THE IMPLEMENTATION PROBLEMS OF MEDICAL INFORMATION SYSTEMS

Master’s (one year) thesis in Informatics (15 credits)

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Abstract

The use of medical information systems is now prevailing in the whole healthcare environment where the focus is on reducing clinical errors and supporting healthcare professionals in their routine tasks. Hospitals adopt medical information systems to facilitate their healthcare staff in providing efficient services to patients. Studies show that most of the time these systems cannot deliver according to their functional capacities due to certain implementation problems. In this research, we have indicated different implementation problems, their root causes and suggested proper approaches for solving these issues. In the textual analysis, we examined different technical, psychological and social problems that may arise during the implementation process. These theoretical findings have been validated through questionnaires and interviews with doctors, nurses, technicians and people involved in the development of medical information systems. The companies that are providing implementation services are also consulted to validate the theoretical facts. The results show that implementation problems are social and psychological rather than technical, so these problems should be solved with interpersonal, psychological and social skills. The focus of the implementation process should be on the social, psychological and technical effects to avoid any conflict. Reasonable user involvement in the decision making process, motivation and proper training reduces many implementation issues automatically. It is concluded from empirical results that development and implementation teams should have reasonable medical domain knowledge to diminish future implementation and maintenance hazards. The theoretical and empirical results show that data security issues are psychological as well as technical and should be dealt with by high priority.

Keywords: Medical information system, IS implementation, informatics, interface, contingency management, implementation process.
Acknowledgements

The implementation of medical information systems is a widely addressed topic in the field of informatics. This thesis provides a comprehensive overview of different implementation problems, their causes and proposes their solution strategy.

We are grateful to our supervisor, Ann Lind for her valuable comments, instructions and suggestions. Without all these, it would have been difficult for us to conduct research in this field.

We are also thankful to Dr. Bertil Lind for his cooperation in solving research problems and his helpful support. We would also like to thank all of our interviewees for their assistance in the empirical phase of our research. We also want to say thanks to all the people who participated in our survey.

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Muhammad Inam ul Haq & Rafiq Ahmed
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1 Introduction

The purpose of this chapter is to describe the problem statement clearly and divide it into the research questions. The need of research in the field of medical information systems implementation is presented with a brief background of the problem statement. This chapter forms the basis for the theoretical and the empirical study that deals with the characteristics of implementation issues.

1.1 Background

Information systems are the assets of any organization due to their effectiveness and profitability; this is why these systems are considered the backbone of any business environment. The information systems’ role is always of prime concern because these systems are the place of information. They are essential for decision-making and management to keep the business on track. As Medical information systems are very specific, complex, rich and highly efficient systems, these systems require the users to have the same kind of skills and that they are highly talented people with essential training and technical knowledge (Lucas, 2008). Medical Information System (MIS) introduction to any hospital environment can be easy, but its implementation is often a tedious and time-consuming process that may extend beyond months or even years. Studies show that MIS face problems right from the decision of their need. These problems may occur in their scope, target users, infrastructure, functionality, training and maintenance (McGrath, 2006). It is understood that managing and ensuring all the tasks which are related to MIS are not straightforward and can only be dealt with by highly skilled staff. For this purpose, implementation of MIS was evolved as a prime research field during the past few decades with the invention of medical information systems. The implementation of MIS has different activities for different environments adopting MIS, but many activities are very similar but with a little variation in their scope and priority to handle. MIS implementation is always considered complex activity as compared to other activities due to its robust nature because people involved in MIS implementations need to have skills and knowhow of the role of different stakeholders. The activities involved in MIS implementation like training, brainstorming, persuading people, installing hardware infrastructure, developing, security policy, contingency planning, integration of MIS components and conversion of paper data into electronic form also involve interpersonal, psychological and social skills with technical abilities. Therefore, the availability of such staff is also difficult and the utilization of their skills needs motivation and socio-technical skills to deal with the implementation problems of MIS. General problems faced in the implementation of MIS are the management problems of resources, training, file conversions, information exchange, transfer mechanism, system validation strategy, quality policy of data and its integrity. The decisions about MIS access rights, installation of equipment, solving staff resistance towards MIS, interface and communication issues between end users, workflow automation, system performance measurement strategy and implementation also require skills to handle them (McGrath, 2006). Few concepts that are specific to MIS implementation problems should be clear at this time. File conversion strategy is the set of principles involved in the conversion of data in its raw form or in any form other than digital form to enter into the computer system. This involves decisions like which data to ignore or give priority to and the order in which data is entered. The type of the data, location and accessibility
can also be decided in this phase. It is dependent on the type of organization and requirements for that data. On the other hand, contingency planning involves the decisions for the restoring or backup of data and plans for disaster management and recovery. Scheduled backup and testing for recovery are also included in this type of planning. Another confusing term is the “work flow automation” which includes the activities related to re-mapping of business process, identifying possible bottlenecks of system and ensuring the automatic flow of medical procedures without any problems and hurdles. Socio-technical aspects are comprised of the organizational structure of interaction between the humans using the technology and the technology itself. It deals with the social aspects of human and society with technical aspects of technology e.g. information systems. The implementation of MIS is somewhat more critical than other traditional information systems because the hospital staff usually have less knowledge about computer systems (Ovretveit, 2007). Therefore, to educate highly qualified people of other fields i.e. the medical field, with complex computer systems is not an easy task to do. Another consideration that remains crucial during the training and maintaining of MIS is the time factor because medical practitioners cannot afford to spend a large amount of time in learning the system. Other obstacles like data sensitivity issues and failing to have fool proof error detection mechanisms cause additional problems attached to MIS implementation. These factors make it very desirable and necessary to investigate the proper and efficient strategy for MIS implementation (Lucas, 2008).

1.2 Statement of problem

Medical information systems help hospitals and other patient care entities in order to improve and maintain their service quality. Companies and organizations pay a lot of money for the computerization of their systems. Hospitals are spending a large amount of their revenue on the development of MIS, but the unusual thing is that after spending financial resources and efforts, few hospitals still fail to achieve their desired goals. Most of the time efficiency and output of the hospitals and organizations decrease due to the problems related to the implementation of medical information systems (Kensing, 2007).

It is an easy task to purchase a MIS, but it is very hard to implement it in the organization. The implementation of MIS cannot be done in a way in which a hospital employer could suddenly announce that they have a new, expensive information system in their hospital, and inform the staff that from tomorrow, instead of the traditional way of work, everyone should use the information system for the execution of the hospital business processes. If it happens, the outcome of this, instead of the increase in efficiency of processes; would be a clear-cut decrease in the efficiency of the processes (Lucas, 2008).

People are not often willing to use the new information systems. A lot of social and psychological factors are attached with the use and implementation of the MIS. Many problems related to MIS implementation are psychological rather than technical. It is necessary to adopt a suitable approach to the current situation in the business to avoid bad user reactions. One of the most important quality factors of an MIS implementation is the user acceptance and adoption in the hospital environment.
1.3 Purpose of study

Nowadays information systems are currently in use in almost every field of life e.g. hospitals, schools, accounting, finance and banks. In short, every field of life is somehow in touch with information systems. One can say that information systems are a necessary part of everyone’s life, but the downside is that companies and organizations are not getting desired benefits from information systems. Hospitals deal with human life, they invest a lot in MIS but most of the times hospitals are failing to achieve desired goals of implementing medical information systems. An efficient implementation of an information system in hospitals is very important. This reason motivates us to study this field. The implementation of medical information systems may meet many psychological, social as well as technology-oriented problems. Since there is no clear knowledge about how such problems can be solved, the purpose of our research is to create an understanding of the character of such problems and activities to reduce these problems during implementation. The purpose of this study is to investigate and reduce the gap between complexity of implementation problems and available implementation problem solving strategies.

1.4 Research questions

Which factors are important to consider while creating an efficient implementation process of a medical information system?

This question will be explored in-depth by dividing it into the following sub questions.

1. How psychologically related resistance from the staff can be handled?
2. What technical problems may arise and how these can be solved?
3. What social considerations must be taken?
4. How can the implementation process be facilitated through actions in earlier stages?

1.5 Target Audience of this thesis

The aim of this research is to generate knowledge about successful implementation of medical information systems. This research elaborates the problems and issues during the implementation of medical information systems and provides their solutions. An obvious target audience is the researchers within the field of informatics. The results presented in this research may be used as a basis for further research in the field of medical information systems implementation process. Another audience for this research are hospitals that are using medical information systems or
planning to implement MIS, as this research is very informative and helpful for them. This research is very useful for the staff and physicians that are using medical information systems. Since this research elaborates the technical problems and issues that arise during the implementation of medical information systems, so the companies and people that are involved in the development and implementation of medical information systems are an important audience for this research.

This research is a good guide and basis for the students who will carry out research in the field of informatics and information systems. The teachers in the field of informatics and computer science can also take help from this research.

1.6 Expected Outcome

We expect that by analysing the thesis on technical and social grounds, one can has a clear idea about the implementation bottlenecks of the MIS implementation process. The nature of the problems faced during MIS implementation, their possible consequences, criteria for dealing such problems, problem avoidance and recovery planning will be clearer to the target group of audiences. The mechanism to modify already implemented measures, the need for new research criteria and emergence of new research questions in MIS implementation field, will be highlighted to the target readers of this thesis. A new process guide with formalized, unified and customized implementation activities will be the best outcome of this research.

1.7 The Authors Experiences and background

This research is conducted by two master level Informatics students, Muhammad Inam ul Haq & Rafiq Ahmed. Both have different past experiences and backgrounds.

Muhammad Inam ul Haq completed a bachelor degree in Computer Science and currently studying Informatics at Master level at the University of Borås. He has research experience of writing a few conference papers, articles, reports and analysis of different publications during his academic career. He has written research papers on software development models and informatics. Rafiq Ahmed completed a bachelor degree in Computer Science and Information Technology. He is currently studying Masters in Informatics at the University of Borås. He has over 3 years of experience in web applications and web-based information systems development.

1.8 Over all research design

Introduction In the introduction chapter, a short background of the research area is
presented. The research questions and the purposes of the research are also described in this chapter. We also have written our past experiences and educational backgrounds. The expected result and target audiences are also stated in this chapter.

**Research Design**

We argued for the methods and perspectives that we chosen for this research. Data collection and analysis procedures are also discussed in this chapter. Finally, strategies for validating the finding and result presentation methods are briefly discussed.

**Theoretical Study**

We described key concepts and subject areas relevant for the research. Discussion about each subject area is presented in detailed form. Argumentations for empirical study are also presented at the end of this chapter.

**Empirical Study**

The purpose of empirical study and sampling methods are discussed here. All the interviews are discussed in detail. Later on, questionnaires results are presented and discussed. At the end of this chapter, the results of empirical study are presented.

**Analysis and Result**

In this chapter we analyzed the finding of above two chapters; the findings of theoretical and empirical study are compared in this chapter. The results of the research questions are proposed here in this chapter. We have proposed solutions for improving the implementation process of medical information systems. We suggested different ways by which a lot of implementation problems can be eliminated automatically.

**Discussion**

The conclusion of the results is presented and research implications for the field of informatics are discussed. In the middle of this chapter, method and result evaluation strategies are discussed and argued. At the end, the possibilities to generalize and ideas for continuation of the research are presented.

The association between different sections of the thesis is illustrated through the diagram below. The research questions are based on the background that is also part of introduction chapter. The selection of methods is deeply influenced by the questions, problem statement, background and purpose of research. These methods will give directions for the later chapters like theoretical study, empirical study and comparative analysis. The theoretical results will be verified through the empirical study. This study as well as theoretical results will provide input for the comparative analysis.

The comparative analysis and findings of theoretical and empirical study gives the research results that will help in answering the research questions. This will form a basis for the discussion. The research questions are reflected by the discussion and this discussion evaluates the methods and research results.
Figure 1: Complete Research Design
2 Research Design

The aim of the research design chapter is to describe the research perspective and the research strategy that the authors have adopted in this research. In this chapter, the overall structure and criteria of the thesis are presented. The authors have discussed the data collection and analysis procedures in detail.

2.1 Research perspective

The character of knowledge that we are going to achieve is the understanding and comprehension knowledge to describe what values and constraints it should have. Basically we are going to present knowledge about different medical information systems implementation problems that arise and how to resolve them. This knowledge will try to answer what to do, when to do, why to do such things and how to do certain tasks. The knowledge that is to be created is comprehension knowledge to highlight the different concepts related to medical information systems field, their contextual meaning and their perspective. This will also be explicit, which will be collected from readings, interviews, questionnaires and discussions to show the measures that must be taken to resolve medical information system implementation issues.

Hermeneutics and positivism are two major scientific perspectives for performing research. Hermeneutics perspective aims at explaining meaningful concepts and interpretation (Gilje and Grim, 1992 cited in Lind, 2005). The aim of our research is to create a comprehension knowledge that will lead to deep understanding of better implementation process. The most relevant approach is hermeneutics because we are going to create comprehension knowledge.

After Dihltey and Schleiermacher stated their ideas, hermeneutics evolved into different perspectives. It is not considered as a uniform science. A debate is going on in the field of hermeneutic science between the ‘objectively’ bent researchers who believe that meaning of the text is free of the interpreted object and on the other hand few researchers believe the interpretation as a necessary part for all understandings (Rudestam, 2001 cited in Lind, 2005). Emilio Betti thoughts represent one of the today’s existing hermeneutic perspectives. According to him, texts as well as other criterions are basis for interpretation. For other people to inspect the text, ideas and thoughts of the researcher emerge in an objective form. Betti’s hermeneutics hermeneutical theory is addressed by Alvesson (1994 cited in Lind, 2005) and pinpoints that it is created on a polarity among objects and subject.

In the hermeneutic process the text is not necessarily determinable upon the authors view, but it is interpreted from the readers. A totally different understanding of the subject area can be achieved, but this does not necessarily make this interpretation false. According to Gadamer world is a horizon of different meanings. Furthermore hermeneutic loop is an alternation between comprehension and pre-comprehension, foreign world is related to comprehension and while ones' own world is related to pre-comprehension. An integration of horizons occurs by own world revision and perceptive of the foreign world (Christenses, 1994 cited in Lind, 2005).
The reflection of the world can be represented through text. The pictorial representation of the world that is created through the text can be considered as a migration of symbolic world from the real world (Flick, 2002 cited in Lind, 2005). Therefore, when the reader reads the text, he or she creates a picture of world in his or her mind according to what is described in the text, thus it depends on the reader how he or she interpret the text.

The authors applied the hermeneutic perspective for this research paper. The overall picture of the main problem is to be considered very important. Implementation of information systems is a process, but this process comprises of different factors and phases. In order to get a better research results, deeper understanding of sub-questions as well as consideration of the overall big picture of implementation process is very important.

Qualitative and quantitative are two main types of methods that can be use for data collection. Investigating the distribution of earlier facts and studying the connection between different concepts is the main aim of a quantitative research. Investigation of unknown structures, processes and variations for a phenomenon is the basic and main goal of qualitative research. Qualitative research is use to understand thoughts and uncover opinions, thus provides a basis for further decision making. Qualitative research is concerned about interpreting, describing and decoding the meanings of phenomena taking place in social contexts (Fryer, 1991 cited in Bhatti and Khan, 2010). The methods of choice are given by the qualitative approach when description of the phenomena is required (Sandelowski, 2000 cited in Bhatti and Khan, 2010). Qualitative research is employed to understand the feeling of users and how this influences their behaviours. It is utilized to identify the needs of a user. Qualitative research is suitable when one has to generate new ideas about improving a particular product or system. In Qualitative research, information cannot be analyzed numerically. Instead the participants’ perception to the world thoughts must be analyzed through words. The way in which people interpret their social reality is the motive behind qualitative research. (Bryman, 1988 cited in Bhatti and Khan, 2010).

