EXPECTATION BASED EVALUATION FRAMEWORK FOR HOSPITAL INFORMATION SYSTEMS

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I hereby declare that all information in this document has been obtained and presented in accordance with academic rules and ethical conduct. I also declare that, as required by these rules and conduct, I have fully cited and referenced all material and results that are not original to this wok.

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ABSTRACT

EXPECTATION BASED EVALUATION FRAMEWORK FOR HOSPITAL INFORMATION SYSTEMS

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Evaluation is essential for Medical Informatics as well as many other disciplines. There is a growing interest and investment for evaluation researches and self evaluation works. Hospital Information System (HIS) evaluation frameworks have largely been discussed in the literature. However, existing frameworks lack one important aspect, to what extent user expectations from HIS are met.

To complement this deficiency we designed an evaluation farmework for evaluating the user expectation in HIS. User expectation data are collected by means of "Expectation Questionnaire". Fuzzy logic methodologies are used to evaluate the expectation meeting in the proposed evaluation framework. The evaluation variables are not represented in the result equally; they are reflected by the weights assigned by the users.

Our proposed framework provides the overall degree to what extent user expectations are met. It also gives the opportunity to analyze to what extent each expectation is met and degree to what extent different user groups' expectations are met. Education, sex and business title is determinants of general expectations about HIS. IS experience is not a determinant of medical users' expectations in any expectations.

The proposed framework is not a rival but an alternative or complementary to the existing frameworks. It is a different approach and has different computation methodology supported by fuzzy logic. The framework can give detail to the each variable level. These results are just a photo of the current situation; a deeper analysis of these findings must be done for further information about the causes of these results.

Keywords: Evaluation Framework, Medical Informatics, Hospital Information System, Fuzzy logic, Expectation

ÖZ

BEKLENTİ TEMELLİ HASTANE BİLGİ SİSTEMLERİ DEĞERLENDİRME PLATFORMU

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Değerlendirme diğer disiplinlerde olduğu gibi Tıp Bilişimi için de çok önemlidir. Değerlendirme araştırmaları ve iç değerlendirme çalışmalarına olan ilgi gün geçtikçe artmaktadır. Literatürde Hastane Bilgi Sistemi (HBS) değerlendirme çerçeveleri oldukça geniş olarak tartışılmıştır. Ancak mevcut değerlendirme çerçeveleri önemli bir nokta olan kullanıcı beklentilerinin ne ölçüde karşılandığı konusunda eksiktir.

Bu eksiği tamamlamak amacıyla, HBS kullanıcı beklentileri karşılama oranını değerlendirmek için bir değerlendirme çerçevesi geliştirilmiştir. Kullanıcı beklentilerine ait veriler beklenti anketi ile toplanmıştır. Önerilen HBS değerlendirme çerçevesinde bulanık mantık teknikleri kullanılmıştır. Mevcut değerlendirme çerçevelerinde olduğu gibi her değişken eşit olarak değil, kullanıcılar için önem derecesine göre değerlendirme sonucuna katkı yapmaktadır. Önerilen

değerlendirme çerçevesi genel olarak Hastane Bilgi Sisteminin kullanıcı beklentilerini karşılama oranını verebildiği gibi, her bir beklenti değişkeni ve her bir kullanıcı özelliklerine göre de (unvan, eğitim durumu, bilgisayar tecrübesi gibi) beklentilerin karşılama oranını verebilmektedir. Eğitim cinsiyet ve unvan Hastane Bilgi Sistemlerinden genel beklenti karşılama oranında belirleyici olduğu tespit edilmiştir. Bilgisayar bilgisi ise hiçbir beklenti için belirleyici olmadığı tespit edilmiştir.

Önerilen değerlendirme çerçevesi mevcut çerçevelere rakip değil, alternatif ya da tamamlayıcıdır. Yeni bir yaklaşım ve bulanık mantık destekli değişik bir hesaplama yöntemidir. Çerçeve beklenti değişkenleri seviyesinde bilgi vermektedir. Dolayısı ile sonuçlar sadece mevcut durumu tespit eder. Elde edilen sonuçların nedenleri için daha derin bir araştırma yapılması gerekmektedir.

