilization and conversion of tacit knowledge."

4.6.2 Ability to have a shared context (goal):

Knowledge can be amplified or crystallized at the group level through dialogue, discussion, experience sharing, and observation [12]. Tacit knowledge is derived from personal experience. It is subjective and difficult to formalize (Nonaka et al., 2000). Therefore tacit knowledge is often learned via shared and collaboration experiences (Nonaka and Takeuchi

1995); learning knowledge that is tacit requires participation and "doing". Having an insight or a hunch that is highly personal is of little value to the organization unless the individual can convert it into explicit knowledge. Akadamiska hospital physicians and clinicians are very good at realizing this exchange between tacit and explicit knowledge throughout the patient diagnosis, treatment and prognosis phase. Recalling this example:

"We have regular multi-disciplinary video-conference meeting with other small and bigger hospitals clinicians and representatives in the Uppsala region to discuss, share tricky clinical cases and the majority of the sharing are done by **Tandberg video-conference systems** *and (at times we use secure* **skype***) where we have connectivity to other hospitals and share different clinical cases (Oncology cases, prostate cancer cases, cancer pathology data) and the (collaborative) tool we have here at Akadamiska supports and is pretty much adaptable to relay the information between us"*

Above example by one of the interview respondent illustrates the central role teams play in the knowledge-creation process they provide a shared context in which individuals can interact each other. Team members create new points of view through dialogue and discussion. This dialogue can involve considerable conflict and disagreement, but it is precisely such conflict that pushes employees to question existing premises and to make sense of their experience in a new way. This kind of dynamic interaction facilitates the transformation of personal knowledge into organizational knowledge [Nonaka pp 14 the knowledge creating company].

4.6.3 Give boost for the creation of new explicit knowledge from tacit knowledge

Tacit healthcare knowledge sharing or transfer in healthcare industries (or in profit and non-profit making organization) is the process through which individuals are affected by the experience of others. For the paper of this paper, collaboration tools and technologies is defined as the process of two or more people working definition together on a common task. Moreover collaborative tools and technologies comprise one or more computerized tools that support the communication, coordination and/or information processing needs of two or more people working together on a common task. This definition emphasizes some

significant benefits of collaborative tools whilst supporting the communication, coordination and information flow between the people working together. Collaboration tools and technologies help tacit knowledge sharing by providing numerous collaborative tools that supports best practice such as e-mail, computer conferencing, video conferencing, video walls, discussion-boards, chartrooms, knowledge repositories, workflow management systems, and so on. Here are some of interviews where Akadamiska hospital physicians had to say about the support they are getting from the type of collaboration tools and technologies they currently have at Akadmiska.

"When we use the (collaboration) tools and technologies we currently have here at Akadamiska, there wasn't too much continued conversation (via the tools) and the users (clinicians particularly in the radiology department) of the systems, I would say weren't just large enough. However, Once we get to use the tools quite often than before, one of the ways we're getting value it is bringing us very close with the people who do work here at Akadmiska cancer research center and other Akadamiska hospital customers (our hospital gives training and other technical support to other sister hospitals) everyday giving us just as much as a chance to interact with my department (radiology) as I, when I get a chance, participate in the training (knowledge sharing and transfer) session via video conference with them.

Another participant of the study adds this:

Even if we don't think that the whole (collaboration suits) tools we have here at Akadamiska hospital something that we use it every single day, but keeping the systems here is very important I would say: its speeds up the ability for us to get the knowledge and information we need: It is also a good tool for us in building community (collaborative learning environment) for sharing knowledge and exchange information amongst us (professionals)."

4.6.4 Brings people and ideas together

Pursuit of tacit, explicit and self knowledge, self-renewal and innovation are timeless and endless [71]. According to Nanoka and Takuechi an organizational knowledge creation is a continuous and dynamic interaction between tacit and explicit knowledge. Such interaction

is shaped by shifts between different modes of knowledge conversion, which are in turn induced by several triggers for example the SECI knowledge spiral process. When tacit and explicit knowledge interact, as in Akadamiska hospital physicians and clinicians tacit knowledge sharing via their collaborative tools, an innovation emerges. Organizations that dictate emerging technologies have a collective sense of identity and a shared understanding of what they stand for, where they are going, the kind of world they want to live in and how to make that world a reality (Nonak, 1991). Companies with interactive learning environments develop ways to find sort, use store, retrieve and link the growing number of data and information bases. First, they learn what local knowledge exists. Second, they put valuable knowledge into wider circulation (Brown and Dugid, 2000). Let's hear to what an Akadamiska physician had to say about:

"…The benefit of the (collaborative) tools we clinicians at Akadmiska hospital have probably is the ability to communicate (collaborative learning environment). To have conversation with people who know something about something. Using Tandberg, skype, Citrix, bunch of Ipad apps et al personally makes me feel connected to all of colleagues and other hospital physicians here and around Uppsala. In addition it gives me the ability to think differently and perhaps change the way I am doing things. Because I thought things that other clinicians need and I can build on their own ideas to make them the very best ideas that can be for Akademiska hospital. Today I think there is huge expectation out there. Things happen much faster, more medical information is produced. Thus, to meet expectations and achieve the objectives, It would be great to have such tools available"

4.6.5 Enable to embodying articulated tacit-knowledge during a healthcare interventions.

The use of tacit health care knowledge in a health industry enables clinicians to have effective decision making process and enables them both in embodying and applying this knowledge to generate more innovative ways during diagnosing, treating a specific clinical case as well as improving operational work flows and outcomes [72]. According to some of the interview participants of this study, physicians and clinicians have more or less related opinion when it comes to clinical intervention in which every clinical case or patient scenario offers a unique experience ranges from non-critical to life threatening, thus gaps in

not only in tacit healthcare knowledge but also knowledge in general can be crucial in making the right decisions during a healthcare interventions. Contemporary, health organizations are experiencing huge shortages of experts in every field of medicine; new strategies are required to cope with the increases pressures from the public [73]. Coupled with this argument, the healthcare informatics revolution- employed at their organization - for collaboration or supporting an operational flow - has presented new challenges such as how to deal with information flood and information overload. This has resulted in a slow shift from a pull strategy to push strategy; collaboration tools and technologies employed at healthcare organization is therefore can be viewed as a savior in facilitating tacit healthcare knowledge sharing and diffusion from the perils envisaged in healthcare organization.

The transformation of tacit knowledge to become explicit ends when it is articulated. Articulated tacit knowledge needs to be stored for future use of for further discussion [74]. An electronic medical record (EMR) is an emerging tool used in medical informatics to computerize medical records and to a knowledge sharing platform among physicians (Hersh, 2009; Herschel et al, 2001) Since EMR stores various items of important medical data, it is argued that these data items can be turned into knowledge that is valuable in making clinical decisions. Moreover, EMR is an explicit medical record that stores the physician's tacit knowledge being deployed in each diagnostic process [Herschel et al., 2011].

According to Penrose (1959), cited at Nanoka and Takeuchi (1995), a firm can be viewed as "*both an administrative organization and a collection of production or productive resources, both human and material*". Furthermore, "*It is never resources themselves that are the 'inputs; in the production process, but only the services that resources can render. Services are a function of the experience and knowledge accumulated within the firm, and thus firm specific. In essence, the firm is repository of knowledge*".

Here are some statements from physicians regarding the above argument,

"*I guess the way we see it now is that, you know, you have the power to connect to achieve a common purpose and Information technology tools, apps, social media and (digital connectedness) for us are more and more becoming part of our everyday life. It has already revolutionized how we approach the task of organizing and go beyond that as well.*"

4.6.6 Better collaborative group-decision making on a tacit basis

Tacit knowledge appears then as an essential and daily element of the management of an organization. Although there is a very weak correlation between profit and the formalization of tacit knowledge into explicit knowledge (Grinyer and Norburn, 1975), articulating tacit knowledge of explicitly mastered knowledge, though, contribute to the preservation of a firm's knowledge, perhaps even to the development an 'appropriation regime' (Teece, 1987). What distinguishes tacit knowledge from objective knowledge is its characteristic quality of non-communicability. According to many studies of healthcare directors' agendas, governmental decision and decision made in emergencies show that decisions are taken largely on a tacit basis. It is in fact the interaction of tacit and explicit knowledge that allows firms to make sense of their environment, by appealing as much to the exercise of moderation, to control and modellization, as to organizational memory, to their experience and that of others, and to intuition (Philipe Baumard, 1999). Tacit knowledge is thus a reservoir of wisdom that the firm strives either to articulate or to maintain if it is to avoid imitation.