Keeping in view the characteristics of the hermeneutic perspective in relation to our motive and goal of this research, qualitative research is suitable for finding the answers of research questions, as the expected outcome of this research is mostly in the textual form. The purpose of this research is to elaborate the factors that are important during the implementation of medical information systems. The main research question is divided into different sub-questions in order to get in-depth knowledge about the main research question. The authors will conduct several interviews with companies that implement MIS. This will make it possible to create a deeper understanding of the implementation issues. The authors are not going to prove any numerical notation to answer the research question; instead their research is focused on finding the solutions of implementation problems of medical information systems in a social context.

2.2 Research strategy

The role of theoretical and empirical study is very important for the researchers to select the research strategy. The study of theory can be utilized into different perspectives. Theoretical material can be utilized for investigation and it can also influence the researchers in selecting
data. The research results are in the form of theory (Bryman, 2002 cited in Bhatti and Khan, 2010). Humans have to interact with the information systems, so theoretical study is used to identify the different factors about human psychology. Theoretical study elaborates factors of how humans react to change and how they adopt new things. This provides a good basis for research; afterwards interviews and surveys play their role in verifying the theoretical studies.

There are different ways to conduct a research, so before performing the research it is better to know the few different ways of research. The four different ways of conducting research are proposed by Marshall & Rossman (1999 cited in Bhatti and Khan, 2010).

<table>
<thead>
<tr>
<th>Type of Research</th>
<th>Description</th>
</tr>
</thead>
</table>
| **Exploratory**  | • For investigating less-understood phenomena  
|                  | • For discovering or identifying valuable categories of meaning  
|                  | • For creating hypotheses for advance research  
|                  | • For investigating and exploring new areas of interest.  
|                  | • For investigating new and unexplored areas |
| **Explanatory**  | • For describing the patterns which are related to the phenomenon in research questions.  
|                  | • For identifying plausible relationships between the phenomenon. |
| **Descriptive**  | • For describing and documenting the phenomenon of interest |
| **Emancipatory** | • For creating the will and opportunities to connect in social action |

*Table 1: Research Source types (Marshall & Rossman, 1999 cited in Bhatti and Khan, 2010)*

The explorative study is conducted when very short or no previous research has already been done. The purpose of such a study is to find a new and better understanding that helps in further research. The aim of explorative study is to create new knowledge (Babbie, 1995 cited in Lind, 2005).

The evolutionary study is a study in which the results come gradually and evolve over time by further studies. The results of one research are used as bases for further researches. Therefore, this forms a chain of results that leads to a compressive and good quality result (Andersen, 1994 cited in Lind, 2005).
The Deductive study starts with facts that are more general and narrow down towards more specific facts. These specific facts are based on the old facts and empirical results (Yin, 1994).

The type of research questions, the level of focus on contemporary problems and the grip of researcher over behavioural events determine the appropriate research strategy (Yin, 1994). Therefore, in the case of MIS, a lot of research has already been done, yet still need for new research is always present within this field. This is why we have adopted deductive research strategy based on these facts. We started with literature study to find out general facts related to medical information systems implementations. After that, we narrowed down the research from general to more specific facts. With the help of empirical results we proved our specific results and with the combination of theoretical and empirical results, we concluded our research objective. The diagram below shows the flow of research strategy adopted by us.

![Figure 2: The Deductive research strategy](image)

The following table shows the different research strategies with the specific questions which are focused during that specific strategy.

<table>
<thead>
<tr>
<th>Strategy</th>
<th>Type of Research Question</th>
<th>Require grip on behavioural events</th>
<th>Focus on contemporary events</th>
</tr>
</thead>
<tbody>
<tr>
<td>Case Study Survey</td>
<td>Why, How</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td></td>
<td>How much, what, How, Who, Where</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>History Experiment</td>
<td>Why, How</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td></td>
<td>Why, How</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Archival Analysis</td>
<td>How much, what, How, Who, Where</td>
<td>No</td>
<td>Yes/No</td>
</tr>
</tbody>
</table>

Table 2: Source for Research Strategy (Yin, 1994, p.4)
The research questions are related to problems during the implementation of medical information systems, so in order to elaborate and identify the issues during implementation, the authors have conducted interviews with doctors, MIS developers and patients. Survey is a good method that is used for collecting information from a sample of individuals. This is a systematic approach for collecting information from a section of individuals who are members of target group (Scheuren and Winkler, 1993 cited in Bhatti and Khan, 2010). By a survey, one can conclude the basic characteristics or experiences from a large or small population of the world. Mail, telephone, personnel and hybrid are four basic types of survey. For this research, the survey is designed in three phases.

- Planning and development of survey.
- Execution of survey and collecting data.
- Analysis of collected data.

Interviews are conducted formally and informally. The authors utilized the online medium for conducting interviews with distances. The basic objective of the interviews is to get the opinions about MIS implementation from doctors, MIS developing & implementing companies, nurses and patients.

### 2.3 Data collection procedures

#### 2.3.1 Different Alternatives

For the purpose of data collection in context of our research many different qualitative methods can be used. Textual analysis, interviews, observations and questionnaires are good examples of qualitative methods that can be used for the purpose of data collection. Below we discussed the advantages and disadvantages of each method in the context of our research.

Reading the written material and then analyzing that text is known as text analysis (Repstad, 1999 cited in Lind, 2005). One of the main advantages of text analysis in the context of our research is that it facilitates us in reviewing knowledge and opinions of different authors that provides basis for our research. Text analysis gives us required knowledge that is relevant to the research. We will use text analysis so that texts of different authors can create a good scientific base for our research.

The process of communication between two or more people in order to obtain information is known as “interview”, where an interviewer asks questions and the interviewee answers those questions. The aim of the interviews in a qualitative research method in the context of our research is to get a deeper understating of problems that arise during the implementation process of MIS from the people that are directly involved in this process and are the potential users of MIS. Interviews provide the opportunity to find the answers of numerous questions that are directly related to the implementation process, such as what factors that are considered to be important during the development process which can affect the implementation of MIS? One of
the advantages of interview is that it provides us the facility to get a deeper and specific response from the interviewee. This is why the interviews will be a significant part of our research. One disadvantage of this method is that it is not possible to interview many people. Another disadvantage of this method is that it is a time consuming process and it is hard to find the target professional respondents, but this disadvantage can be reduced through proper planning, in advance to the occasion.

Observation is another way that can be use for collecting data in a qualitative research approach. Observation in the context of our research means visiting the healthcare centers and trying to watch and observe the problems and issues that arise during the implementation of medical information systems in medical environments. Looking at our research questions it could be very inappropriate to use this method for our research. First thing, it is very hard to visit any healthcare environment, observe the interaction between the healthcare professional and MIS in a limited amount of time. Secondly, it is not possible to observe the implementation process; therefore, we will exclude this kind of method for our research.

Questionnaire provides the facility to gather responses on a large scale from the target group with fewer amounts of efforts. This method has some disadvantages as well. One of the risks attached to this type of data collection method is that there is a chance that different respondents may interpret a question in many different ways and that the researcher may not know this aspect until the completion of the questionnaires. The effect of this disadvantage can be reduced by better preparation of the questionnaire questions. We will use this method in our research in order to understand the psychological factors that affect the implementation of MIS.

**2.3.2 Theoretical study: Text analysis**

The results of previous researches are easily available in scientific literature with a good amount of examples that can be used as a base for further research (Kuhn, 1996 cited in Lind, 2005). Thus it is very important for us to find previous results and examples in order to create a link between the previous created knowledge within the area of our research.

In order to create a successful knowledge in the field of implementation problems of medical information systems, it is necessary and important for us to research on more than one area of knowledge. A lot of material is written about each area of knowledge, therefore it is not possible for us to make a text analysis of everything that is written within that area. Therefore it is essential for us to sample literature for the text analysis in the theoretical study section.

For the purpose of the sampling of literature, it is good to create the criterion and then use that certain criterion for text analysis. We have created the certain criteria that we will use when looking for literature for the purpose of text analysis. As we have an Eastern background but we are performing this research in the west, we will use a mixed combination of Eastern and Western literature. We will also use the literature that we studied in our previous educational background. Credibility is another selection criterion that we will use during the selection and sampling process.
Scientific conference and research papers contain a great amount of knowledge. Gathering knowledge from scientific research papers is much easier and less time consuming than studying from a textbook. We will use knowledge from scientific papers for text analysis in our research.

We will look at material in different online databases provided by the University of Boras for the purpose of gathering literature for our research. For the subject area of informatics and computer science, we will use IEEEExplore, INSPEC, LISTA, Scitopia, and Scopus. Google search engine is a great source for gathering information and we will find relevant material for our research through the internet by using any search engine including the Google search engine.

### 2.3.3 Empirical study: interviews and questionnaires

It is very vital to sample the interviewee for knowledge creating in a research. In our case, the interviewees are the potential users of medical information systems, developers of MIS and people involved in the implementation process. We will use online questionnaire to get instant, easy, cost-effective feedback from a large amount of respondents.

Non-probability and probability sampling are two major kinds of sampling. Random procedures are the bases for probability sampling while this is not the case in non-probability sampling. Since it is hard to find an interviewee with sufficient knowledge, experience of development and usage of MIS, we will use the non-probability sampling method. In such a method, any interviewee can be selected that is available during the research period.

From the start of the research, we decided how many objects with specific qualities should be included in the study. Gender discrimination is not considered during the sampling. Subjective sampling is another kind of non-probability sampling. This method of sampling can be used if the researcher has sufficient amount of information about the people (Holme & Solvang, 1997 cited in Lind, 2005).

We will use our personal references to find the appropriate interviewees from the area of development and usage of MIS for our studies. We intend to limit the interviews to at least two people, one from the development side and one from the healthcare professionals.

**Interviews:** For the purpose of data collection, interviews are a good way of getting information. The actions, thoughts and feelings of the interviewee can easily be observed through verbal and non-verbal communication. The perception of interviewee is also considered very important during the interviews in order to get maximum knowledge.

The procedures and roles are well defined in the literature about interviews. An interview is not just a conversation between two or more people, it is the role and responsibility of the interviewer to define the situation and introduce the purpose and topic of the interview. The interviewer has to control the flow and maintain consistency of the interview. Preparation of the interview is also considered very important for getting good results from an interview. It is also considered very essential that the interviewee should know the purpose of the interview, have
knowledge about the motive behind conducting the interview. Interviewee must know what the interviewer wants to achieve through this interview.

Open-end and close-end are two main types of interview questions. In a close-end question, the interviewer expects only yes or no as a response from the interviewee, but for open-end question, the interviewer expects a longer answer rather than just a single sentence. Open-end questions give freedom to the interviewee to answer as much as he or she can in order to express experiences in a better way that helps in reducing nervousness and uncertainty. Close-end questions are used when the interviewer needs a more specific or to-the-point answer. In addition, close-end questions also help in controlling the verbal flow in case the interviewee is very talkative and diverts from the original question.

We shall prepare our interview based on both open and close-ended questions. We intend to start the interview with open-end questions, with a brief introduction of the purpose and topic of the interview. We will change the flow of questions according to the situation. We will use close-end questions in order to get more specific and to-the-point answers. We will use open-end questions when we want more deep knowledge and understanding of some certain phenomena. Open-end questions are helpful in keeping the communications alive.

Questionnaires: Questionnaire surveys will be conducted in order to get feedback from the potential users of the medical information systems. Questionnaire surveys will be conducted online through the medium of email. It is not possible to capture the non-verbal communication in online questionnaires, but it helps in getting feedback from a large amount of the targeted group. Questionnaires are cost effective and less time consuming, this is the reason we will utilize them to get better and instant understanding.

2.4 Data analysis procedures

Analysis of the research data is always a complex task as it is the base of future findings and progress. That is why it seems to be the important part of the research. Based on our research data, we have selected different ways of analyzing the different sources of data like textual data, interviews, surveys and other published resources. We will use the strategy to analyze a concept from different perspectives and from different sources. After that, we will pay attention to the deep meaning of the concept conveyed in the research, rather than just getting the overall or quick perception (Davidson, 2007). We selected the Ricoeur’s Hermeneutics research approach. This approach consists of three phases. These are pre-figuration, configuration and re-figuration. In the pre-configuration phase we shall analyze the starting point in reality where the research is conducted by analyzing the structure and values in this research. During the configuration phase the main focus of the analysis is on the text written with special focus to real world scenarios presented in the text. In the re-figuration phase, the outcomes of the first two phases are merged to get the interpretation (heather, 2009). Due to this, the interviews with the practitioners and other people related to MIS are analyzed not only on practical bases but also on a theoretical basis by comparing their view with what is already written in the research papers. As in our case we have to address the socio-technical and psychological aspects with their implications, so interviews are analyzed from the psychological perspective too.
2.5 Strategies for validating findings

The research evaluation of literature for quality is of great importance. It is always beneficial to judge the trustworthiness and quality of research before adopting it. The explicit criteria for validating the research can assure the way to highlight and strengthen the research work. Anyone can only determine the quality of research outcome based on the explicit criteria mentioned about the research evaluation. The criteria for truth is also important to be define explicitly to show the reader insight that how truth value is determined of all the facts.

During the process of evaluation of quantitative research, validity and reliability are the two most used concepts. Larsson (1994 cited in Lind, 2005) described three criterions for validation and evaluation of research findings as under.

- Criteria for Validity: consistency, heuristic value, and empirical study value.
- Qualities of result: theoretical contribution, resemblance with previous findings, structure and richness of meaning.
- Text quality: ethical value, internal logic and perspective consciousness.

Validity is a very important question in hermeneutic research. Reality may be divided into three different worlds in order to explain the validity problem. A world with which one interacts, ones’ own perceptive world and ones’ surrounding world. Ones’ own perceptive world describes our perception of the world and how we perceive the people in our surrounding environment. The surrounding world is the surroundings around us which consists of material world whereas the interaction world can be defined as the world of interaction between people. Based on perception, people built artifacts and they interpret the surrounding world. Ones’ own world will be greatly influenced by this. We connect the surrounding world to our own observation of the world (ibid).

A validity problem is represented by hermeneutic analysis. How do we compare the material while validating the interpretation? What is not valid if we create an understanding based on our own observation of the world around us? Alternatively, something we observe as true in our own world related to our observation of the surrounding world (ibid).

The aim is to add scientific value to the research which increases the importance of validity. We believe that the validity of any fact can be tested if it conveys meaning to the studied phenomenon. The degree of truthfulness decides about the validity of any fact or statement. We will use hermeneutic criteria with special focus of validity and feasibility analysis for the evaluation of research findings.

2.6 Result presentation method

The outcome of the research directly influences how it is presented to the target group and how efficiently it is presented to add value to the research paper. Here in our case, only one type of
result presentation method is not enough because in different scenarios we may need to model different actors with their possible influences. That is why we decided to use state of the art results presentation methods like graphs and obviously textual description (Milutinovic, 1996).

Graphs are a differently treated entity in different fields like mathematics and computer science. In the special terminology of computer science, a graph is considered to be the abstraction of data structure, with finite states, edges, pictorial descriptions of facts and figures that may contain nodes and vertices which are used to implement some digital and analogical data. The graphs in our case have been utilized in various ways like pie graphs, bar graph and customized or hybrid graphs.

A pie graph is the easiest way to model the percentage of any entity in the whole, with the help of colours and labels. Mostly this is used as the simplest form of showing the numbers distribution in the whole part. It is a quite common way of presenting facts as it is more visually appealing, easy to understand and faster to interpret the motives of the presenter, whereas it also suffers with many drawbacks. For example, it is not always possible to show the exact numbers of each entity or it cannot depict the relationship between any two parts. Comparisons of entities are not possible especially when more than five entities are involved and only suitable for discrete data structure. In our case of medical information systems it is the most common notation for showing the improvement of patients in MIS, medication process progress, treatments and other facts related to patients. We will use this notation to show our findings which are continuous in nature (ibid).