Anahtar Kelimeler: Değerlendirme Çerçevesi, Tıp Bilişimi, Hastane Bilgi Sistemi, Bulanık Mantık, Beklenti

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TABLE OF CONTENTS

LIST OF TABLES

TABLE

LIST OF FIGURES

FIGURE

LIST OF ABBREVIATIONS

IT : Information Technology

HIS : Hospital Information Systems

EU : European Union

US : United States

RCT : Randomized Clinical Trials

HOT-fit : Human, organization and technology-fit factors

CHEATS : Clinical, Human and Organizational, Educational, Administrative, Technical, Social

TEAM : Total Evaluation and Acceptance Methodology

SDLC : Systems Development Life Cycle

MEM : Multi-disciplinary, multi-method framework

ITAM : Information technology Adoption Model

HTA : Health Technology Assessment

ICT : Information and Communication Technologies

HCI : Human–Computer Interaction

CIS : Clinical Information System

FITT: Fit between Individuals, Task and Technology

PHR : Personal Health Record

PRISM : Performance of Routine Information System Management

TTF : Task Technology Fit

COA : Center of Area

BNP : Best Nun-fuzzy Performance

EMR : Expectation Meeting Ratio

SPSS : Statistical Package for Social Sciences

UE : Usage Expectations

SDE : System and Data Expectations

IE : Improvement Expectations

ME : Managerial Expectations

ATC : Attitude Towards Change

WU : Working Unit

PoCCS : Point of Care Clinical Systems

CHAPTER 1

INTRODUCTION

In our era of information technology (IT), health institutions invest huge amounts in Hospital Information Systems (HIS). The purpose of these investments is to make health care more effective and efficient. Findings from considerable amount of studies reveal negative effects of IT implementation to health care [1]. It is estimated that nearly 70% of IT implementation projects fail [2] resulting in loss of huge amounts of money, more importantly loss of confidence to these implementations. The reasons for such perceived failure is the lack of knowledge or tools available for evaluating the costs and benefits of IS and the effectiveness of planning and implementation [3]. Voss [4] claims that technology-focused investments fail due to organizational problems, and identified economic justification as a significant contributing factor. Despont-Gros summarizes the major reasons for failure as; technical issues, project mismanagement, organizational issues and explosive growth of information systems [5]. However, reason for failure in any IT implementation is rarely purely technical [6]. The other reasons can be avoided or at least the rate of failure can significantly be decreased by means of easy to use management tools for evaluating, prioritizing, monitoring, and controlling IT investments [7]. The considerable high rate of failures despite huge investments raise one big question: "Is the system good enough?" Many investigations by the IT industry have been conducted to get the answer. The academic translation of these investigations is "evaluation". Evaluation is a transdisciplinary issue. Therefore, there is no generic template of what to evaluate and how to perform evaluations.

Effective evaluation of any IS is crucial to determine if these systems adequately meet the requirements - needs of users and organizations.

International Atlas of Evaluation [8] tells us that the number of evaluations is rapidly increasing. According to the information in International Atlas of Evaluation [8] these evaluations are made on behalf of government and public sector organizations, besides governments, European Union (EU) and Word Bank are active players in evaluation. In addition professional evaluation institutes are emerging in United States (US), Canada, Europe, Africa and Australia [8]. Stockdale and Standing introduce [3] an interpretive approach resulting in a framework to evaluating information systems through a focus on content, context, process. Evaluation is performed by addressing the questions: Why is the evaluation done? What is evaluated? Who affects the evaluation? When does the evaluation take place? And how is the evaluation to be carried out?

In order to be able to compare IS investment proposals by means of evaluation; there mustn't be any misinterpretations about the different concepts used. Also, in evaluation practice the communication between stakeholders in the evaluation process can be improved by the use of a common language. That means all the people related to the evaluation under performance must understand exactly the same thing from the same words and terminologies.