Industries like that of healthcare, physicians and clinicians are ultimately the biggest assets. They highly rely on their expert's skills and knowledge to deliver quality healthcare services for the population. The collaborative tools they have there at Akadamiska Hospital help physicians to break down the silos and improve collaborations (when collaboration is needed) amongst our professionals. Furthermore, it helps them accelerates the direction that they are going to give the best healthcare services and catch up with the constantly changing environment.

The following statement of a clinician who participated in this study reflect some of the above arguments

"..the fact that we want our physicians to be the most effective networked of people in the healthcare industry hear around Uppsala and around the world has now become part of our everyday life. Physicians and clinicians are connected. We want to make the most of the technology we have here at Akadamiska. We want to help patients and provide quality healthcare service. The (collaboration suits) we have here at Akadamiska have nothing to do with the diagnosis and treatment I would say. The basics of the health care procedure remains

the same before we have the technology, but how we do the task at hand has now changed. It encouraged us to share information, at times we use them in the decision making process despite face-to-face meeting is our primary way of making decisions – (being able to do such thing is valuable)"

Collaboration suits that fall into the category and assist physicians do such activities focuses on the group communication and decision making perspective, supports individuals and groups in the critical task of sharing information for group decision making.

4.7   Implications

This research highlights the importance and contribution of collaborative tools and technologies have in facilitating tacit healthcare knowledge sharing amongst physicians who often have a collaborative learning environment – meaning, group of physicians who share occupational challenges and engage in sharing experiences, providing recommendation, and explicating their tacit know-how and getting themselves acquainted with practical knowledge in diagnosing a given type of clinical case. This study has implication for physicians – who are willing to share their expertise knowledge - and health practitioners and clinicians – who are ready to learn either by interacting with domain experts by leveraging their explicated knowledge. The finding of this research may contribute to the current and future studies in expanding the understanding and conceptual clarity of the presently less evident literature of collaborative tools and technologies and their impact in facilitating tacit healthcare knowledge sharing. This study's findings could also help Akadamiska Hospital in closing the knowledge gaps experienced by the healthcare community to adopt collaborative tools and technologies as a knowledge sharing medium to support their collaborative learning, which in turn could give them a strategic benefits and the ability to create and sustain core competencies and to realize improved and effective knowledge sharing and problem solving.

Chapter Five

5. Conclusion

This chapter has response for the research question stated in the introduction chapter of this paper. It presents six potential contributors of collaborative tools and technologies that facilitate tacit healthcare knowledge amongst Akadamiska Hopsital physicians. It also comprises Author's selected reviews of few existing literature on the role of tacit knowledge sharing discourse and its use and relationships with Web 2.0 (the Second Generation of Internet based Applications) and its major features such as collaborative tools and technologies and that of social networking.

5.1 Conclusion and Discussion

The purpose of this thesis was to assess the contribution of collaborative tools and technologies to facilitate knowledge sharing and diffusion amongst physicians and clinicians of Uppsala University Akadamiska Hospital, one of the largest and oldest university hospitals in Sweden. In addition, this paper reviewed high quality medical/health informatics and information systems literature in an attempt to evaluate the use and support of IT-enabled tools - such as social media tools and collaborative technologies – to the current state of tacit knowledge sharing and diffusion. The result of this study suggests that collaborative tools and technologies are the most important current development in clinical knowledge management settings and are likely to remain so for the foreseeable future.

Clinical knowledge management systems are striving very rapidly from handling the old-fashioned creating, storing, retrieving and disseminating explicit knowledge to the demanding and challenging undertakings of the Knowledge Management (KM) endeavors such as the creation and sharing (new) knowledge that is tacitly held by individuals, advanced search technique for executing complex clinical queries and knowledge repositories. The findings of this thesis suggest that collaborative tools and technologies have the potential to support tacit

knowledge sharing and diffusion through quite a few factors. Internet collaboration tools and technologies often referred to as WEB 2.0, can provide a space where physicians and clinicians can collaborate in a real-time such as that of standard conference call and hold meeting and instant messaging, and do some collaborative processes such as routinely communicate about a specific case with colleagues, managing workflow, producing clinical case documents sharing them with like-minded people within or outside the hospital, scheduling and receiving internal news and update.

From this research it has been observed that the collaboration tools and technologies at Akadmiska Hospital have six potential contributions in facilitating tacit healthcare knowledge sharing amongst physicians - which now leads us to answering the first research question.