Textual form is definitely the most useful form of describing the facts and figures about any research. Therefore, we will mainly use this form as it is understood but with the help of the above-mentioned notations and diagrams, we will try to elaborate what we are going to say in the text form. Textual form will describe the rules, states, principles, problems, solutions, criteria and other findings (ibid). Our text will be empowered with the strong reference of published materials, based on surveys, use of practical facts and will cover the practical grounds. In this research Harvard referencing system is used for citations. We write the author surname and publication year in brackets when referring to someone’s text.
3 Theoretical Study

The purpose of this chapter is to identify the different subject areas that are important to consider from the perspective of research questions. The relevant theoretical facts and subject areas are discussed in sufficient detail to get a better understanding of the research objectives.

3.1 Key Concepts

These are a few concepts that are frequently used in literature about medical information systems. Therefore a brief definition of such concepts is provided here to ensure better understandability of the research paper.

3.1.1 Implementation Process

In the software industry, the word deployment is often used as the implementation process, whereas in the information technology industry the implementation process comprises of all the steps involved in the accomplishment of new hardware or software systems in a particular environment. This process may consist of installation, configuration, testing, maintenance and successful running of particular software.

3.1.2 Psychological resistance

This is the term often use in healthcare environments in which people indirectly or directly resist in adopting the new technology and changing their behaviours due to psychological factors. Sometimes this resistance has not any valid reason but people resist changing which is a natural behaviour.

3.1.3 Technical problem

In the context of this paper technical problems are the problems that are specifically related to a disorder in hardware and software. The situation in which the hardware or software diverts from its normal behaviour and behave in an unexpected way is known as a technical problem.

3.1.4 Social consideration

The term social refers to as attributes and characteristics of human beings. It is normally referred to as the interaction of human being with another human being and its surrounding environment. In our context human have to interact with information systems so it is better to have a good understanding of human characteristic norms and behaviours.
3.1.5 Usability

Usability is the term used for the ease of use of any object. The object that is to be used can be anything with which human interacts, for example a web application, an interactive mobile phone, a software application, a tool or a machine. Usability is the major concern of any system analyst and it is the less major concern of a designer and developers as their main concern is the functional requirements. In our case usability is the term use for how easily a person interacts with a medical information system. Usability is the measure of how much user-friendly the interface of the system is.

3.1.6 User Satisfaction

User satisfaction deals with the user attitude towards the computer systems in the context of their surrounding environments. The technique for measuring and defining user satisfaction has been open to questions and ad-hoc. User satisfaction is a primary scale for computer system success (Succi, 1999).

3.1.7 Data security

Data security and information security both are the same terms used in the context of protecting data and information from unauthorized access in the terminology of information systems. Different terms like information assurance, information security, data security and computer security are often used for same thing. These disciplines have many things in common and share some common goals but there are some differences between them. In the context of this paper, the term data security is used in the context of protecting the patient’s medical and personal information from unauthorized access.

3.2 Subject Area Relevant for research

The relation between the subject areas and the research questions is explained and elaborated through the diagram below. Research questions are mapped against their relevant subject areas to provide a pictorial description of relationships between the research questions and relevant areas of the research.
Factors important to consider while creating an efficient implementation process of medical information systems.

**SDP**
Q No. 2 & 4

**Socio-tech Theory**
Q No. 2 & 3

**User acceptance**

**HCI**

**Interface**
Q No. 1

**Information systems**

**User Adoption**
Q No. 1, 2, 3 & 4

*Figure 3: Subject area relevant for the research*

### 3.2.1 Human computer interaction
The term human computer interaction is used for the study of interaction between humans and computers. Humans interact with computers through the interfaces which consist of both software and hardware. In this subject area, we discussed different aspects and factors about how humans interact with computers and how to create a better communication channel between them.

3.2.2 Information systems

This subject area is related to the main research question. It is better to have a deep understanding of information systems before researching the implementation of medical information systems. Information systems consist of a combination of components that are integrated and work together for the purpose of collecting, storing, processing and transmission of information. For the management of operations and to participate in the marketplace, organizations have to rely on their information systems.

3.2.3 Socio-technical theory

Socio-technical theory is about the social aspects of society as well as people and the technical aspects of business processes and its structure. This theory relates the combination of social and technical aspects. The major objective of utilization of socio-technical theory is to find an optimal combination of technical and social sub-systems. Under this subject area, the different aspects of social life and its relation with the technology are explored.

3.2.4 Software development process

The term Software development process also known as the software development lifecycle, is an organized way of developing the software products. Several models with a variety of tasks and activities are presented for software development processes. Software development is considered to be a more specific term while software development lifecycle is considered to be a more general term. Many specific software development processes can be fit in a software development model.

3.2.5 Interfaces

Interfaces are the medium through which a user interacts and communicates with the computer systems. This subject area deals with the study of how the communication gap can be reduced through better user-friendly interfaces between the users and computer systems. In this subject area we discussed the different theories about efficient interfaces presented by different researchers.
3.2.6 User Acceptance

User acceptance is the term used for checking how much the system is user-friendly and it is about testing whether user is ready to accept the new developed technology or not? Here in this paper the authors used user acceptance as how much user-friendly the medical information systems are so that their potential users can be ready to accept them. The authors have discussed different theories and methods about user acceptance of technology. The different factors and measures that should be taken into account in order to ease the user to accept the technology are discussed.

3.2.7 User adoption

This subject area deals with the social, technical and psychological facts that may have an impact on user adoption of a particular computer or IT system. Here in the section of user adoption we discussed different factor and models presented by different researchers for MIS adoption.

3.3 Previous Research

This section describes the previous research in the relevant research areas of MIS implementations. The relevant research areas are described in reasonable detail to present an overview of the research which is already conducted in these fields.

3.3.1 Information Systems

Information systems play a very vital role in today’s civilization. One can find information systems in every field of life. These systems are considered as the basic building blocks of these modern age organizations. Information systems are part of schools, offices, businesses, organizations, universities and banks. A lot of business functions are handled through information systems. These systems help in managing business operations that are important for competing in the market place. Such systems are extremely very important and necessary for everyday business environments because these systems help in controlling and coordinating business processes and visualization of complex problems. They help in reducing the communications gaps between stakeholders of systems and help the decision makers in making smart decisions. They help in maximizing the output and improving the efficiency and effectiveness of business cycles. There is not any standardized definition of information systems exists as different researchers presented different definitions of information systems according to their own perspective and experiences. Some of these definitions are written below to get a better understanding of this key research area.

Laudon and Laudon (1991) defined information systems in their words as
“A set of interrelated and interconnected components that work together to collect, store, retrieve and process information for the purpose of decision making, planning, coordination and control in any organization or business industry.”

King and Chang (2005 cited in Bhatti and Khan, 2010) defined information systems as
“An interconnect sets of management processes, hardware, software and human skills that work together for translating financial investments into IS performance.”

Castro (2001 cited in Bhatti and Khan, 2010) defined information systems as
“A connection of data structures, interface (hardware), modules (software) and entities (like agents, objects).”

Within the business organizations and their surrounding environments, information systems use to transform contained information into a form that helps the employees and managers of organizations to make better decisions and make them able to coordinate the workflow in the organization.

### 3.3.2 Information system Implementation research

One new area of research that is known as information systems implementation research has been introduced after many years of the development of information systems. The implementation of information systems is defined as “effort put by an organization to diffuse technology within the organization” (Kwon, 1987). The implementation is a process that diffuses information technology in a community. As time passed, many different research methods were imported for the research area of implementation from different research areas. In start, the quantitative methods are recognized and considered best for the research area of the implementation of such systems (Orlikowski, 1991), but now from the last few years qualitative methods are getting popularity and are recognized as a good approach toward the implementation of IS research. Now both the qualitative and quantities approaches are widely appreciated and accepted in the research area of the implementation of information systems. Sometime for a better understating of a research problem, a combination of quantitative and qualitative approaches is applied. The statistical and mathematical results of quantitative methods give strength to qualitative results (Davis, 1993). Sometimes for the research of IS implementation, broad spectrum of qualitative and quantitative methods are integrated. The qualitative research requires making publications in journals that is why it is not widely reachable to the quantitative researchers. The strange part is that usually research publication journals of quantitative research are different from the research publication journals of qualitative research. So most of the time quantitative researchers do not go through the productive qualitative research that is way high potential is not achieved. The main purpose of implementation research area is to classify and elaborate the essential aspects that are required for the successful implementation of information systems. For illustrating the connection between aspects that are engaged in the implementation of information systems “aspect research” is considered inappropriate. Unable to clarify the dynamics of implementation process and identification of part of implementation process are the limitations of this perspective research.
3.3.3 MIS Implementation

The implementation of MIS is an extremely difficult task (Davidson, 1999). From the history of MIS implementation it is clear that there are many successful stories about MIS implementations with variation in cost and efficiency but on the other hand similar amount of failures are illustrated in the historical literature. There is no apparent scale that measures the degree of success of an MIS implementation. The significance of success is varied from time to time and place to place in a MIS implementation process. It depends upon who and when the assessment of the significance is performed.

Two documents namely “Crash” (Bicknell and Collins, 1998) and “Leading Change” (Kotter, 1996) are considered as traditional Information and Communications Technology (ICT) tasks implementation experience documents. Kocher targeted its research on elaborating those aspects that were big hurdles towards success and pointed out extra dependence, extra aspiration and overestimating computer technology on ICT experts and ICT specialists. The excessive poise in the power of the agreement to castigate an underperforming ICT company and trust in expensive custom manufactured software were presented as key factors. Kotter listed the sense of urgency, creating a vision, planning short-term wins, powerful coalition, communicating the vision, consolidating improvements and institutionalizing new approaches as the main aspects approaching toward successful implementation.

From the previous research related to this area, social aspects are considered as more critical than technical aspects when discussing the success of implementation. The most common aspects identified in the literature about this subject area that affect the success of MIS implementation indirectly or directly are change management, identifying the need of recognized managerial expertises to manage the transformation, necessity of helpful communication channels and value of a change of visualization (Ovretveit, et al. 2007; Alvarez, 2004).

The elaborated essential success aspects are: Implementation from higher level (Scott, et al. 2007b); broader straightforward planning (IT, 2007) and sheltering political favour (Alvarez, 2004). The other important aspect that is to be evaluated is the end user, who is actually the potential uses of IS. Ensuring the user involvement in the development and design of the ICT so that advantages of change and increasing user’s understanding of requirements can be recognized (Alvarez 2004; Scott, et al. 2007). There are a lot of factors that caused failure to information systems implementation. The identified failure factors are complexity of the project; pathetic and hard to understand interfaces; the required functionality is not clear and well presented; over expectation of projects; lack of compassion to the local system (Bicknell and Collins 1998; Lucas, 2008). The verified and struggled systems that were intuitive and need minor or no training were said to decrease failure ratio (Scott, et al. 2007a).

From the literature study related to the area of MIS implementation research there are lots of other factors and aspects that are specific to developing and developed countries. These factors restrict and become a hurdle in the successful implementation of MIS in hospitals, clinics and medical institutes. Inconsistency in electricity supply, incomplete computer infrastructure, low level of educational background of the healthcare professionals and technical staff, lack of investment, unsustainable funding and much more are the specific problems and factors that
affect the process of implementation of MIS in developing countries. Cost, internet problem, IT ignorance and neglecting the value of IT in the healthcare sector are some other noticeable factors that may cause failure of MIS implementation (Cornford and Idowu, 2008).

3.4 Relevant literature sources

For providing a better understanding of implementation process of medical information systems, we took ideas from various different publications. These publications includes many well know publications, these includes an article titled as “Barriers to the Successful Implementation of Healthcare Information Systems” by ‘Adam Baus’ 2004. We got idea about MIS implementation from another article titled as “Understanding the Implementation of an Electronic Hospital Information System in a Developing Country: A Case Study from Pakistan” by ‘Muzaffar A. Malik’ and ‘Haroom A. Khan’. For the research area of Human Computer Interaction (HCI) we utilized a course book “CS408 Human computer interaction” published by virtual university of Pakistan. One other article “The role of human computer interaction in medical information systems: Principles and implementation of MEDIGATE” by ‘Joseph William Yoder (1989) provided us a good basis for subject area of human computer interaction and interfaces in relation to the medical information systems. For the subject area of software development we consulted two course books “CS504 software engineering-1” and “CS605 software engineering -2” published by virtual university of Pakistan. For the subject area of user adoption we examined a research paper titled as “Understanding hospital information system adoption in china” by Peng and Kurnia, which was submitted at the University of Melbourne. For socio-technical-theory we took help from a webpage titled as “Socio-Technical Theory” published by Appalachian State University and YORK University in 2005 by two authors, Hamid Akbari and Frank Land. For the understanding of user acceptance and its measures, we studied various research papers including the article by ‘Dillon, A. and Morris, M. (1996), “User acceptance of new information technology: theories and models”. Another research paper titled as “Evaluation of user acceptance of information systems in health care” by ‘Elske Ammenwerth, Frieda Kaiser, Immanuel Wilhelm and Stefan Höfer’ is also consulted to develop understanding of user acceptance research area.

Other than all these literature sources, Google search engine provided us a great help in understanding the literature review about our related subject areas. The sources for collecting the relevant data are databases like ACM digital library, IEEExplore, Scitopia and SpringerLink. Publications of different universities, course contents of information systems and video lectures were the significant sources of our literature studies for the relevant subject areas.

3.5 Human Computer Interaction

There have been a lot of attempts to define Human Computer Interaction (HCI). Some of these definitions are described below.
“Human-Computer Interaction is a discipline concerned with the design, evaluation and implementation of interactive computing systems for human use and with the study of major phenomena surrounding them” - ACM/IEEE

HCI is a study of how people design, develop, implement and use computer systems. It also covers the study of how computers affect society, individuals and organizations (Myers, 1996).

The subject area that deals with the research of human interaction with technology is defined as HCI (Baecker, 1987 cited in Yorder, 1989). In more simple words HCI is designed as a study of how people communicate and interact with computer systems in order to perform their everyday tasks.

3.5.1 Human verses Computer

Humans have to interact with the computers and software systems so it is better to have a look and compare different aspects of these two species to identify how both these differ and how they act alike (CS408, n.d).

**Human species:**

On the earth, the most fascinating, interesting, strange, and unpredictable specie are humans. Human beings are considered as most complex objects on earth. Human beings are free and very intelligent by nature. Human act, think and perform according to their determinations. The humans have diversity in their nature. They think on a problem from different perspectives and find many alternative solutions to a problem as they are capable of inventing things. They make mistakes unfortunately or fortunately but these mistakes sometime become a blessing for them and sometime produce catastrophic end results. They make decisions rationally as well as emotionally as their thinking bases on their emotions and thoughts (CS408, n.d).

**Computer species:**

Human invented the computer system. These computer systems are pretty dumb as well as very complex in nature. Computers have the thinking capability but they can’t think according to their own will. They think according to how they are programmed to think. Their speed is much faster than humans and humans tired up but the computer never tired up. Humans have a feeling, emotions and desires, but computer have no feeling, no desire and are emotionless and hence don’t make mistakes (ibid).

Before the invention of computers and computer software, humans have been performing their daily tasks manually. In organizations, humans have been communicating and dealing with one another. Manual paper entry systems were used for the organization of records. For example in a hospital, when a patient comes for admission, admission department enters his or her information into the admission register, bed is assigned to the patient and this entry also recorded in some other register. Patient previous medical history is entered into the patient history register. The records of different medical tests are entered manually in the registers by the concerning
departments. Doctors and physicians write their prescriptions and comments on different papers. A lot of paper movement is involved, if one department needs the information of other departments and a lot of duplication of data is involved in this system. But now in this age of information technology, we are expecting computers to imitate human behaviour. While using a computerized information system, data is stored in a centralized database that is why communication between different departments and professionals becomes very easy. Information is easily accessible for the authorized person without any paper movement.