In Turunen's study [9], medical domain frameworks have three common properties: The emphasis is on technology, user, and organization; employing subjective and objective evaluation methods, and related distinct components.

1.1. Overview on Evaluation

1.1.1 Why evaluation

What is evaluation? Before telling what evaluation is let's tell what evaluation is not. Although used interchangeably, evaluation is not equal to assessment. One can find many different definitions of "evaluation" in the literature. Some examples are; "decisive assessment of defined objects, based on a set of criteria, to solve a given Problem"[10] , "the act of measuring or exploring attributes

of a HIS (in planning, development, implementation, or operation), the result of which informs a decision to be made concerning that system in a specific context" [11], "Collection, analysis, and assessment of data relative to project goals and objectives" [12] , Evaluation is act of measuring or exploring some property of a system, in a specific context [13]. Drawing from the literature, in this study, evaluation is defined as, measuring the extent of meeting the specified criteria of a system in a specified context.

One can evaluate any system. Philips et al. say that by evaluating information systems the value of information to the decision maker is often measured indirectly with some criteria [14]. A single sentence tells us more than pages as in the "If you can't measure it, you can't manage it" saying; it tells us alone why we need evaluation.

1.1.2 Evaluation in Medical Informatics

Medical Informatics is very familiar with the evaluation idea. The actors of medical domain are well aware of the importance of HIS evaluation.

The evaluation of HIS can help improve the healthcare quality, safety and effectiveness, decrease the costs [14]. There is an opinion that the evaluation of Healthcare Information Systems may become a must in the future [14].

The evaluation process is considerably complex and this issue is more recognized in Medical Informatics than any other domain. All we know healthcare domain itself is a huge combination of problems. When we put the words "Evaluation" and "Medical Domain" together, then the "complexity coefficient" increases exponentially. Besides the complexity of Evaluation process itself we must tackle with the complexity of evaluated subject.

What, why, who, how, when elements can be main borderlines of evaluation [15,16]. *What* element refers to what is going to be measured in an evaluation context. The reason for evaluation, in another words, the goal of the evaluation study stands for the *why* element. *Who* element refers to the evaluators and the stakeholders. The methodology going to be used accounts for the *how* element. The final when element refers to timing of the study. [15,16]. Types of evaluations differ

depending on the system being evaluated and the evaluation purpose. The literature gives two main evaluation types as “Formative” and “Summative“evaluation. [10,17,18].

1.1.3 Evaluation Frameworks

“An evaluation framework is a decisional space defined by the characteristics of the evaluation context that helps in the selection of the appropriate approach “[19]. These characteristics are the project phase, evaluation methods (formative, summative, qualitative, quantitative etc.), and the data type (clinical, fictive, etc.)[5].

The question “Is there a generic framework to evaluate all Hospital information systems?” is the key for the need of a new evaluation framework. The answer is hidden in the nature of evaluation and the evaluated object. Literature gives just an opposite answer [9,20-21]. Some frameworks tried to be generic by improving existing frameworks [22]. But, these solutions are not true because of lacking enough consensuses and sufficient proof that they have accomplished [22].We can say there is no generic framework and according to us it is impossible, because the framework is specific to the measurements of evaluation. While defining the “evaluation”, almost all the definitions state that the evaluation takes place in a specified context. The specified context makes the frameworks differ. We will see as the document progress that some deals with organizational issues while the other deals with profit and cost-effectiveness and some other deals with technology acceptance. In the literature there are 24 evaluation frameworks proposed. We will examine them respectively.

Let’s begin our example evaluation frameworks with the five step evaluation process framework.

Five step evaluation process [23]

In this model Evaluation concerns the five steps of a history of an information project. These are

General Conception: Model, Aims, Meaning, Ethics

Preparation of Machine: Software, Data definition and Entry,

Execution of the program

Output of the program: Interpretation

General Impact: Decisions taken, Social Representation

This framework is a conceptual model and it has no application framework. It states that in every step of the evaluation, we are subjected to human subjectivity.