Ability for creating and acquisition knowledge thorough combined perspectives of expert network is one major finding this paper. Physicians at Akadamiska hospital, department of radiology, Oncology, and Radiation Science highly engage in a regular multidisciplinary conference with other smaller and big hospital around hospitals clinicians and representatives in the Uppsala region to discuss, share tricky clinical cases and the majority of the sharing are done by the collaborative tools Tandberg video-conference systems and secure Skype - where they have connectivity to other hospitals and share different clinical cases. The tools creates space for physicians to have activities such as collaborative brainstorm sessions, real time collaborate with fellow clinicians, generating different clinical contents and inviting clinicians to have their say and collaborate, gathering and organizing ideas remotely and communicating verbally over VoIP. Hence these activities increase the chance of supporting shared goals, operational coordination, and innovation through ideas and spawn innovation.

Ability to have a shared context is another potential that collaborative tools and technologies have in supporting tacit knowledge sharing in a clinical settings. Its helps tacit knowledge sharing by sharing milestones to let know everyone in the project team shared the project goals, file sharing, during shared desktop and saving sessions, creating white boards and inviting clinicians to join and update, change in real time, video conference sessions, Instant Messaging (IM).

Another important finding of this paper is that collaborative tools can give boost for the creation of new explicit knowledge from tacit knowledge. Physicians getting value through the tools they have at Akadmiska Hospital. It is bringing them very close with the people who do work there at Akadmiska cancer research center and with other Akadamiska hospital clinicians everyday giving them just as much as a chance to interact with their department (for example at radiology department) as they get the chance, to participate in the knowledge transfer/sharing session via video conference. Even if some of the physicians don't think that the whole collaboration suits they have something that they use it every single day, but keeping the collaboration environment and the systems there is very important: its speeds up the ability for them to get the knowledge and information they need. It is also a good tool for them in building community for sharing knowledge and exchange information amongst them whilst engaging in discussion to solve problems, archiving best practice lessons, managing tasks, informally communicating and video calls.

Collaborative tools and technologies can also bring people and ideas together**.** As express by participants of this study, A few physicians at Akadamiska have taken advantage of the use of collaborative tools and technologies to create and share still images, audio presentation to communicate through varies activities such as networking, real time interaction, conversation (formal and informal) with other physicians and clinicians to let them know what is going on in their respected field with common interests. This is mainly because access to experts and the know-how 'who knows what' is crucial in the tacit knowledge sharing process.

Yet another fundamental potential contribution of collaborative tools and technologies for facilitating tacit healthcare knowledge amongst clinicians is the ability to network. To have conversation with people who know something about something. Speeding up the ability to connect for like-minded people to get the information in need have been regarded as effective ways to facilitate tacit knowledge sharing. As participants of this study have thought using Tandberg, skype, Citrix, and different Ipad apps on their Ipads, personally give them the impression that somehow they feel connected to all of colleagues and other hospital physicians here and around Uppsala.

Public service organizations like that of healthcare, physicians and clinicians are ultimately the biggest assets. They highly rely on their expert's skills and knowledge to deliver quality

healthcare services for the population. The collaborative tools they have there at Akadamiska Hospital help physicians to break down the silos and improve collaborations (when collaboration is needed) amongst our professionals. Furthermore, it helps them accelerates the direction that they are going to give the best healthcare services and catch up with the constantly changing environment.

This paper has also reviewed a few existing literature on the role of tacit knowledge sharing discourse and its use and relationships with Web 2.0 (the Second Generation of Internet based Applications) and its major features such as collaborative tools and technologies and social networking in an attempt to see the possible similarities and/or difference between the existing clinical knowledge management systems literature about tacit knowledge sharing and the empirical findings of the thesis – leading us to analyze the second research question.