Figure 4: The Development process (Hewet, 2009).

### 3.6 Interfaces

Computer systems are the replacement of paper and pen. The goal and the main purpose of medical information systems is to help in recording the medical processes and to provide assistance in the diagnosis process. One of the major loopholes in these information systems is that the healthcare professionals and the technical staff connected with the healthcare field usually adapt the computerized system rather than making the system to be according to human behaviour.
The idea behind HCI is to examine and identify how people work and perform their tasks before the actual development of the system and its interface. Software engineering paradigms should be developed in order to get a greater achievement in all the software design phases (Pressman, 1987). This will act as a main basic dominant building block of software implementation, which provides a technique for improved software quality assessment and an overriding philosophy for improved management, coordination and control of the software development process. As the software development process prompts high level of design through analysis of requirements so these main aspects improved over time. Their centre of attention is more toward the user requirements that what the user wants and how the user performs a particular task rather than how the system will be developed. User modelling systems focus on how to support the needs of the users and what are their operational characteristics. Many ideas have been developed by different researchers that focussed on finding the ways and mechanism for development of the user model (Baecker, 1987 cited in Yorder, 1989). The research about efficient interfaces is explored, observed, evaluated and some possible solutions of the expert interfaces are presented by different researchers.

The basic idea behind the expert interfaces is to minimize the constraints of the user when the user interacts with the system. Windows environment is a good example of user-friendly interfaces. Interface is rich with colour graphics, menus and meaningful icons. These interfaces are highly user-friendly and less restrictive in contrast to command based interfaces where users have to enter different commands in order to interact with the system to perform a particular task. But the aspect of user friendliness is also considered in the command line systems. The commands for such a system are designed and developed in a way so that these are self explanatory, short and easy to understand.

People are generally good at visualizing things. It is a famous saying that a picture worth more than thousand words, so textual interfaces should be replaced by graphical interfaces. An important aspect of user-friendly interfaces is good graphic design that allows a direct manoeuvring approach in computer user interfaces. The first confront is to identify a set of objects that are suitable for the user needs, replacing the textual interfaces with these objects and presenting them in such a self explanatory way that will reduce learning time and facilitate intuitive use. Interfaces should be designed in such a way that provides immediate feedback. By making the system work in such a way that is closer to the user’s world, some of the conceptual load in transforming from the problem domain to the computer domain can be reduced. The interfaces designed considering all these aspects are generally regarded as more adaptable to the users and easier to use (Verplank, 1985 cited in Yorder, 1989).

The features essential for the development of a user-friendly interface are summarized by Baecker and Buxton (1987 cited in Yorder, 1989). They base their examination by categorizing the Hansen’s (1971 cited in Yorder, 1989) ideology for design of interactive graphic systems:

- Know the user: The first step is to identify what the user wants and needs.
- Minimize memorization: Interface should not be designed in such a way that the user has to memorize things. Select boxes and drop down is the better option than that of an open input box. Use names instead of number.
• Optimize operations: Interface should be designed in such a way that minimum steps are required to perform a particular task. With minimum efforts, user should be able to perform tasks in an efficient way.
• Engineer for errors: Interface should be designed in such a way so that users have a minimum chance of error and it is easy for user to reverse or undo some action.
• Carefully observe that what the user wants and identify what are the expectations of a user from the system.
• Screens are designed according to what the user wants.
• A reasonable amount of steps are included for performing a particular task. Too short and too long steps can create complexity.
• The feedback given in response to a particular user action is meaningful and appropriate for the action.
• Feedback is immediate and rapid in response to actions so that there is a rare chance of doing something wrong.
• Feedback is given whenever it is needed. Unnecessary feedbacks delay the process and create anxiety and tension.
• The interface should be designed in such a way that gives the user great degree of control and freedom.
• The interfaces allow the user to focus their attention on their task and avoid too much eye movements.
• The appropriate visual ground should be present in the interface.
• It is easy for a user to abort, skip or escape an action.
• The interface is designed in such a way that it is difficult to make a mistake and system is intelligent enough that it can minimize the risk from mistakes made by the user.
• The interfaces should not be designed in such a way that it tests the user memory.
• The techniques used are natural, easy to understand and learn.

3.7 User Acceptance

In order to explain, increase and predict user acceptance, organizations should understand why people reject or accept information systems. Researchers have developed different models in order to get a better and deeper understanding about user acceptance. From the different proposed models, the Technology Acceptance Model (TAM) (Davis 1989; Davis et al. 1989) that is adapted from the Theory of Researched Action (TRA) is most widely accepted by researchers of information systems (Venkatesh, 2000).

The prediction of IS acceptance and identifying the interface and design problems before user experience in actual is the main goal of TAM. TAM proposed two main factors when a user encounters with new information system technologies that influence how and when they will use the system. Perceived ease of use (PEOU) and perceived usefulness (PU) are two main constructs of TAM. Perceived ease of use is described as a person’s believes that how much the usage of a particular system is effort free. Perceived usefulness is described as a person’s believes that how much his or her performance enhanced using a particular system (Davis,
PEOU and PU are two particular constructs of primary significance proposed by TAM for information and IT systems that affect the attitude of user towards systems. Usage of the system is determined by the attitude that relates to the user’s intention.

Technology usage and individual’s acceptance are the basic building blocks of PEOU, TAM and PU. These building blocks are replicated and explored deeply by the IS researchers. IS researchers agreed that acceptance of user is easily predicted and determined by these building blocks (Venkatesh, 2000). Self-reported usage, system development applications or examining office automation software and students participation as empirical sample were considered the loopholes of past TAM research (Legris et al. 2003). Trust is an important construct that is found in the research study as the widely accepted PU, PEOU and TAM use-antecedents.

An integrated model based on user satisfaction and technology acceptance literature was developed by Todd and Wixom (2005). This model was validated by gathering data from 465 users of seven different organizations that were using warehousing software. The result proved that system characteristics and information explained have 75% variance from information and system quality. According to their findings PEOU and PU were significantly affected by the system and information quality. Future technology acceptance research needs to address how different variables and factors affect user acceptance, ease of use and usefulness (Davis, 1989).

Unfortunately, in the field of health a small amount of empirical and methodological work has been done particularly in the area of acceptance of technology (Succi, 1999; Anderson, 1994). In the field of healthcare, the computerized information systems have been introduced relatively late and most of the time these systems encountered resistance by professionals. A large amount of MIS projects fail not only because of technical reasons but due to social and organizational factors that have a great influence on failure (Anderson, 1994). Enhancing the quality and processes of healthcare are the main goal of any MIS. Improvements bring changes but change is always resisted in any organization. Contradiction rises between the need to keep the system in state and changes needed for enhancements. The risk of failure increases with an increase in well-know efforts of huge and abrupt change (Dodd, 1995). Integration into the characteristics of any organization is a key factor of success for MIS (Anderson, 1994). Interferences of teams, negligence of political, social considerations and resistance of users toward change are the main reasons of a system failure, but most of the evaluation tools focus mainly on the performance and efficiency of MIS and the importance of social impact is neglected (Aydin, 1994).

3.8 User Adoption

In the present MIS adoption literature, different studies presented different definitions of MIS adoption. Few researches limited their exploration to decision making adoption (Stewart, 2007). On the other hand some researchers adopted a wider study scale and investigated the problems attach to system usage and implementations (Ammenwerth et al. 2006). It is better to treat MIS adoption as a continuous process rather than that of a once-off event. System assimilation stage, adoption decision making stage and system implementation stage are the three primary phases of
MIS adoption processes. Numerous studies presented in the literature were categorized depending on the above three steps of adoption process.

3.8.1 Key Factor and Model of MIS adoption

Perceived usefulness, slack resources and organizational size, executive commitment, cost justification and computer skills are the five primary key points that are accepted as the most important determinants of MIS adoption. Even the impact of these factors varies from case to case.

*Perceived usefulness (PU):*

PU is considered as one of the main factors that affects the behaviours of people who are involved in the healthcare process towards the adoption of technology (Ash, 1997; Goldschmidt, 2005). Attitude of the healthcare professionals towards adoption of technology is also based on their previous knowledge and experience about medical information systems. A large amount of the current research verifies that people who are involved in the healthcare process, especially the general practitioner, nurses and other clinical staff, base their decisions about adoption of technology on their observation of the new technology capabilities to improve present work practices (Goldschmidt 2005). Keeping this behaviour of healthcare professionals in mind, user involvement and training are very important in improving the perceived usefulness of professionals.

*Slack Resources and Organizational Size:*

It is clear from the literature about MIS adoption that slack resources and size of the hospital are mainly considered as a vital perspective that affects the hospital’s capability in achieving MIS adopting (Stewart, 2007). Slack resources and size of the hospital are the important identifiers that have to be considered while implementing a MIS. It is also identified that without enough complex structure and work processes, the advantages offered by MIS can’t validate the funds required for the development of MIS. Due to time taking and resource demanding nature of the MIS projects, it is important for the hospitals to ensure that they have enough slack resources in change management process and in practical implementation of the MIS in the hospital (Ash, 1997).

*Executive commitment:*

This aspect is mainly identified in studies which focus on system implementation stage and also on decision making stage. High level of risk is attached to any change in the business structure or process, similarly a high level of risk and investment is attached to the process of IT adoption in the hospitals. For maintaining the control over the project execution, the proper attention, involvement and support from the top level managers is considered to be very crucial and vital (Gottschalk, 2005; Stewart, 2007). The involvement of top level management helps in maintaining alignment between the organizational goals and MIS adoption that is crucial for obtaining the desired outcome of the adoption of MIS.
Cost-Justification:

It is not always easy to financially justify the investment of IT (Feldman, 2005). An important aspect to consider while deciding to adopt MIS is cost-justifying and its impact on hospital adoption of IT is worth studying. Hospitals can easily be motivated to invest in taking initiative in adopting MIS if return on investment is presented to them in a good way; On the other hand it is verified from the study of Alverson and Sobol’s (1999) that MIS investments are not cost-justified. Outcome and benefits of technology adoption such as standardization of the processes and improvement efficiency are harder to measure in terms of money. Few advantages of MIS cannot not be recognized until diffusion of MIS adoption is attained a significant mass in the hospital environment. Technology adoption is a hard, expensive, time taking and an on-going process. Its consequences to other work practices and complexities prevent direct cost to be assigned.

Computer Skills:

It is clear from the existing studies about MIS adoption that lack of computer skills aspect creates a great chance of failure for MIS adoption process. Without computer skills it is impossible for any organization to adopt MIS. One of the most common hurdles in adoption of MIS is the deficiency of computer knowledge and skills. Healthcare professionals are mainly expert in domain knowledge which is related to healthcare and their knowledge about computer and computer skills are very less. This fact increases difficulties when they interact with IT systems. Due to this reason, efficiency of the work decreases and when the efficiency is effected, frustration is created that creates a negative impact on the adoption of IT system and as a result, there is a great risk and change of failure of IT system adoption (Heineke, 2007).

3.9 Socio-technical Theory

Lucas (1975) studied more the 2000 systems of 16 different companies and he concluded that the major reason for the failure of information systems in organizations is that information systems are built according to the functional requirements of the organizations. The behaviour and culture of organization is totally ignored during the design and development of information systems.

Most of the time information systems are blamed for their failure because information systems are considered as inflexible but in reality IT is neutral. Implementation of information systems is a merging of social and technical systems. Socio-technical theory is used to maximize the output by merging the social and technical factors together.

3.9.1 Properties of Social System

- Attributes of people (attitude, skills, values, behaviour)
- Relationship among people
Different people have different attitudes, behaviour, values, background and norms. All these things combine together and form the overall culture of the organization. Relationship among the employees is also very important. The social subsystem consists of people that are related to the organization in any case. The knowledge and skills of the employees are of great importance. They reflect the working environment of the organization. The technical system consists of tools, techniques, methods and processes that are required for the transformation of input into output in such an optimal way that enhances the organization economic performance.

For finding the causes and reasons for the failure of information systems, researchers with the background of behavioural science (Sociology, Psychology and Anthropology) worked together and they suggested that for decreasing this big ratio of failure of information systems there is a need for finding a fit between the social systems and technical systems. Later the authorities related to this research enhanced the definition of social subsystem by increasing the boundaries through adding the suppliers, customers, formal and informal rules and regulations. All these aspects reflect the relations of the organization with the society. This becomes another subsystem that is known as environmental subsystem (Yorku, 2005).

Any organizational system can increase and enhance its performance, output and efficiency only if the interdependency of the subsystems is particularly renowned. Therefore, in order to get better results, any design or redesign of the organization structure must seek out the impact of this change on each subsystem and how this change affects the impact of one subsystem on the other. Better results are achieved if the design is constructed aiming that all the subsystems should work in harmony. This fit proposed by researchers was achieved by creating a design process that aims at the join optimization of the subsystems. The value and importance of socio-technical approach has been a renewal in the 21st century as organizations have revealed the deteriorating returns from investment in the new software development techniques. The approaches and ideas of socio-technical theory may not all the time be specifically referred (ibid).

System development is continuously advocated the socio-technical techniques and methods. This approach is mainly suitable for some specific areas. For example this research has been regularly advocated within the field of health informatics for the purpose of development of software systems for healthcare sector (Whetton, 2005). Many systems of healthcare sector are not giving their 100% output and affect badly the efficiency because healthcare professionals fail to adopt and accept such systems. The reason behind this is that these systems conflict with the way and working style of healthcare professionals or theses systems require changes to procedures that
affect the responsibilities of other people connected to that system. The consideration of working structure during the development is very important for adaptation and acceptance of such systems from their users. In short, socio-technical approach is required (Berg, 2003). In the last few years the need of socio-technical systems design has been elaborated and enhanced (Brennan, 2007). For the design of dependable domestic systems, a procedure was proposed and suggested by Sommerville and Dewsbury (2007). This model adopted the socio-technical properties in which system consist of a combination of environment, technology and its users.

3.10 Software Development

Two types of activities are performed during the software development process. The activities which are directly involved in the development of the software systems are called construction activities, whereas the activities which are not directly linked to development but help in the process of development of software systems in order to perform construction activities are called management activities (CS504 and CS605, n.d). These activities are described below in detail.

3.10.1 Construction Activities

The activities that are directly connected to the development of software systems are called construction activities. For example, construction activities are requirement gathering, development, testing with respect to requirements and implementation of the software systems.

- Requirement gathering
- Design development
- Coding
- Testing

3.10.2 Management activities

The activities that help in achieving efficient and successful end results of construction activities are called management activities. For example project planning, project management and software quality assurance.

- Project Management and Planning
- Configuration Management
- Software Quality Assurance
- Installation
- Training

For the purpose of smoothly flow of development process, the construction activities are surrounded by management activities. All the construction activities are managed and controlled
by certain processes and rules. The important thing to notice here is that these rules and processes are for management of construction activities and not for the development (CS504 and CS605, n.d).

### 3.10.3 Software development Loop

Software development is an iterative process and this process of software development is mostly performed in a loop called software development loop.

**Problem Definition:** Before the start of actual development, the first phase is to identify what are the requirements for which we are going to build the software application. In this phase we define and identify all the requirements.

**Technical Development:** After identifying the problem, the second step is to find the solution of these problems on technical basis. This is the stage where software is actually developed for the solution of the problems identified in the first step.

**Solution Integration:** The third phase is solution integration. If the new system that is developed is a part of an existing system and the newly developed system has to interact with that existing system, then the integration of a new system with the existing system is performed in this phase.

**Status Quo:** When all of the above mentioned three phases are completed and system is developed, then the deployment of the system at user site is initiated and this stage is called status quo. When there is a change in the existing requirement or a new requirement comes, then this loop of software development starts again. In this way, software evolved and developed over time in an efficient way and integrated easily with the existing system.