Socio-technical approach framework [24]

In this approach, work practices are thought as networks. Networks of people, tools, organizational routines, documents etc. The elements that form these networks acquire specific characteristics, roles and tasks 'only as part of a network' rather than discrete, well-circumscribed entities with pre-fixed characteristics. It sees IT application in a health care institution should be seen as forming a seamless web rather than a Technology in an Organization This framework is a conceptual model and it has no application framework.

Task Technology Fit (TTF)[25]

The framework introduces the term "satisfactoriness". The study states that individual rates the satisfactoriness of the system, much as the supervisor rates the satisfactoriness of the individual. They argue that user beliefs about IS is a function of the fit between the task environment and the IS environment.

According to Ammenwerth et al. [2], beside considering the complexity of the clinical tasks supported by an IT system, the framework also takes into account the technology and user. The influence of the three factors are examined; individual abilities, technology characteristics, and task requirements, by taking attention to the fit of these three factors. It argues that TTF is the extent to which technology meets the task requirements and individual abilities. It does not consider the interaction of user and task, which is an important success factor for IT introduction projects [2].

Televaluation [26]

Televaluation is a different approach to clinical information systems assesses web-based clinical information systems. The specific questions they seek to answer regarding Web-based clinical information systems are:

- ✓ "How do providers' and patients' perceptions of use of technology change over time as they begin to interact and use Web-based information systems? "

- ✓ “How does previous experience in using computers and expectations about using information technology affect actual use of such systems over time?”
- ✓ “Is the content and functionality provided by the system of value to users for their decision-making and provision of improved health care? “
- ✓ “What problems do providers and patients have in comprehending, understanding and applying information provided on-line over the WWW?”
- ✓ “How does the use of such technology affect the patients’ interaction with their health-care providers? “
- ✓ “How does the use of information systems affect what patients do regarding daily management of their condition, in terms of reasoning, decisions and actions?”
- ✓ “What are the current limitations of Web based information systems in providing

  user-specific information and how can they be improved from the point of view of usability (i.e. their efficiency, effectiveness and enjoyability)”

They used several methods to perform the evaluation. Users (e.g. patients or physicians) can email any comments or concerns to the evaluators. They create log files getting information about usage of system features automatically recorded for all subjects’ interactions with the systems. Periodic telephone interviews with subjects about the use of the system, usability issues, cognitive and lifestyle issues and suggestions for improvement of the system.

4Cs (Communication, Care, Control, Context) evaluation framework [27]

Kaplan has stated that controlled clinical trials (RCTs) are the ‘gold standard’ for evaluation. He claims that because RCT and experimental evaluation approaches do not include social, organizational, cultural, cognitive, or contextual issues, they cannot answer key questions such as : What influences whether clinical systems have the desired effect? Why do clinicians use or not use clinical systems, or any other IS? So he presents alternative approaches to evaluation. He express there are a variety of dimensions to ‘fit, ’.the notion of ‘fit’ runs in both causal directions. The degree to which an information system fits other aspects of organizational life is very important in this approach.

The framework calls attention to four of the many interrelated areas when conducting an evaluation:

Communication, communication of the system with the stakeholders

Care, system's improving patient care

Control, System's role of control

Context, the context that the system is evaluated

Social network perspective framework [28]

This framework has a different approach. It states that the adoption, diffusion and use of information technology in practice settings are influenced by the organization's structure characteristics, relationships among individuals and organization's units. It defines Social network analysis as "the study of the pattern of relations among a set of people, departments, organizations, etc." In this approach, the elements of the evaluation are, the units that comprise the network being evaluated, the type of relations among the units, the properties of the relation, and the level of analysis. The framework evaluates the relations, their presence or absence and strength of the relation.

HTA (health technology Assessment) framework [29]

The framework claims that a Comprehensive Health Technology Assessment Framework is presented as a conceptual tool for decision making about health technologies. The aim is to provide a framework for health technology decisions.

The major dimensions of the framework are; epidemiological context (population at risk, population impact), economic context, social context (including ethical, legal, and political concerns) and technology assessment activity. Decision-makers assign a relative weight of importance to the different dimensions.