Tacit knowledge sharing amongst clinicians such as the sharing of clinical expertise skills is known to have a significant impact on the quality of medical intervention and decision. A paper by Panahi et al (2012), posits that social media can provide new opportunity for tacit knowledge sharing amongst physicians. Furthermore, watching and observing others' practice is accepted as a conventional and effective way to transfer tacit knowledge [12] – in which Panihi et al best put it as demonstration of best practice to colleagues. Interactive story-telling and narration is also another way for sharing tacit knowledge sharing stated in Panahi et al paper. Social media easily enables people to talk about or write down their stories and experiences in blogs, wikis and so on. Linde (2001, p. 161) defines narrative (story-telling) as a form of individual tacit knowledge where "language is perhaps the most tacit form of tacit knowledge: one knows how to speak but cannot articulate how one does it or the rules which govern language its use. Part of the knowledge of language includes knowledge of discourse forms: how and when to tell a story. Knowledge about identity, who one is and what one's history has been is very important part of an individual's tacit knowledge". In this regards Mulder and Whitely (2007) suggested tacit knowledge could be captured as narrative within three settings; the teleological motive which determines the purpose of capture, the bounded environment where the business operates to support corporate objectives and lastly its drivers and controlled vocabulary that is familiar to respondents in their business context [75].

Interaction with existing knowledge and access or exposure to information from various point of view and sources are vital for capturing and creating tacit knowledge. Moreover Panahi et al (2012) asserts that the more visible the information the more ideas and tacit knowledge will come out [13].

Another theoretical link relevant to the tacit knowledge sharing, which is one of the finding of is this paper, is the concept of distributed cognition [76]. It is related to the representation of information both within and or themselves as well as the transformation of information across to the receiver - and the use of some physical medium, paper, pens and calculators to story other tacit knowledge temporarily [77].

The role of ICT plays in the tacit knowledge sharing process encompasses different perspectives [78]. Although some study Hansen et al. (1999) argue that ICT can have a disruptive impact with regard to exchanging tacit knowledge; as collaborative tool and most communication technologies often means that employees may email rather than engage in a face-to-face meeting with a coworker. In a direct contrast, (Goh 2005; Tsui, 2005; Hustad, 2004) argue that ICT can have a positive impact [79,80,81] even though machines can only process information, whilst knowledge ought to and must be processed by humans [82].

One interesting finding of this paper is that collaborative tools and technologies have the potential to help physicians in storing descriptive amount of tacit knowledge for the purpose of reusability. To this regard, (Bush and Tiwana, 2005) remark that component of tacit knowledge could be codified, one way of storing such knowledge would be through repositories such as Lotus Notes database or similar systems, where experts of a given domain are persuaded to enter their tacit know-how (particular way of solving a problem) into a knowledge base and "even knowledge that cannot be codified or stored in a knowledge repository can be shared through hyperlinks, pointers and multimedia." [83]. Moreover (Harrington, 2005) backs the Bush and Tiwana's argument "Depending on the nature of the firm, staff will be expected to enter articulable tacit knowledge as a means of changing from a knowledge hoarding to a knowledge sharing culture [84].

5.2   Further Research

One of the main thrust of this study and that of collaborative tools and technologies studies is improving the flows of information and/or knowledge in an organizational context. Although this study presented a few contributions of collaborative tools and technologies have in facilitating tacit healthcare knowledge, yet it didn't examine to what extent tacit knowledge can be codified and make it available for further use. It is recommended that future research examines more on how to store descriptive tacit knowledge through collaborative tools and technologies significant to the process of knowledge codification. In addition as collaboration tools and technologies become more embedded in everyday applications, further research into the protection of user privacy and anonymity is necessary to understand fully and make the most use of the tools and their applications particularly where the collaborating teams are geographically distributed.

Finally the influence of ubiquitous computing, mobility, many different interfaces and a host of other factors are changing the dynamics in which collaboration takes place. Research needs to evolve alongside the technological changes. Finally, many other current and emerging social networking and Internet of Things (IoT) factors are at play in facilitating tacit knowledge sharing. The influence and potentials these factors may be far reaching and further research from Internet of Things perspective will develop our understanding the potential of collaborative tools and technologies.

5.3   Appendix

Interview Questions

Before asking the interviewee about the specifics, it was important to let the interviewees have some insights about what we actually mean by Collaboration Tools and Technologies. Here is a directory for some of the Collaboration tools and Technologies that are currently used by different organizations.