### 3.10.4 Software Development lifecycle Models

There are a number of software development lifecycle models. Every lifecycle has its own advantages and disadvantages. Following are some of the software development lifecycle models (CS504 and CS605, n.d).

- Waterfall model
- Incremental model
- Extreme Programming
- Rapid prototyping model
- Synchronize-and-stabilize model
- Object oriented lifecycle model
- Build and fix model
- Spiral model

The selection of a particular model depends upon different factors such as the nature of project, the nature of the organization, its management and employee’s experiences and skills. There is no single method that fulfills the needs according to all the situations and factors, so one can also use a mix and match of different lifecycle models (ibid).

[34]
3.11 Information System

Information system is a very vast subject area. In relation to our research questions, we discussed the implementation activities of information system here in this section.

3.11.1 Information System Implementation activities

The implementation of any medical information system depends on how efficiently it is developed and to which extent the involvement of the medical experts takes place during its development. Therefore, to discuss MIS implementation it is important to understand the role of MIS users during the development of medical information systems (Ovretveit, 2007).

Preparation of the Functional description and System specification:

The Functional description of the MIS is prepared with the proper involvement of MIS users. Idea about how the typical business processes take place, priorities, different users’ role, functionality descriptions, constraints and user expectation are documented in functional requirement specification documents. This activity is performed by the system development team and middle level management team of hospital environments because middle level management is considered to be the most regular user of MIS and having more technical skills as compared to clinician staff and physicians. The outcome of this activity is a well documented and agreed upon functional description of medical information system. System specification includes hardware & software specifications, system maintenance procedures, training manuals, managerial process manuals, activity descriptions and other documents to describe the system specifications. These documents can be included in one system specification and not in others as it depends on the type of MIS and the level of detail required to be covered (Ovretveit, 2007).

Development Activities:

Development is mostly done out of the medical environment where programmers develop the MIS according to the documented requirements. These activities like standardizations of code, terms and algorithms, database design, time issues, flow of business processes, exception handling, backup strategy and suitable information flow mechanism is also developed with the involvement of users. System rejection scenarios, expected user response to system, level of user technical skills, desired usability, interface complexity, information exchange and retrieval mechanism is considered as of prime factors during development (Ovretveit, 2007).

Procurement:

This is the process of hiring new technical staff for the medical information systems. This process is not initiated until medical information system is nearly ready to use. Procurement can be of different scope in different scenarios, like in few cases most of the users are the current clinical or managerial staff and a few new technical staff hired for medical information system
maintenance and configuration (Ovretveit, 2007). After procurement mostly at least 4 weeks before the final release of medical information system, training activities are started (Davidson, 2007).

**Installment of hardware resources:**

This activity initiated when the system scope, expected required system resources and system complexity is determined. It can be started at any time when we get the required knowledge about the hardware requirements. Especially in the medical environments, it takes place by outsourcing. Another firm with hardware installment background is hired to do this task with the involvement of medical staff. The involvement of medical staff is highly required at this stage to carry out the installation according to their location requirements. The connectivity mechanism, network techniques, installation or re-configuration of networks is done at this stage to ensure the proper environment for the medical information systems which is going to be launched (Ovretveit, 2007).

**MIS Testing:**

Although it depends on the organization how they decide to test the medical information systems but in most of the cases two types of initial testing are performed by the medical staff, these are: in-house testing and testing after deploying MIS to its target environment. In-house testing is performed by technical experts and sometimes middle level managers are included which are the typical users of the MIS along with the development team members. Database design, flow of information, time analysis and system responsiveness to user requirements are tested in this case. MIS is then transferred to its target environment after successful critical testing by the MIS staff and developers. In the case of testing in the MIS environment, testing is mostly done informally during the training phase where each trainee is asked to uncover the possible flaws in the system. The problems like unnecessary jamming, slow database connection problem, the repetition of same events, undesired output and integration problems to other systems can be uncover in this phase. In a few cases these errors are cleared in the medical environment if such errors are not complex otherwise a modification of MIS is performed in the development environment (Ovretveit, 2007).

**Training:**

Before the training, it is analyzed who needs training, the most common answer to this question is that anyone who will use the system, can give or receive data, managerial staff, and anybody who can be affected by the medical information system are the persons who may need the training. Now the methods of training differ from person to person and scenario to scenario, few methods like lectures, manuals, training databases, discussion, on job training and meetings are the conventional ways of training. Other questions like when to train, how to train and how much to train is decided before actually starting the training phase (Ovretveit, 2007).

**File Conversion Strategy:**
The new MIS may need data in its desired format. It may be required to get data from old legacy system and then normalization and storing of data, which is yet another complex task to do. In most of the cases it takes a lot of computational resources as MIS needs a huge amount of data whose retrieval, conversion, transformation, normalization and storage is not an easy task to do. At first, it is decided which type of file to convert like master files, transaction, temporary, security, audit, reference and backup files to the form adaptable for the new MIS. Once it is decided then other considerations related to file design like file size, normalization, updating frequency, media, hit rate and updating method is decided. Especially in case of medical information systems a huge amount of sensitive data related to patient history records, treatments database, clinician tasks and physician notes need a lot of care to handle them safely and without any error because consequences of data mistakes can be catastrophic (Goldschmidt, 2005; Shmitt, 1992).

**Change Over Strategy:**

System change over is the process of putting off the old legacy system and making operational the new system. It can be done in any of the following four ways. All the methods of changeover have certain limitations and advantages, some are almost impractical in case of medical information systems but here is their brief description.

**Direct Cutover:**

In this method of MIS changeover, a new system is to become operational and at the same time the old system is abandoned. This is a sudden change from old to new medical information system. Although it is less expensive but considered to be impractical for the medical information systems where small amounts of data lost, malfunctioning of system or any other risk created due to direct cutover can be dangerous. This strategy is mostly adopted in commercial software systems changeover where margin of error is limited.

**Parallel Operation:**

In this type of changeover, both the information systems, old and the new one work for some period of time. Same data input is given to both the systems and output of the new information system is analyzed to validate the working of new medical information system. Therefore, after predefined tests and validation, the people related to information system can decide to terminate the old system and make alive the new medical information system. This strategy is suitable for medical information systems but it is much expensive and less risky (Goldschmidt, 2005; Shields, 2007).

**Pilot Operation:**

In this strategy new information system is implemented in a specific place of organization called pilot site and meanwhile old system is not terminated unless the output of the new system at pilot site is analyzed. Once IT staff and other technical staff are assured that the new system is now able to replace the old system then system changeover is done. It is less expensive as it does not
need to implement the new system in the whole environment at first for testing and also it is somewhat parallel so chances of risks are limited. The drawback of pilot strategy is that in few cases, when the system is implemented in its complete environment then it may cause a few problems which cannot be identified at implementation on the pilot site (Goldschmidt, 2005; Shields, 2007).

**Phase Operation:**

In this changeover strategy the new information system is implemented in phases by implementing one or a few modules in one phase. This strategy is also suitable and has less risks but it takes too much time to validate and adopt the new medical information system. Another drawback is that implementing in this way, it is required that the information system should be able to work in modules which can perform independent of every other module. Another reason of its failure is that it takes a lot of resources for various activities needed for implementation of medical information systems.

**3.12 Summary of theoretical findings**

This section provides the summary of the theoretical facts investigated during research and their relation with the research questions. A brief overview with proper link of theoretical findings with the appropriate research question is established.

**3.12.1 Summary of theoretical results**

We can divide the MIS implementation problems into different categories based on their type and then identify their linkage with research questions. These problems are described here with relation to their specific research questions.

1. **How psychologically related resistance from the staff can be handled?**

MIS implementation mostly suffers with psychological problems which are, most of the time, difficult to identify. People feel hesitation to give their private data to store in the system; on the other hand, doctors and clinician staff have concerns with the error correction mechanism of the medical information systems while using this data for the diagnosis process. The users of the medical information systems have uncertainty about the returns of MIS to their organization which is yet another psychological problem that makes them able to resist the system. Some people have fear about their future place in the environment after the implementation of MIS, some of the users suffer with the fear that they might be observed through the MIS. Other problems like fear of catastrophic results of system in case on any error in the system usage and other psychological problems are the hurdles in the successful implementation of medical information systems.

2. **What technical problems may arise and how these can be solved?**

Physical and cognitive problems like insufficient computer skills, MIS immaturity and system
interoperate ability constraints violations and system integration management hazards and less training materials are the problems that fall into this category. The organizational problems like workflow automation, system performance measurement, system review planning, system contingency planning, complex system interface, system change over management, handling paper-based information and resource allocation for implementation efforts still need a lot of concern during MIS implementation.

3. What social considerations must be taken?

Liability problems like data privacy concerns scared of being misuse of information from patient and hospital ends, legal considerations and responsiveness to different medical care monitoring authorities are liabilities that affect the MIS implementation. We found that there is a need to ensure a fit between social systems and technical systems. Third research question deals such social concerns.

4. How can the implementation process be facilitated through actions in earlier stages?

Knowledge based problems like less research for the MIS for its development, deployment, training, implementations and maintenances are problems related to knowledge. These problems are very risky because their consequences can be the insufficient use of MIS, failing of MIS, total budget overrun, total system failures and beyond the bounds maintenance cost which can close down the MIS in any environment. These issues are technical but require managerial skills and planning to solve. Fourth research question deals that how prior actions can be taken to avoid a rising trend of such issues.

Other aspects like user acceptance, usability analysis of MIS, understanding of human and computer species and MIS interface are the core concept that contributes a lot towards successful MIS implementation (Wilson, 1988; Lederer, 1992).

3.13 Arguments for an empirical study

There are a lot of strong reasons for empirical study for our case. We discovered a lot of implementation problems and their solutions in the literature review, so to actually validate them either these are right or wrong only two options are available. One is to practically implement or observe the implementations of MIS, secondly get in touch with practitioners to know their experience about MIS implementations. How they analyse MIS implementation problems, how they find out, what they find out, how they solve and how they rate different MIS implementation problems can validate our theoretical findings. Second most strong reason is that MIS implementation is somewhat social and psychological rather than just technical so empirical study and evaluation will give us more insight into the psychological and social considerations of MIS implementation.

Obviously just the reference from published material, the use of mathematical and statistical formulas are not the only things to prove some concept or hypothesis, empirical study is always
needed to validate theoretical findings. Last but not the least, a concept or idea proved by theoretical findings, observations, interviews, case studies and with practical implementations have more value than any other way of proving any hypothesis. So we adopted empirical study to validate our theoretical findings.
4 EMPIRICAL STUDY

The purpose of this chapter is to verify the theoretical facts with the use of empirical findings. The interviews preparation, sampling, the way of organizing empirical data and empirical results are described here.

4.1 Purpose

Through the theoretical study, the authors have identified and elaborated different aspects that affect the efficient implementation of medical information systems. Different solutions are proposed by different researchers. The basic purpose of empirical analysis is to create the implementable new knowledge by verifying aspects which are collected in the theoretical analysis. Theoretical knowledge adds a lot of value to the research purpose but the problems with theoretical findings can be there due to the wrong perception of researchers. As every researcher may have different perception, mind frameset and experiences so it is likely that he or she can perceives the knowledge from different angles. That is why; the verification of the theoretical findings with the results of interviews, surveys and questionnaires not only verifies the facts but also provides the opportunity for creating new knowledge. We used questionnaires and interviews with medical staff to validate our findings. We put a strong focus on getting new knowledge from the practitioners by getting their experiences, their way of solving problems and especially their point of view about MIS implementation. For this, we contacted three types of people in our empirical analysis. These are medical information system developers, medical staff using MIS, patients and joint analysis of these three important stakeholders to get more accurate validation of the theoretical findings.

4.2 Sampling

The selection of empirical objects is always vital because wrong selection can lead to insufficient or totally off target results. We followed the criteria for selecting the empirical objects as stated in section 2.3. We targeted companies which not only develop MIS but also provide implementation services of medical information systems. We targeted a company that has experience in developing and proving implementation services for medical information systems. The basic objective of selecting this company for empirical analysis is to get maximum knowledge from it. It is evident that development of MIS also plays a role in the implementations and further maintenance of medical information systems so we thought to get in touch with such a company to get its experiences. Other empirical objects are physicians and managerial staff of medical environments because these are the actual end-users of MIS and we could not ignore their point of view. Their satisfaction and perception can decide about the success of any MIS. We targeted doctors, clinical staff, laboratory and managerial staff according to our selection criteria for empirical objects. A big hospital that has web-based
medical information system and experience of using the system for more than 1 year is selected for interviews. These objects are selected based on their experiences, role and use of medical information systems. The third type of informants are the patients who have awareness and concern with medical information systems. We analyzed the empirical results for their feasibility to know whether these facts can actually be implemented or not? For this reason we verified these empirical facts from various recommendations proposed by different authorities related to MIS implementation. We also verified our empirical facts with theories, philosophies and other validation models. At the same time we also verified our empirical results with other empirical results concluded by different researchers about medical information systems to check the authenticity of our empirical results.

4.3 The interviews

Interviews are conducted to prove the theoretical facts with empirical objects. This section shows how the interviews are prepared and how effectively these have verified the theoretical findings. The problems faced during the interviews, interviewee responses, seating plan, how the results were noted down and structured are described here in sufficient detail.

4.3.1 Interviews Preparation

First and the most important thing to select is the interview place. We selected a sitting place with no noise distraction where we and the interviewee felt comfortable because noise distraction, an unpleasant happening and uncomfortable environment can lead the interview towards total failure in getting desired results.

We started interviews with explaining the purpose of the interview in short words and also addressed the confidentiality terms of the knowledge collected during the interviews. Other factors like interview timing were decided before the interview. The most important activity was the selection of the interview questions which was given proper consideration and time to identify the knowledge needs. Actually the type and number of questions to the interviewee depended on our research questions, issue found during theoretical study, proficiency of interviewee, timing of the interview and the willingness to share knowledge of the interviewee. So although the questions in most of the interviews were almost same but differ in numbers, complexity and details.

During the interviews, noting down the opinion was the most critical and somewhat technical activity because you could not decide in advance which type of information you can ignore, so we noted down the whole information as abbreviations and simple text. After that we sorted out the desired information. Another thing that made our interview tough was that we also needed to address some social and technical considerations. Few of these facts were known to be controversial so before asking any controversial question we tried to assess their attitude, perception and thought about those specific facts. We also put great emphasis on wording of questions and made sure that questions should not be reflecting our opinion about facts because
being neutral on controversial issues was more productive rather than taking one side. Right after the interview, we constructed that raw information into a meaningful form to formalize the validation process.

4.3.2 The first interview

*iFish Technologies* is the globally recognized IT company providing software solutions and services. They develop products like ERPs, academic management systems and medical information systems. Their services like IT outsourcing, implementation, training, technology management and medical transcription services are notorious globally. They have a lot of clients from all around the world. The interviewee person was from this company and having at least three years experience of developing MIS and its implementation in medical environments.

He has given us a brief and concise opinion about various implementation issues and their solutions. He thought that most of the time the understandability of the MIS requirements is not clear due to less technical expertise of medical staff. To solve this issue, they involve technical experts to refine the requirements for making them realistic. Refining the requirements to make them realistic is the first step that can lead to successful implementation and training of MIS. In a medical environment, some people don’t have technical awareness so this technical skill deficiency can badly affect training, refinement of requirement and system interface. Another issue is the customization of interface for different users that needs a lot of time to assess the user level; secondly adaptation and training required for different customized interfaces are the complex issues especially in a medical environment where a small mistake in the records can lead to catastrophic results. Another issue which he faced during the development and maintenance of MIS is to preserve huge medical records, maintain and synchronize data for integrating with other MIS located globally.