They also claimed that proposed Framework has greater power than existing frameworks in the evaluation of information systems in health care. It aims to identify all relevant interest groups, and, through comparison of the wider social and political impact of information system technologies, to place competing technologies within a consistent and defensible process of assessment. But there is no evidence given to justify this claim.

This framework is for the health information systems that are under consideration of newly adopted systems. There is no sign of user or user evaluation. Maybe this is not available because of its being framework for technology selection for decision makers. This is not an application but a theoretical framework.

ITAM (Information technology Adoption Model) evaluation model for designing and evaluating strategies for IT implementation [30]

According to Ammenwerth et al. [30] the ITAM model is designed to provide a structure for designing and evaluating strategies for IT implementation. This is not an application but a theoretical framework. The framework proposes a term "fit" and states that perceived usefulness and perceived ease of use does not depend on the features of the system design, but on this fit of user and system design features. Ammenwerth et al. state that it stays unclear whether the ITAM model was more formally validated but it is interesting because it introduced the notion of fit, explaining the important thing is the quality of fit between IT complexity and IT knowledge other than the individual attributes.

Total Evaluation and Acceptance Methodology (TEAM) multiaxial evaluation framework [31]

The framework has three main dimensions for the evaluation role categorization, phases of evaluation and structure of evaluation.

Role categories are, the people involved in conception and design of the information system, responsible for implementation and functioning of the information system (specialist user), use the information system (end user) and a stakeholder having strategic interest that the information system is successful.

The phases of the evaluation are;

Phase 1: design, prototyping and testing of functional system and its components.

Phase 2: evaluating prototypes of the integrated system at designated sites.

Phase 3: evaluation after a period of mature use.

Phase 4: continuing periodic evaluation.

The fundamental levels; strategic, tactical or organizational and operational are the structure dimension. As above this is a model and there is no application

available for that model. This framework is a systems development life cycle (SDLC) model. It states an ongoing evaluation from beginning to the time as the system is operational.

CHEATS (Clinical, Human and Organizational, Educational, Administrative, Technical, Social) Evaluation Framework [32]

Six aspects for evaluating Information Communication Technologies (ICT) in health care have been identified:

Clinical,

quality of Care,

diagnostic reliability,

impact and continuity of care,

acceptance of technology (both by patients and professionals),

changes in work practices and redistribution of resources,

differences in acceptance and efficacy between different areas,

cultural differences,

different patient/client groups,

interviewing techniques,

effects on referral rates, and

appropriateness of referral.

Human and organizational,

Educational,

Impact on recruitment and retention of staff

Training provision, acceptability and continuity

Administrative,

Convenience

Change in interaction styles

Cost effectiveness

Technical

appropriateness of technologies implemented,

video and sound quality for the application

differences associated with different techniques,

ease of use,

technology specific training,

reliability of technology.

Social.

The impact of computerized systems on social interaction was evaluated.

SDLC evaluation framework [33]

In this framework a full cycle approach to evaluation of health care systems is argued. It states that evaluation must be considered throughout the entire SDLC in creating health care applications. In this approach "usability testing" is stated as a key method for evaluations during iterative system development. "Usability testing" means the evaluation of information systems during the analysis of typical end users interaction with the system.

Effken Evaluation Framework [34]

The claim is proposing a structured, hierarchical approach to the analysis of complex, dynamic sociotechnical systems. The aim is to help analysis and design of HIS. The model is on making a Cognitive analysis of work domain, control tasks, strategies, social-organizational domain and worker competencies on the base of empirical ethical, personal and aesthetic dimensions. Some examples of the analysis can be given as, data elements values and relationships of work domain on the empirical dimension, which control tasks are right and appropriate for each group of users on Control Tasks on the ethical dimension.

Limpopo Province Project [35]

The project was performed in the Limpopo Province in South Africa [23]. The project was managed by a team consisting of staff from the Department of Health and Welfare, IBM, and its subcontractors. 24 Randomly selected hospitals out of 42 are evaluated as an early and late evaluation.