Collaboration Tools and Technologies Directory:

1. **Calendar Tools**

    - **30 Boxes** – lets you connect who matters most
        - o   Get stuff done
        - o   Keep up with Friends
        - o   Remember Birthdays
        - o   Painless organization / sharing
    - **Airset** – manages all your important groups in one place.
        - o   Private productivity network
        - o   Powerful online group services
        - o   Each group has private messenger
        - o   Shared calendar and shared files
        - o   Data stays private, safe and secure
    - **Google Calendar**
    - **Yahoo Calendar**

2. **Collaborations Suits**

- **Webx WebOffice -** Work more easily with coworkers, clients, and vendors in a Web Office. Share documents, coordinate calendars, hold web meetings, manage tasks, build web databases, follow discussions, make announcements and run business on the web. You can control access to sensitive files while allowing guests to view public ones, take polls, and manage expense report customizable with your company logo to create a branded Web Office.
- **GroupSite –** Social Media + Collaboration
  - Files and Media sharing
- **MangoApps –** Social networking, team collaboration and Intranet.
- **PB Works –** Online team collaboration
  - Knowledge sharing
- **HyperOffice –** collaboration, communication and social

3. **Conference Calls**
- **AccuConference**
- **AT conference –** Web Conference and 800 calls
- **Global Conference**
- **Rondee**

4. **Email Tools**
- **Google Groups –** Online discussions from anywhere
  - People power discussions
- **Yahoo Groups -**
- **tgether –** help employees collaborate, stay in touch with friends, manage projects

5. **Extranet Tools**
- **Microsoft Share Point –**
  - Share ideas, discover answers and keep track of what your colleagues are working with new social features throughout SharePoint
  - Publish content to SharePoint from any Office application and share with people inside and outside your organization in a few simple clicks.

- **BaseCamp** - keep track of every file, discussion, and event from beginning to end—all in one place.

6. **File sharing and online storage tools**

   - **Dropbox**
     - Lets you put your stuff in Dropbox and get to it from your computers, phones, or tablets. Edit docs, automatically add photos, and show off videos from anywhere.
   - **Windows Live Sky Drive**

7. **Instant Messaging Tools**

   - **Skype**
   - **Yahoo Messanger**
   - **Google Talk**
   - **Windows Live Messanger**

8. **Mind Mapping Tools**

   - **GroupSystems -**
   - **Comaping -** online mind mapping software to manage and share information.
   - **Mindjet** - A virtual whiteboard, collaboration & project management suite for everyone on your team.
   - **Mindmeister**

9. **Online Meeting Tools**

   - **ShowDocument -** Document sharing and web meeting
   - **Glance –** Screen sharing and co-browsing
   - **GatherPlace –** Distance learning and webinars

10. **Online Office Tools**

   - **Google Docs –** Lets you create, share, and collaborate on the web with documents, spreadsheets, presentations, and more.
   - **Google Apps –** Web Based email, calendar and documents that let you work from anywhere.
   - **Numsum**

11. Project Management Tools

- **ActiveCollab -** Team Collaboration and billing
- **Huddle –** A way to collaborate on content in the cloud. Store, share, and work on files with anyone inside and outside your organization—from your desktop, iPad, or smartphone.
- **Microsoft Project**

12. Social Bookmarking

- **Delicious** - is an easy, free tool to save, organize, and remember the links you find interesting on the web.

13. Social Networking

- **LinkedIn**
- **Groupsite**
- **Facebook**
- **Socialcast –** conversation, project, collaboration, people and users, community management.

14. Wiki Tools

- **Web-based**
  - o **EditMe -** Lets you share content and files, capture knowledge and manage processes with your entire team.
  - o **Wikia**
  - o **DokuWiki**
- **Enterprise**
  - o **BrainKeeper –** corporate knowledge and enterprise wiki software
    1. With BrainKeeper, every member of your organization has instant access to the entire company knowledge base, providing complete access to your most valuable resource.
  - o **Confluence –** content creation, collaboration, knowledge sharing for teams.
  - o **eTouch Systems**
  - o **Twiki -** enterprise wiki, enterprise collaboration platform, and web application platform.

Interview participants' are health practitioners and professionals', including, but not limited to:

- Health Practitioners (physicians, physician assistants, dentists, and clinical pharmacists)
- Nurses (helping nurses, nurse-midwives)
- Research assistants
- Emergency medical technicians
- Therapists
- Medical laboratory scientists
- Pathologist
- Optometrists
- Psychotherapists

Revised Interview Questions:

1. What kind collaborative IT tools and Technologies your organizations use?

Motive why we need to ask this question and its relevance (directly or indirectly) to the research question:

The aim of this thesis focuses on the contribution of collaborative tools and technologies in facilitating tacit knowledge in health care in general. Hence, it's no surprise that if we could raise such question during the data gathering phase just because we can **NOT**, I'd say even impossible, to discuss about the contribution of collaborative technology on something that does not already existed. This question clearly makes sense and is MANDATORY. It also may well have direct connection in answering the research question.