Some of the problems that he faced during his experience are social and psychological like if a user had a past worse experience of MIS then it becomes difficult to get the desired level of user satisfaction. Data security issue plays a great role in MIS because many people think it is not safe to input their confidential data into the MIS. Error detection and correction mechanisms also need great attention. He thinks that aspects like training, file conversion strategy, user satisfaction level assessment, interfaces complexity, data availability and system contingency planning are the prime factors of the successful MIS implementation.

Therefore, iFish technologies company has formulated various issues like clear criteria for selection of system changeover plan, training according to priorities with respect to easiness and utility of features, strictly focusing on the boundaries of the MIS because people just need to get bonus features but don’t want to pay any extra amount for luxurious features.

4.3.3 The second interview

In the first interview we got opinion about different issues from a company that develops and implements MIS. It is always important to get in touch with the real end-users of the target
system to get their knowledge for validation of theoretical findings. Shokat Khanum Memorial Cancer Hospital and research centre is a big hospital in Pakistan with over 1300 employees including doctors, nurses, lab staff, researchers, technician, management and IT staff. They are using web-based medical information system to carry out their patient care and other daily routine tasks. We conducted online interview with a doctor working there for over one year. He thinks that the implementation of such systems is costly especially in developing countries. Secondly most of the time medical staff doesn’t have technical skills and awareness of such systems. Other issues such as lack of training, complex interface and insufficient system contingency planning are the core problems of MIS. He and his colleagues believe that they are not being given proper training, less time for technical skills development and gap between two fields, medical and information systems is itself an issue. He believes that MIS implementation can only be successful if it covers technical and social aspects appropriately; if not so then it may lead to bad user experience. He also criticized their web-based MIS because all the information they need is not available over the system. Most of the times they need to contact different departments manually for tasks other than routine work.

The issues like being scared of catastrophic results due to improper use of MIS, scared of losing place, the feeling of being monitored due to MIS, time wastage due to the use of MIS for every single matter, always being under the eyes of top level management, forcefully implementation of standards and rules, unnecessary alerts, automatic unwanted messages, wrong perception of patient state are the important problems which he raised. These are the factors that forbid the users from accepting the medical information systems mentally and psychologically.

Data security issue is always very important for him; he provided a brief feedback about this issue and proposed different solutions. He thinks that data security is not only a technical issue with MIS implementation but a social and psychological issue. Patients feel that providing their personal records to MIS can harm their privacy. The information like test reports, body images for diagnostic and other tests like pregnancy tests are their personal information and only a doctor can know but by saving this information electronically can harm their cultural and social values. Doctors feel that small change in data entry can divert their diagnostic and treatment activities. Therefore, he thinks that data security; training and time are the main issues of MIS implementation. He proposed that this psychological issue can be solved by providing sufficient technical knowledge of medical information systems to the medical staff so that they can know how actually these systems work and save data. Awareness about the data security standards implemented in the MIS can avoid this psychological fear.

Other issues like complex MIS interface, bad interaction design, long path of usual features, failing to meet usability constraints are the things which are awfully important for them. He also demanded that; users should be trained properly, should be paid for training, must have easy access of system support, intelligent interface and focus should also be on the technical skills development.

During the interview, we felt that doctors are not always satisfied with the MIS and their consideration are social rather than technical which were not handled properly in MIS implementation. Also they feel hesitation about their social concern with MIS, this failing to
social issues, develops a conflict between human and technology which will be analyzed later on in the result section.

4.4 The Questionnaire

Questionnaire is the instant source of information where time is short and interviewees are not available geographically. We utilized this source for getting empirical facts to validate our theoretical findings. The response of the questionnaire is much positive as compared to interview requests due to less time consumptions and easiness of questionnaire. This section shows how questionnaire is prepared, which criteria was used for selection of questions and how answers organized to validate theoretical findings.

4.4.1 Questionnaire Preparation

We decided to use online questionnaire to get knowledge about MIS implementation. We made the questionnaire simple, short and interesting to get audience attention because long and complex questions cannot get the attention of audience. Another thing that we focused on is that we could not ask the entire question that we need because we could only ask questions with short answers. We tried to use simple language, avoided the use of domain specific words and double negation terms to ensure clarity in questions. Questionnaires are given to people electronically with special personal request to answer the questions. The problem with questionnaire is that questions can be perceived differently by different people, so we tried to avoid discussion of any concept that can mislead the audience. All the questions which we selected were short, had short answers to ensure that the target audiences don’t need to think a lot for answering the questions and maintained a logical sequence of questions.

After the successful drafting of questionnaire, we thought about introducing the questionnaire in minimum words because too much text can cause frustration for the audience which most of the time results in failure to get answers, so the questionnaire was introduced with at most three lines and total of 14 questions included. After getting the results from the audiences, the activity to structure the answers was initiated. It seemed to be tough because not all the audience answered all the questions and secondly we needed to divide the questionnaire results by their role wise. Another consideration that we needed was to show answers from different stakeholders of MIS separately. That is why sorting of answers was carried out after getting the answers from all the target empirical objects.

4.4.2 Questionnaire presentation

The results of the questionnaires are presented here, it is notably that majority of the patients were not satisfied with the MIS and were having issues with MIS data security. The reason is that they supposed that doctors spend most of their time in feeding their records into MIS and have less time for diagnosis and other patient care activities. Another reason of data security
issue is their belief that their personal data can be accessed by unauthorized person. The results are presented from a sample of 15 patients.

This graph shows the complete results of questionnaires taken from patients. All the answers are plotted in this graph to describe their opinion graphically.
Other medical staff like doctors, nurses, technicians and managerial staff were also given questionnaire. Feedback of twenty people was collected. The following graph shows the results.
4.4.3 Empirical research results

This section gives an overview of the empirical results that how and to what extent these have provided answers to the research questions. Empirical results provided us a closer overview of how people treat, feel, perceive and use medical information systems. Their expectations from MIS became clearer for us. The implementation of MIS involves technical problems like data security; file conversion, hardware infrastructure, system contingency planning and change over strategy etc. but the major problems are social and psychological. These problems cannot be solved with just technical skills, socio-technical and interpersonal skills play a vital role in solving such issues. Most of the people including patients and medical staff have psychological resistance from using MIS due to various social and psychological reasons which were addressed in first two research questions. Patients don’t think about technicalities or have no concerns with technicalities but have concern with how their data will remain safe and other social concerns.

The empirical results verified the facts related to 2nd and 3rd research questions fully which are related to technical and social problems respectively. But the 1st research question which is related to psychological problems is not verified completely. This is due to the facts that people don’t want to disclose their psychological problems which is human psychology itself. Facts related to 4th research question that how implementation process can be facilitated by actions in the earlier stages is only verified by the technician and developers. This is due to the fact that non-technical people don’t have much knowledge about how the development activities are carried out and how the implementation of MIS is done, its constraints, criteria, limitation, measures and standards. That is the reason why these facts are verified by just one group of the empirical objects which is the technical staff related to medical information systems. The overview of the empirical results, how these validate theoretical findings and how much these have verified the research questions are briefly presented below.

The 1st research question was related to psychological aspects that create resistance from accepting MIS. During the interviews; we found the psychological factors that can affect the MIS implementations. Problems like being scared of losing place, fear of being monitored by the use of MIS, fear of catastrophic result due to any wrong use of MIS, fear of losing privacy of personal data and past bad experiences of MIS are the reasons that forbid the user from accepting MIS. These problems are of great concern in any successful implementation of MIS. People also criticized the way and type of training; they argued training is not according to their technical skills, insufficient and is of bad quality. The help support of MIS was also criticized as instant help is not always there.

Second research question deals with technical problems which are still there as it is evident from studies and the empirical results but can only be solved by keeping in consideration both the technical and social aspects otherwise the end results may solve the technical problems but can create socio-technical problems. The technical problems which were unhidden by interviewees during the interviews are related to data conversion strategy, error detection mechanism, data security measures, integration problems; complex interfaces and accessibility problems are common in MIS implementation.
Another problem that found to be very alarming is that people were not satisfied with the training. In more brief words, empirical results showed opinion of people concerned with MIS which is influenced by psychological and social factors as it was stated in first two research questions.

The social issues which were addressed in the 3rd research question should be taken into consideration to avoid unnecessary results as highlighted in the empirical results that most of the people are not satisfied with MIS. These problems are also attached with MIS implementation. People thought that they should be paid to have training, time allocation for training should be reasonable, privacy should be ensured, their involvement should be entertained and especially they should play their necessary role in the implementation process of medical information systems.
5 ANALYSIS AND RESULT

The purpose of this chapter is to analyze the finding of theoretical and empirical study. The comparison of theoretical and empirical finding with respect to the research questions is also performed here.

5.1 Analysis of theoretical and empirical results

In this section the outcomes of the theoretical and the empirical phases of the research are compared and analyzed. The similarities and differences between these sections of the research are identified. The basic objective of this type of analysis is to set the ground for further conclusions on research questions.

5.1.1 How psychologically related resistance from the staff can be handled?

MIS implementation problems are mostly psychological rather than technical and very alarming because they require extraordinary interpersonal, psychological and social skills. These are the few sub problems found in the theoretical and empirical part of this research. Fear of losing place in healthcare environment, fear of being monitored, fear of data piracy and fear of a catastrophic result of MIS.

Uncertainty about the return of MIS

From theoretical studies it is clear that many people involve in medical environments just resist the implementation of MIS due to this psychological fact that they think return from MIS to their organization is uncertain. They are uncertain about the financial, organizational and technical benefits of medical information systems. They resist because they are afraid of decrease in the efficiency of the organization and wastage of financial resources. From the empirical results, it is proved that people suffer from this psychological problem and resist the adaptation of MIS. Empirical studies show that organizations arrange sessions for creating awareness and acceptance of medical information systems.

Fear of losing place in healthcare environment

Some people resist MIS just due to this thinking that if MIS is successfully implemented then they might lose their place in healthcare environment. This fear is mostly from the manual data entry staff of old legacy system. Theoretical studies show that this psychological factor creates unnecessary resistant by the staff in accepting MIS. During the empirical studies although users ignored such questions and did not give their point of view clearly but this problem definitely exists although it is not proven extensively by MIS users. This problem relates to the psychology of persons and difficult to identify. The reason of less response from empirical audience can be
that they don’t want to unhide their psychological problems, which is a human behavior. Such psychological problems create undesired system rejection by the MIS target end-users.

**Fear of being monitored**

People especially the low level management staff thinks that by using MIS they may be monitored by the high level management. This psychological problem is widely narrated in many different published materials. This fear is the real psychological fact and mostly noticed in non technical staff. The reason is that they don’t know actually the limits of the functionality of MIS, they perceived MIS as a tool that can do a lot of things and few of them may be harmful for their privacy. But actually this is not the case in the real world. MIS can do only the tasks for which it is designed. The empirical studies explained this problem and technical staff pointed out this psychological problem clearly in interviews and questionnaires. They have awareness of such problems existences in MIS environments. This psychological fact is proven by both theoretical and empirical findings.

**Fear of data piracy**

This is considered to be the most threatening psychological problem that resist from accepting MIS. Theoretical findings showed that doctors have data security concerns. They think that a slight error in data can result in non-recoverable losses. They think that data presented to them through MIS may be misleading. On the other hand, patients have their own concerns with data security. They think that their personal data like diagnosis information, test reports like pregnancy test reports, body screening images and medical records can be stolen by unauthorized persons. This fear is true to some certain extent but not always true. Data security issue is widely researched in the MIS field. Empirical findings also showed this concern and more than 70% people have their serious concerns about their data security in MIS.

**Fear of catastrophic result of MIS**

Theoretical studies narrated that non technical staff of medical environments like clinical staff, low level management and nurses think that if they do anything wrong with medical information system then it may create catastrophic results. Due to this fear, many people don’t use the luxurious features of MIS; they just use the features of MIS that they just need to use. This creates less utility of MIS and stops the technical skills to grow. During the empirical analysis, it is not proved to a certain extent because people don’t want to disclose their psychological problems easily; especially it is harder to know from online questionnaires. These problems still exist which result in less interaction of users with MIS.

**Resist accepting new technology**

The theoretical studies narrated that switching from paper based system to MIS is a big change and it is clear that change is always opposed by the people. This is human a psychological characteristic that they oppose changes. This statement is proved by the empirical study that when MIS is implemented, people are afraid and not willing to accept the new technology.
Human psychology problems

It is clear from the theoretical study that human and computer are two entirely different species. It is concluded that a major reason for the failure of information systems is that information systems are build according to the functional requirements. The behavior and culture of organizations are totally ignored during the design and development of MIS. Different people have different attitudes, behaviors, values, background and norms. Same thing is proved through empirical study that doctor, nurses and other lab staff has different backgrounds and norms and play a very vital role during the adoption of MIS.

5.1.2 What technical problems may arise and how these can be solved?

Technical problems occurred in any medical information system at any stage. These are the common technical problems found in theoretical and empirical studies. These includes failing to meet required hardware infrastructure, Lack of system support and troubleshooting skills, inappropriate file conversion strategy and improper contingency planning.

Failing to meet required hardware infrastructure:

It became evident from theoretical studies that hardware infrastructure availability and maintainability are the core technical problems towards successful medical information system implementation. Most of the time, a MIS needs to process a lot of information, generate too much access connection, send and receive data and process queries. All these functionalities need computer resources in terms of speed, memory, network bandwidth and graphical interfaces that is why MIS requires complex and expensive hardware resources. From the theoretical findings it was uncovered that many of the organizations were unable to provide recommended resources for the MIS for server and clients. Also from empirical analysis it is noticed that people using MIS claimed about less system resources given to medical information systems that reduces the efficiency and speed of MIS. These factors eliminate the success ratio of successful implementation of medical information systems. Another dark aspect uncovered during theoretical analysis is that organizations don’t provide sufficient funds for proper maintenance of MIS due to their wrong perceptions about MIS, although in few cases a MIS requires more economical resources for maintenance than its development and deployment costs.

Lack of system support and troubleshooting skills:

Theoretical studies show that most of the MIS is having support features by some IT outsourcing, so the unavailability of technical staff is a real threat towards accepting and utilizing MIS by non technical staff like doctors, nurses and lab staff. System error messages contains domain specific information, insufficient information to troubleshoot and requires technical skills to resolve even minor problems. Sometimes minor errors like loss network connection and access failure to databases create a deadlock in MIS working. These problems need instant troubleshooting support but due to unavailability of instant system support, mental frustrations especially for non technical staff are created. Empirical studies also identified the same problem that physician spend their time in resolving minor problems with their own efforts just due to
unavailability of instant system support. Patient also pointed out this problem because they demand that doctors’ time should be spent in diagnosis rather than dealing with information systems.

**Inappropriate file conversion strategy**

Theoretical studies proved that sometimes file conversion strategy is not planned properly according to time and resource availability and hence results in time constraint violation. Other aspects like file size, normalization form, media, updating method, updating frequency, hit rate, categories and format of file is not ideally planned. People overestimate and most of the time underestimate this activity due to lack of knowledge and experiences. This problem results in budget cost overrun, delay in system deployment and changes the MIS implementation schedule. From empirical results we concluded that most of the non technical staff of healthcare centers is not familiar with such problems because they don’t know how the data was entered and which file conversion strategy was adopted. This is due to the fact that file conversion tasks are hidden from potential users; they just use the system and don’t know what was actually done behind the scene.

**Improper contingency planning:**

In case of MIS, every healthcare organization should have a disaster recovery plan for undesired system states with minimum disruptions in less amount of time with less cost. From the theoretical analysis it became evident that result of MIS failure produce catastrophic results. Loosing of patient data like diagnosis information, test reports, care cycle status and medication schedule may create catastrophic results. From a theoretical perspective it is proved that such problems still exist in MIS environment due to insufficient system contingency planning for recovery. Practitioners also pointed out this problem in empirical study as these problems are handled by a technician that is why doctors, nurses and laboratory staff don’t have technical know-how of such problems emergence and solutions.