Projects in evaluation framework were

• Assessing whether training, change management, and support are optimal

• Assessing whether the reliability of the system (including peripherals, network, hardware and software) is optimal

• Assessing the project management

• Assessing whether the system improves the communication of patient information between healthcare facilities

• Assessing whether data protection is adequate

• Assessing the quality and actual use of decision making information to support clinicians, hospital management, provincial health executives, and the public

• Assessing whether patient administration processes are more standardized and efficient

• Assessing whether costs per unit service are reduced

• Assessing whether revenue collection has improved

• Assessing whether information is used for audit or research

This evaluation framework is specific to this project and in the article there is no claim to be used by other HIS'.

MEM (multi-disciplinary, multi-method framework) [36]

The focus is on the evaluation of point of care clinical systems (PoCCS) (specifically, order entry and electronic prescribing systems) in major academic medical institutions. The aim is to evaluate the impact of information and communication technologies on organizational processes and outcomes.

The dimensions are Safety, Quality, Efficiency, Organizational, and Technical.

There are three stages in this framework that are

Stage 1 Pre system implementation;

Stage 2 Six months post-implementation;

Stage 3 18 months-two years post-implementation.

Human–computer interaction (HCI) based model evaluation framework [37]

In this approach, a model of user–Clinical Information System (CIS) interactions is proposed. The HCI field defines four main dimensions, which take part in interactions: CIS characteristics, user characteristics, development process, and context of use. CIS characteristics are defined as input–output devices, dialogue techniques, computer graphics and architecture. User characteristics are defined as human information processing characteristics, communication characteristics, and

physical characteristics. Development process means that the degree of user involvement in the development process

Context of use means workflow, communication patterns, constraints of the environment such as mobility, space available, and manipulation of other existing tools.

Individual professionals' technology acceptance evaluation framework [38]

The authors of the frameworks states that recent innovation studies have shown another variable, personal innovativeness in the domain of IT (PIIT), the willingness of an individual to try out any new IT, plays an important role in determining the outcomes of user acceptance of technology. In view of that information, they concentrate on technology acceptance and make a case study about Personal Digital Assistant acceptance of healthcare professionals

Design-reality gap model [39]

This approach states that the amount of change between ''where we are now'' and ''where the HIS wants to get us'' is central to health information system success and failure. The difference is called as "design—reality gaps". Seven dimensions of relevance to information are; technology (both hardware and software); processes (the activities of users and others); objectives and values (the key dimension, through which factors such as culture and politics are manifest); staffing and skills (both the quantitative and qualitative aspects of competencies); management systems and structures; and other resources (particularly time and money).

The authors claim that this analysis has confirmed these seven dimensions are necessary and sufficient to provide an understanding of design—reality gaps. For each of the seven dimensions, the gap between design and reality can be assessed and rated (e.g. low, medium, high).

Fit between Individuals, Task and Technology (FITT) framework [2]

The framework states that the existing models are failing to include one important aspect, the interaction between user and task.

FITT framework claims to be based on the idea that IT adoption in healthcare depends on the fit. This fit is between the attributes of the users, of the attributes of

the technology, and of the attributes of the clinical tasks and processes. They give the following list as some example on attributes that affect the various fit dimensions:

"Attributes on individual level: IT knowledge, motivation and interest in the task to be completed, flexibility and openness to new ways of working, team culture, organizational context, cooperation within a team, and politics within an organization. "

"Attributes on task level: Organization of the tasks to be completed, activities and their interdependence, complexity of tasks. "

"Attributes on technology level: Stability and usability of a software or hardware tool, costs of a tool, functionality, available technical infrastructure, integration of tools, availability of tools in a certain clinical situation"

Information and Communication Technologies (ICT) Acceptance Evaluation framework [40]

In this framework technology acceptance and use amongst occupational therapists is aimed to be evaluated. The claim is; "when fully developed, the model will offer a way of examining technology acceptance within the health sector". The primary objective of the framework is, by examining the acceptance and use of ICT by occupational therapists, to search how well occupational therapists are to adapt to the imminent changes in their workplace, and in their interaction with patients. This framework is stated to be applicable for five major stakeholder groups that are; the public sector, tertiary educators, occupational therapists and information systems professionals and researchers.