Precondition: At least the health care organization (or the employees) that we collect data from have to make use of a few types of collaborative tools and technologies in their daily activities.

2. If so, what type of information (we don't say knowledge here, because healthcare personnel might not be familiar with the Knowledge Management technical terms, such as tacit knowledge) do your share in a real time interaction or discussion with a

colleague about a specific clinical case/s through one of the collaboration tools you have in your organization?

Motive why we need to ask this question and its relevance (directly or indirectly) to the research question:

> This question can help answer the research question in different ways. Participants might tell us more about the **objective** of (or what to achieve) using such tools when it comes to sharing different clinical cases they might have done - which in turn could lead us to the type of tacit healthcare knowledge that can be shared through collaborative tools and technologies. Yet, another **mandatory** question that needs to be raised during the data collection phase. Interestingly enough, it has got direct relevance in answering the research question.

I just can't see any precondition to put here since the 2nd interview question follows the 1st. Thus, 'the 1st question must be answered' could probably be a precondition for this one.

3. Do you listen to podcasts, or do you watch "how to do videos" type of practical video demonstrations about a specific clinical case?
   a. If so, would you mind explain it how or to what extent the video demonstrations helped you in assisting the task at hand? And what do you personally find that?

Motive why we need to ask this question and its relevance (directly or indirectly) to the research question:

Podcast, practical video demonstrations are some very good examples of collaboration technologies that are often used by much in today's modern organizations. Thus, I believe, the 3rd question might give us some insight if we would like to examine their potential in facilitating tacit healthcare knowledge among the potential users in the healthcare domain.

4. Have you discussed or share on one of the collaboration tools your organization uses about your own experiences about specific case that you may thought helpful or instructive for other people on how to handle the same case?

For example: Your experiences with patients who have shown some positive progress or it could be about those who have done poorly so then your colleagues might learn from it?

Motive:

Tacit knowledge according to the existing literature and Michael Polanyi, "we know more than we can tell" – this literally could mean, with tacit knowledge, people are not often aware of the knowledge they possess or how it can be valuable to others. As Goffin et al asserts, "*Effective transfer of tacit knowledge generally requires extensive personal contact, regular interaction and trust. This kind of knowledge can only be revealed through practice in a particular context and transmitted through technology. To some extent it is "captured" when the knowledge holder joins a network or a community of practice*"[85]. Data gathered by asking this simple and straight forward question could yet lead us to another kind of tacit healthcare knowledge that could be shared through collaboration tools and technologies among healthcare colleagues. Thus, I really think raising this question may well be another interesting stuff when it comes to defining a crucial 'theme' so as find the connection between the data gathered and the type of tacit (experiential) health care knowledge we would want to get. I believe, it also has direct link with the research question.

5. Tell me your experience on prior to using any type of collaboration tools and technologies and after you start to use one of them, in terms of
   a. getting new information,
   b. Ability to share your views on any clinical cases or related to your field of experience.

Motive:

The motive behind raising this question is nothing but the impact or experience an individual user has on a specific tool – prior to using a tool and after the user starting to use it. This is important because, it could lead us to examining the potential impact a given collaboration tool after its available to the potential users in an organization. The research question could be answered by focusing on the post-implementation impact on the potential of a given collaboration tool in facilitating tacit healthcare sharing.

6. Do you sometimes use tools to save the links about what you love on the web or could be related to your field of work, whether it is a video, picture, blog post, published article or e-books, and the share the link with your colleagues or people whom you share similar interests?

Motive:

There are whole bunch of essential collaborative tools and technologies that help information to be accessed and captured online. As Giffin et al asserts, to some extent tacit knowledge can be "captured" when the knowledge holder joins a network or a community of practice. Thus, the more the information we have in a cyberspace, the higher the chance of capturing and sharing a tacit knowledge[86]. Then, this may well lead us in answering the research question according to Giffin et al and Dinur A. assertions.

7. Have you used tools like web conferencing to make online conference or online meeting with physicians or colleagues about a given task or your work in general?

Motive:

The motive behind raising this question is more or less similar to third question, albeit its more general and very wide (open) ended question.

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