**Less technical skills availability:**

Maintenance of medical information systems requires efficient technical staff to carry out maintenance and troubleshooting routines. But the unavailability of technical persons is a well known hurdle towards successful MIS implementation. Technical deficiency of potential users and technical staff affects the overall efficiency of MIS. So this factor is a hurdle in the successful implementation of MIS at healthcare centres. Although from empirical findings these factors are not proved because people don’t want to discuss their technical deficiencies especially in questionnaires.

**MIS immaturity:**

It is noticed that in few cases, the MIS which is implemented in healthcare centres is not matured and hence produces the user dissatisfaction, lack of efficiency, inconsistent performance and usability problems. Theoretical studies showed different case studies in which immature system is implemented and then produced catastrophic results for the organization. But the sample of
our informants did not have such experience in their medical environments. That is why this problem is not proved empirically in our research case.

**MIS integration management:**

Theoretical studies showed that sometimes MIS need to collaborate with some existing IT system or exchange data with other medical information system located at geographically dispersed locations. To ensure this integration, MIS needs to be comfortable with other systems data format, exchange mechanism and standards. Integration management needs efficient technical skills both in development and during implementation. Integrations problems are difficult to track and troubleshoot and this problem is also evident from the empirical results. Practitioners believe that the reasons of total failure of MIS can be failing to meet integration standards and requirements therefore difficult to manage integration of MIS.

**System change over management**

Theoretical studies showed that sometimes MIS need to change according to the legislative change, externally imposed requirements, change in IT infrastructure and change in processes. Theoretical findings stated that change management especially in MIS is not easy because these systems hold a huge amount of running data. Changing the processes may involve changing data and change may need to be adjusted in the connected external system modules. The empirical studies also showed this fact but only the technicians posed finger on it. Other users like doctors, nurses and laboratory did not consider this as an issue towards MIS implementation.

**5.1.3 What social considerations must be taken?**

Social concerns are extremely important to consider for having a successful implementation of medical information systems. These are the few important social concerns that resist in implementation and need to be addressed efficiently.

**Legal considerations imposed on archive data:**

Legal considerations are always there and are imposed by various governments and agencies to store archive data for a specific amount of time. Theoretical findings showed that organizations have to maintain their historical data alive for long periods of time and hence increase the storage medium requirements. Our empirical results did not prove this fact as not all the people are aware of such legal considerations.

**Possible cultural effects:**

Medical information systems may have cultural effects on patients, doctors and on the other medical staff. Theoretical findings did not highlight cultural effects in details like inputting some information which is against some person’s cultural values and beliefs that may affect the cultural values. For example, in medical information systems, a patient may need to provide his personal details which his culture doesn’t let him to disclose but due to that specific MIS he is
bound to provide such information. But this fact is not proved with empirical results. Not a single person stated that medical information system has some effects on his cultural values.

**Religious effects:**

From the theoretical study related to MIS implementation, it is proved that MIS affects the religious factors of users in few cases but we are unable to find strong and clear evidence from the empirical facts. Few evidences found from interviews that can show that religion has an effect on the MIS implementation. Even there is a specific question in the questionnaires related to this specific factor, but just a few answered received that there is any religious effect of MIS implementation. Some illiterate people are afraid of entering their data into computerize system. They feel insecure about putting their personal private data in computerize systems.

**System interface language:**

Interface is very important for any software application for its successful adoption by the end users. Interface language plays a very vital role and we found lots of material related to the interface but unable to find any specific topic that deals with the interface language of MIS. It is found out from the empirical study that sometimes it is hard for potential users of MIS to navigate and perform their desired tasks due to the language barrier. Most of the times, interface language of MIS is English while in many countries ‘English’ is the second language, so it creates a barrier in dealing and communicating with MIS. According to the empirical results, many potential users of MIS were not comfortable in adopting the second language.

### 5.1.4 How can the implementation process be facilitated through actions in earlier stages?

From the theoretical study related to software development, it is clear that the development of any software application is an iterative process. Different lifecycle models are adopted for the development of software depending on the situation. So for the development of MIS, involvement of potential user is very important in the earlier stages of system development. It is also clear from the theoretical study that development should be user centred. During development, it should be kept in mind that the focus should be on user needs and how the users perform a particular task. Empirical studies showed that users’ involvement during the development stage is not entertained properly.

The understanding of environment and workflow is very important for developing a good information system. It is observed from the theoretical study that in few cases the development team of MIS is not familiarized with the working conditions and environment of the hospital; they are only expert in their technical development specific domain. Just functional requirements are given to them and as they are not domain specialists in medical environments, sometimes they misinterpret the requirements. The same thing is proved from the empirical studies. Most of the time developers don’t have any knowledge about the domain for which they are developing the system.
5.2 Result summary

This section provides the answers to the research questions. Each research question is addressed separately to answer its sub research questions.

5.2.1 How psychologically related resistance from the staff can be handled?

The potential users of MIS sometimes resist implementations of MIS for no reason. Actually this is a psychological problem that resists in adoption and successful implementation of medical information systems. The reason behind the scene is that, they are unsure about the outcomes of the system that either this system is beneficial or not. So to resolve this problem requires psychological understanding as well as technical knowhow of MIS. We think potential users should be briefed before the decision to implement the system is taken. They should be given proper and enough information about the beneficial aspects of MIS; they should also be told that how this proposed system will help them in their daily routine and performing daily tasks. Their comments should be entertained and keep in consideration in the implementation process. Few people just resist MIS due to the fact that their point of view and involvement in decision making was not entertained. By involving all the levels of management, doctors, nurses and technical staff, you are making an impression to them that they are involved in the decision making process of implementing MIS. If it is so, the chances are there that they will accept the system easily, therefore uncertainty about the return of MIS will be removed at the initial state.

Many people resist medical information system because they think if this system will be implemented, they might lose their jobs and their authority will be reduced. This is clearly a psychological problem and requires dealing with great care. We recommend that before launching the system, the potential users should be given an introduction about their future job descriptions in the organization after the MIS implementation. In this way they will feel comfortable in accepting and adopting MIS. Some people especially the top level management think if the system will be implemented their authority to control the processes will be reduced or eliminated. This wrong perception about the system should be cleared before the system launch. The third main psychological reason for rejecting the system is that people think if they do not adopt the system quickly they will be fired. Users should be briefed about the training methods, time period, criteria and relaxation about training so that this psychological issue can be overcome.

Many non-technical users think that if they adopt the system, they may be monitored by the management through the system. This issue plays a very crucial role because people don’t want to compromise on their privacy and let anyone to monitor their routine tasks. This creates user dissatisfaction and users feel uncomfortable with the MIS. The solution to this problem is that technical and non-technical users should be briefed about the scope of the system. They should be presented with the functional boundaries of the system so that it cannot create any ambiguity in their minds that they are being monitored through the system. They should be educated that these are the functional abilities of the system and system don’t have any invisible feature like recording keystrokes, making log files, taking screenshots and other privacy related matters. The
organization policy about the privacy of users should be strict and clear to everyone, so that every potential user doesn’t feel any psychological dissatisfaction.

Fear of data loss and misuse is considered as one of the most alarming psychological issues of medical information systems. This issue has both technical and psychological aspects. Patients think that if their private and confidential data is entered in the MIS then it may be misused and shared among unauthorized people. They can trust doctors but not the intermediately staff that they need to visit before going to doctors. This problem should be treated in a way that healthcare environments should have clear, strict and open policy about the personal information of the patients. So that patients can feel comfortable in providing their private data. Doctors and other hospital staff should be trained about this issue and they should know that if such a problem arises then how to persuade and convince patient to provide private data with full confidence. They should have social, personal and persuasive communication skills to treat such psychological problems and can assure patients that their data will not be misused and remain confidential. The other aspect of this psychological issue is that doctors also feel fear about the data accuracy. Because sometime the doctors’ predicted facts and figures do not match with the historical data stored in the MIS, so they think that data in the MIS is not accurate and hence affect the diagnosis process. Doctors should also be educated that how data accuracy and error detection mechanism is implemented so that they can use the historical data for diagnosis without any fear of data inaccuracy.

It has been observed from theoretical findings that few potential users of MIS scared of catastrophic results that if they do anything other than routine tasks. For example, they feel the fear that during performing their routine tasks, if they press any wrong key then it will result into a catastrophic damage to the whole system and in a result they might lose their jobs. This fear can be resolved by educating the potential users about the functional scope of the system, how much they can affect the system and how technicians recover the system from failed states. They should be educated about their access rights so that they can know they cannot do anything wrong with the system intentionally or unintentionally. The system should be designed in a way that if a user makes a mistake then the system should have to guide the user how to undo the task and recover from that situation. Some people just resist the system because they don’t want to change. This is human psychology that sometimes they don’t want to disturb their routine tasks and their patterns. They should be educated how new changes will make their routine tasks procedures easy, efficient and fast. Another problem is that developers and technicians don’t care about is that they don’t differentiate between humans and computers. Both the entities are entirely different. They should consider organizational behavior, values, norms and cultural facts while designing and implementing medical information systems to avoid any cultural and behavioral conflict.

5.2.2 What technical problems may arise and how these can be solved?

In rare cases, the hardware infrastructure requirements are not realistically collected and hence create problems in implementing MIS. This can be due to the fact that hardware installed is not compatible with medical information system requirements. This hazard occurs in mostly two scenarios. In the first scenario, the hardware infrastructure requirements are not realistically collected and when the system is launched it creates performance problems. On the other hand,
MIS is going to upgrade and assumed that the new MIS will be compatible with the current infrastructure but actually this is not the case. New MIS may not be compatible with hardware design and needs additional hardware resources and enhanced hardware design.

Lack of instant system support and insufficient technical skills are common issues that arise after launching of MIS. Because some organizations get technical support by IT outsourcing so minor problems can delay the continuity of work flow for hours or sometimes for many days. This is due to the fact that medical staffs don’t have enough technical skills to troubleshoot such minor problems. Another reason is that system error messages are not self explanatory. The solution to this problem is that medical staff should be technically literate and they should have basic knowhow about solving such issues. Error messages should also be self explanatory so that non technical users may also recognize the nature of problems. By doing so, medical staff will be able to tackle such issues and can explain their problems accurately and explicitly to the system support desk.

Inappropriate file conversion strategy also delays and affects the implementation of medical information systems. A MIS should be designed in a way to support different file formats and organize their data. System should be intelligent enough to understand different synonyms of same column. The duplication of data, spelling errors, format differences and contextual problems should automatically be handled by MIS. Other factors like incremental or batch update methods should be decided on a practical basis because sometimes it was decided to input the whole converted data in the launching of MIS but due to time constraints the whole data is not ready to be inserted, so to avoid such situation, a realistic analysis of data conversion efforts should be done to estimate the required time and resources to finish the tasks within the time boundary.

Medical information systems contains sensitive data and hence loss of patient data like diagnosis information, care cycle statistics, medication information, test reports and inventory status are very sensitive and loss or inaccessibility of this data can have catastrophic results. It may affect the patients’ lives. That is why MIS requires efficient and secure contingency planning. We recommend that MIS should be installed on more than one server and automatic periodical backup should be taken after some predefined time intervals. In case of system disaster, the system should be recovered automatically or within less time by less technical skills. Contingency planning should be according to the nature of MIS, historical problems faced by the MIS and routines that may affect the system disaster recovery routines.

Medical information system immaturity is another problem towards successful implementation of MIS. Many people argue that as development is an iterative process and MIS needs different release cycles to become mature. This argument is valid but this factor should also be considered that in case of medical information systems, immaturity can create irreversible results. So for MIS, system immaturity cannot easily be tolerated. For this, the system should be tested in a real world environment before being alive even in pilot operations. Other ways to check the maturity of the system is to find the possible flaws of system in early stages by examining the prototype of system. Other measures like testing during training, examining the system by medical and technical practitioners can help to reduce the problems that are caused by system immaturity.
Therefore, it is obvious that medical information systems take time to mature, but its consequences due to immaturity can be avoided to a certain extent.

Integration management problems are treated by management in every system development life cycles but in case of medical information systems there are some elements that need extra care. In most of the cases especially in developed countries, a MIS needs to communicate with external systems i.e. MIS of different hospitals located in other countries that is why they should meet the standard requirements of different medical information systems. Secondly, sometimes it is required by Government regulations to integrate with other systems. This is why these scenarios are considered during the development of medical information systems. Another technical issue like frequent system change is also a hurdle towards successful implementation of MIS. Medical information systems suffer from this problem a lot due to change in legal considerations, organizational policy changes, integrated system changes and externally imposed requirements. Due to this, future changes should be predicted in advance so that these changes can be accommodated. We recommend that in medical information systems development life cycles, resources for changes should be allocated in advance to avoid any future budget overruns because resource allocation for changes at later stages is not easy to accommodate. Other constraints like changing the format of huge information, changing in daily routine tasks, legislation changes and interface changes need resources and time that is why realistic prediction of future changes and allocation of funds for change management will help to accommodate the changes.

5.2.3 What social considerations must be taken?

Theoretical and empirical findings showed that the implementation problems of medical information systems are mostly social rather than technical and should be solved on social grounds. That is why implementation team should have enough knowledge about the social problems, how these problems emerged and how to solve. It is noticed that failure in implementation of MIS is mostly due to social constraint violation that is why implementation is somewhat a social activity.

Data and information used in the medical information systems are controlled and regulated by few government legislations in many countries especially in developed countries. In these counties, the regulations are imposed on the storage, sharing and standards of data. Few organizational bodies that work collectively also impose rules on the functionality of medical information systems. These rules, regulations, constraints, standards and liabilities should be clearly documented in the functional requirements of MIS so that these regulations will be perfectly ensured by the system developers. Developing and implementing team should have domain knowledge and must be familiar with such rules to ensure successful implementation. In a few cases, it is impossible for the developers to understand the whole regulations due to the complexity of rules that is why medical representative involvement with the quality assurance staff is highly recommended to ensure imposing such checks to validate that system will follow these rules and regulations. The same case is with cultural values and organization policy matters. The people working outside the organization in developing the MIS should have enough knowledge about such effects that may matter in the long run because future changes are often
difficult to adjust. The religious factors are indeed difficult to analyze because their effect is minor. Sometimes, practically it is impossible to make such a system that cannot affect any religious matters but it should be avoided to a possible extent. Another issue is related to the system language; selection criteria of the MIS interface language should be transparent and agreed upon and if translation facility is provided then it should be available in all the languages of target audience. The discrimination on the basis of geographical locality and language matters produces unethical and severe results. This can easily be avoided by asking the potential users in advance about their first language, languages over which they have grip and the desired language for system interface, we think if a user has any one of the language in the system interface that is either their first, second or the language over which they have a grip then they will easily accept and adopt the system.

5.2.4 How can the implementation process be facilitated through actions in earlier stages?

Easiness of implementation process depends on how actions are taken in the earlier stages like development, training and deployment of medical information systems. If the development and deployment team have the domain knowledge of the medical environments that how the processes flow and what are their constraints, then it will be better for them to create a maintainable system design. We recommend that especially medical information systems require a lot of changes to be implemented that is why the design of the system should be dynamic so that changes are adjusted without the need to put extra effort on changes. Other benefits of such dynamic system design are that future changes will not need to deploy the system again. Other feature that should be considered is that system interface design should be database dependent so a minor change in the database can create the desired change in the system.

Training is considered to be the first step in the successful implementation of medical information systems and this should be paid great attention. We recommend that before organizing the training databases, lectures, slides and other training material, few things are of great importance. These are psychological, cultural and social analysis of audience and language proficiency constraints. Sometime people ignore the training material because the training material is conflicting with their social, cultural and especially religious believes. Another aspect that affects the training results is the language complexity of training material. The analysis of language proficiency should always be done especially where the language used in the medical information system is not the first language of the target audience. The important aspects that need attention prior to training and implementation are the interface and accessibility of training databases. Some training databases are very slow and do not direct the user to desired help module. This is frustrating and decreases the training outcome to a certain limit. Some training databases possesses very complex interface design and hence merely used. Some data entries are conflicting with cultural and religious values of potential users, so if possible then these entries should be declared optional so that these cultural conflicts can be avoided to a certain limit. The assessment of organizational behaviour, organizational policies, ethical values, the legislation related to system functionalities and data should also be considered earlier to facilitate the successful implementations of medical information systems.
We recommend that before the start of the development process, at least some people on the development team has to familiarize themselves with the hospital systems and medical environments. They have to familiarize themselves with the work flow, processes and the way information flows in the hospital environment. They have to understand the working of hospital system. If the development team is familiar with the hospital system then it provides great help and better understating in the development of MIS. This activity results easiness to implement MIS in the medical environment.
6 DISCUSSION

This chapter comprises of discussion about the results and findings of the research work. Method and result evaluation strategies are discussed in details. Results implications for informatics are presented.

6.1 Conclusions

Implementation problems of medical information systems are mostly psychological and social rather than technical that is why to resolve such issues; it is always needed to have more social, interpersonal, communicational and psychological skills. Just addressing the technicalities of problems cannot give better results.

Psychological problems are difficult to identify and hence difficult to solve. These problems are the real barriers towards successful implementation of the medical information systems. For this a realistic and professional approach is required to deal with the psychological resistance from potential users by understanding their cultural, psychological and mental model. Motivation and their appropriate involvement in the decision making process of MIS implementation can automatically solve a lot of issues. If their balanced and reasonable involvement is entertained then chances are there to address psychological resistance more easily and in a friendly environment.

Assurance to the users of MIS about their future place in the organization after MIS implementation, guarantee about the quality of training, incentives for accepting new technology, measure to get rid of the fear of data security violation and fear of being observed through MIS should be treated at very start otherwise these problems make people not willing to adopt the MIS. These issues should be addressed before their initiation.

Something else that should be kept in mind is that medical information systems are more social system than technical that is why the approach to implement them should be more social than technical. The implementation team should be capable of adjusting such social constraints like legislative issues, cultural conflicts, religious issues, system language and interface constraints. During the implementation process social aspects should not be neglected at any stage either in system testing, training, installing hardware and maintenance of system.

It is always beneficial that if developers and quality assurance team have domain knowledge of medical field then it will be much better to adjust the development activities so that these activities can help the implementation process in the future. System design should be more dynamic, database dependent, flexible, customizable and according to the possible predicted changes.
Training media, contents, language level of training material, conflicting modules, interface of training databases, accessibility problems with training databases, possible ethical issues, organizational behavior, organization policy and non technical feedback should be analyzed in advance during the development and testing of medical information systems.

Flexibility of file conversion strategy, practical estimation of hardware infrastructure requirements, realistic estimation of technical skills requirement, system upgrade requirement and measures, integration constraints and type of required system support should be treated with great care and with efficient technical expertise. Assessment of technical expertise of staff, troubleshooting skills and data security issues should be treated from the very first day of the MIS development because these are the major technical issues of failure of medical information system implementation.

Medical information system possesses sensitive data that is why error detection mechanism, sharing policy, accessibility rules, access rights and data duplications should be monitored carefully. Update methods should be realistic technically and financially as it involves a lot of conversion costs. Contingency planning should always be analyzed in turns to check whether it is still suitable for that specific environment or not. Integration constraints can also be changed due to legislative changes. That is why these should be analyzed time by time for possible changes.

In this research we tried to get knowledge about our research questions through the theoretical study, and then we validate the findings of theoretical study through the empirical study. In the end we proposed solutions for these problems. We are hopeful that if these measures will be taken into account then implementation of MIS will be a much easier and problem free process.

6.2 Implications for Informatics

The development of healthcare information systems is a part of medical informatics fields. Medical informatics is the research area that deals with the development, management and use of healthcare information systems. The aim and goal of these systems is to provide an efficient way and mechanism that how information related to patient health is used as efficiently as possible for the benefit of patient’s healthcare. Healthcare is improved through improving the quality of medical records. This research area more focus on development of such MIS that are easily integrated in the healthcare environment and that is easy to adopt for the healthcare professionals.

From the user perspective, the implications of our results have a great influence on all of the potential users of medical information systems. The result shows that a good training can enhance the efficiency of the MIS users. One interviewee believed that different training methods should be adopted for different types of users based on their social values and technical abilities. If this should be considered while training then much better results are expected. Another very practical implication for the users is that if the psychologically related problems attached to the potential users are resolved through involving users in MIS implementation then adaptation of MIS will be much easier.
From the developer perspective, the implications of results can be that medical information system users should be in focus and user modeling systems should be considered by designers when designing and developing the systems. The research results can be used in improving the interaction between MIS and its users. Better interaction and communication between the MIS and its users increase the efficiency of the users and it helps in achieving the overall goals of MIS.

Another implication for the developer practice comes from the fact that before developing any information system the developers have to have the comprehensive domain knowledge about the business processes for which they are going to develop the system. This will help them in understanding and developing the system from both functional and user perspective.

### 6.3 Method evaluation

The purpose of text analysis is to find and elaborate the relevant characteristics and scope of different subject areas related to the research questions and then relates them in the context of implementation problems in the medical information systems. This textual analysis made it easy and possible for us to relate our research questions with the previous research done on this topic and existing theories which are related to our topic. The first problem that we faced during this process is sampling of the literature. In order to get a better and deeper understanding of the research questions and problem statement we have studied different theories and concepts that are related to different subject areas. But sometimes it is very hard to combine and relate all these theories because different theories elaborate same phenomenon and sometimes these theories are overlapping each others as in some situations it is hard to separate different theories from one another as they seem to be similar.

For example the principle presented by Backer and Hansen about the interface design of computer base systems are overlapping. Theories about human species and computer species are not considered in reasonable detail. Theories about investment in the information systems are not adopted in the literature studies as they divert us slightly from main research questions. However these areas are covered in the empirical studies by taking into consideration the perspective from both developers and the potential users of medical information systems.

In order to verify and strengthen the aspects identified in the literature study we conducted interviews and questionnaires from the people who are the potential users or directly involved in the implementation process of medical information systems. Before performing the empirical study we thought that we have much knowledge about our target subject areas, but while conducting the interviews with the developer of information systems we realized that there are many concepts and terms that are new to us and are used by the MIS developers. Despite the fact that some concepts are new to us but we felt that instead of getting nervous we still had good control over the situation and we lead the interview proceedings according to our goal of conducting interviews. We started our interviews with a brief description of purpose and aim of the interview. After few introductory questions our first main question was: “What is the difference between developing an ordinary information system and a medical information
This one question directs to a wide explanation of the problem that is to be faced during the development of medical information systems and its implementation. When the interviewee answered to this question we felt that many of our prepared questions were answered through this question. One problem we faced during interview is that for some questions we expect closed and direct answers but the interviewees had their own perspectives. Some questions were hard to answer for the interviewees because they were more specific toward the medical and technological domains.

We learned a lot from the interviews. The first thing that we learned is that never breaks the flow of interview and let the interviewees to answer as much as they can and never stop them in the middle. For example, in some questions we were expecting short answers but the interviewee talked about then in depth. The second thing that we learned through this interview was that never change the subject area very frequently and rapidly.

Questionnaire surveys were conducted through email. So the first main problem in the questionnaire was that we were unable to capture and observe the non-verbal communication. Most of the questions in the survey are open ended for example if a person answer a specific option, he may also need to comment and justify his answer. The first question was about the size of the health-care center. This question helps in identifying the environment and the size he or she is representing.

After the empirical study we concluded that interviews and questionnaires are very good source of information for verifying the finding of theoretical study. We got lots of new information even beyond our expectations.

### 6.4 Result evaluation

Giving contribution to previous theories, validity, consistency, structure and richness of meaning are the main criteria for evaluating the results quality. As in our thesis, we investigated the integration of different aspects of implementation as a whole process and this is directly related to the hermeneutical view. The perception of any concepts is of great importance for evaluating the quality of results. Our study covers the various aspects that are technical, social and psychological to create a better understanding about the implementation process of medical information systems. We have combined all the different concepts as a whole that elaborate the research questions.

These are the major factors which were considered while evaluating the quality of the results.

**Structure of research:**

The research is firstly conducted on theoretical bases and then the facts are collected and analyzed. These facts are summarized and evaluated, after that the process of empirical analysis was initiated to verify the theoretical facts with empirical findings. The validation of theoretical facts with empirical analysis made us able to finalize our concluded results. The structure of the
research is well balanced and reasonable amount of efforts are put on both these research parts and then on the conclusions.

**Validity:**

The validity of any facts always plays a key role in the research evaluation. Our results are validated through empirical findings and also these results are compared with the findings of other researchers of the same field. The comparisons of the results with other findings, either on theoretical or empirical bases can guarantee the validity of our research. Research validity is always considered as great important factor in the hermeneutic approach. The reasons for a specific interpretation are always very important for such kind of studies. As we have good previous knowledge about this research area, therefore we created meaningful knowledge through the studied material. We presented a valuable knowledge about how to resolve different problems and issues that may arise during the implementation process of medical information systems.

The practical feasibility of the results is yet another important factor contributing the validity of results. The feasibility of the results was also considered to present the refined results those are practically implementable.

**Consistency:**

Through the research, a consistent approach was followed to analyze the facts and results to ensure a consistent look of the big picture of the thesis. The criteria for textual analysis, empirical objects selection and for conclusions were remained consistent. The consistency in the theoretical and empirical study is very important for validating the findings of a research. There is a very close relationship between the reality and its interpretations. For hermeneutic studies, consistency is of great importance. It represents the association between the part and the whole (Larsson, 1994 cited in Lind, 2005). Our study comprises of different theories from different subject areas so there may a chance that our studies might have some differences in characters. All these subject areas are combined to form a whole representation of the MIS implementation process.

**Theoretical contribution:**

*Theory contribution* is the principle which describes that how much new research gives a contribution to the existing theories (Larsson, 1994 cited in Lind, 2005). This criterion is very important for evaluating the research. In the text analysis section, we have used previous theoretical material as a basis and used empirical material for verifying the finding of theoretical analysis. Our intention in this thesis was to give some contribution to the existing theoretical material.

**Richness of meaning and structure:**

The richness of meaning and structure are two different methods for result evaluation. The low degree of complexity and clearness are achieved through a well structured results´ presentation.
Good structure gives simplicity but it can affect the richness of meaning. In our studies we created a well balance between the richness of meaning and structure.

Many different criterions can be used for validating the research results. The selected criterion describes how better the arguments of the researcher are as compared to other arguments. There is always a chance to find arguments that oppose the other arguments and opinions. Our study comprises of different perspectives from different subject areas. Our theoretical and empirical studies lead to a certain conclusion that maybe valuable from one perspective but maybe not as beneficial from another perspective.

6.5 Possibilities to generalize

The theoretical results are validated from empirical findings and afterwards both the results are verified according to the analysis criteria. Results are collected from different literature and empirical sources but these are quite valid in other disciplines and with other sources. The proposed conclusions of the social, technical, psychological and development problems can also be compared with the findings of other researchers published in the research papers. These results are quite reasonable in related disciplines like solution to implementation problems of business information systems. Solution to technical problems like proper contingency planning, criteria for selecting system support, training methods and contents, data security issues and their solutions and proper adaptation of flexible file conversion planning are useful in other filed of information systems.

Dr. T.D. Wilson, head of the department of information systems university of Sheffield UK also pointed out the same implementation issues in his article “The implementation of information systems strategies in UK companies- aims and barriers to success”. He also focused on cultural problems, user training resources, and vagueness about returns and staff attitude. His article presented the few of the facts that we addressed. His theoretical and empirical results have resemblance with our results especially the theoretical results.

Albert l Lederer from the University of Pittsburgh also focused on the organizational behavior constraints that affect the medical information implementation process. Empirical results are based on the sample of informants, their background and experiences, that is why these may be changed but Albert highlighted the same theoretical fact that we targeted.

We proposed implementation solution to different social, technical, psychological and development problems which can also be utilized for implementing other related information systems like business; accounting and inventory based information systems because of the nature of the problems and filed related issues. As every information system implementation process may need to solve training, hardware installment, file conversion, technical, social, psychological and development related problems that is why the solutions proposed by us can also be adopted in those scenarios to a certain extent. Hence we conclude that these results can be generalized where these have resemblances with the nature of problems and implementation process.
6.6 Ideas for continued research

During the research we came across very interesting facts that can be further investigated and it was difficult for us to narrow down our topic by not touching those interesting areas. Data security issues are most alarming issues related to medical information systems and can be further investigated. MIS should be equipped with intelligent error detection mechanism which should be investigated that how such mechanisms can be developed. Psychological aspects of data security issues also matters a lot because people are scared about the security of their data. This area should be explored to understand and assess the mental model, a psychological framework and possible technological aspects that can reduce the psychological problems. Theoretical studies uncover the issues related to underestimation of hardware infrastructure for medical information systems. Although this assessment is done by domain experts but still lots of ambiguities are there that cause the underestimation of hardware infrastructure.

Another factor that is proved by empirical results and is very alarming is the problem related to the unavailability of instant system support and troubleshooting skills. This area should be investigated to find out which type of system support is suitable for certain environments having a specific level of technical skilled people. Learning database interfaces, design and contents should be investigated more to provide users more benefits of using such training materials.

File conversion strategy delays the MIS implementation a lot and creates the budget overrun problems. These aspects like assessment of updating method, updating frequency and media should be investigated more because it is observed that although a lot of research is already done but still these aspects create problems. That is why these should be investigated not only on technical grounds but also on organizational limits and feasibility analysis should also be considered more.

Medical information systems need special and safer contingency planning measures. We think that conventional contingency planning measures that are used for other information systems are not always enough for medical information systems. These systems require more secure contingency planning as the loss of data can result in the loss of patients. That is why this aspect should be investigated more with respect to medical information systems. Cultural effects, although not proven by empirical results but these should be investigated deeply to estimate the user behavior due to cultural conflicts raised by medical information systems. Implementation problems are mostly related to social constraint violations so proper education of social aspects and their consequences should be carried out and criteria should be set to ensure acceptance of medical information systems.

Medical information systems sometimes require to be integrated with other systems due to different legislation rules that are why integration of such different systems becomes tough. Conventional integration management techniques and prior measures are not always suitable so this area should be investigated more to refine and enhance the integration management activities of medical information systems.
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University of Borås is a modern university in the city center. We give courses in business administration and informatics, library and information science, fashion and textiles, behavioral sciences and teacher education, engineering and health sciences.

In the School of Business and Informatics (IDA), we have focused on the students' future needs. Therefore we have created programs in which employability is a key word. Subject integration and contextualization are other important concepts. The department has a closeness, both between students and teachers as well as between industry and education.

Our courses in business administration give students the opportunity to learn more about different businesses and governments and how governance and organization of these activities take place. They may also learn about society development and organizations' adaptation to the outside world. They have the opportunity to improve their ability to analyze, develop and control activities, whether they want to engage in auditing, management or marketing.

Among our IT courses, there's always something for those who want to design the future of IT-based communications, analyze the needs and demands on organizations' information to design their content structures, integrating IT and business development, developing their ability to analyze and design business processes or focus on programming and development of good use of IT in enterprises and organizations.

The research in the school is well recognized and oriented towards professionalism as well as design and development. The overall research profile is Business-IT-Services which combine knowledge and skills in informatics as well as in business administration. The research is profession-oriented, which is reflected in the research, in many cases conducted on action research-based grounds, with businesses and government organizations at local, national and international arenas. The research design and professional orientation is manifested also in InnovationLab, which is the department's and university's unit for research-supporting system development.