A Framework and Approach for Assessing the Value of Personal Health Records (PHR) [41]

This framework is aimed to evaluate the value of the PHR functions and thereby help optimize PHR development. They define PHR as "a set of computer-based tools that allow people to access and coordinate their lifelong health information and make appropriate parts of it available to those who need it"

They state that the value is determined by the number and types of functions supported by the PHR system**,** by determining which PHR functions produce the greatest value, PHR developers produce successful applications. They also claim that

PHR framework and approach should be used to produce a comprehensive evaluation of PHR value.

They claim that the PHR framework presented and the accompanying approach should be used to produce a comprehensive assessment of PHR value. PHR framework includes the following six categories:

Patient-Provider Communication – functions that allow patients and providers to better communicate and interact with one another (e.g. email, secure messaging, online scheduling)

Personal Health Advocate – functions that allow patients to better advocate for their own and for other's health care (e.g. health care proxies)

Personal Decision Support – functions that allow patients to make more informed health care decisions (e.g. web-based disease risk and treatment assessment tools)

Personal Health Journal – functions that allow patients to record and maintain their own personal health information (e.g. online medical record or a portable Universal Serial Bus or "USB" drive)

Personal Health Monitoring and Management – functions that allow patients to monitor and manage their own health status outside of traditional care settings (e.g. PHR-assisted blood glucose monitoring)

Personal Health Reminders – functions that allow patients to improve adherence to care plans (e.g. email reminders for medication adherence)

Interoperability evaluation framework [42]

This framework is aimed to evaluate interoperability standards. It is a conceptual framework developed for the systematic evaluation of interoperability standards. They claim that evaluation of the scope and other aspects of interoperability standards is usually performed against project-specific requirements, but generic frameworks can be used for supporting the evaluation.

A Framework and Model for Evaluating Clinical Decision Support Architectures (focus on decision support) [43]

This framework is aimed to evaluate architectures for clinical decision support. They state that based on review of the literature and discussions with

experts, proposed a four-phase framework for evaluating clinical decision support architectures. The four phases are:

"Feature determination: Desirable features for decision support architectures are developed based on a review of literature and expert opinions and then evaluated the relative ability of decision support architectures to exhibit these desirable features."

"Existence and Use: Four level spectrum of the existence and use of clinical decision support architectures are developed, ranging from theoretical discussion at one end to widespread adoption and use at the other extreme."

"Utility: Each architecture's ability to implement a wide range of decision support use cases is evaluated."

"Coverage: Each architecture's ability to cover a large knowledge base of decision support content is evaluated."

Human, organization and technology-fit factors (HOT-fit) Evaluation Framework [44]

They claim that current evaluation methods evaluate different aspects of HIS and they can be improved upon. The claim is that most existing evaluation studies of HIS focus on technical issues or clinical processes, which do not explain why HIS works well or poorly with a specific user in a specific setting

The evaluation dimensions of the framework are:

- ✓ System Quality,
- ✓ Information Quality,
- ✓ Service Quality,
- ✓ System Use,
- ✓ User Satisfaction
- ✓ Organizational Structure,
- ✓ Organizational Environment.

In this framework, expectation refers to the anticipation of improved patient care delivery from the use of HIS. They also state that the level of system use can affect the degree of user satisfaction and vice versa, for both positive and negative cases. Effective system use causes higher user satisfaction as user is able to explore and

make full use of system features and functions; higher user satisfaction subsequently motivates/leads user to increase system use. According to our point of view, this is true but not alone system use determines the satisfaction, it can be only a small part of it.

PRISM (Performance of Routine Information System Management) framework [45]

This framework is focused on the HIS performance evaluation. RHIS performance was defined as 'improved data quality and continuous use of information'.

It has four tools which are;

"RHIS performance diagnostic tool for (Data quality, Information use, Collection, transmission, processing/analysis, display, data quality check, and feedback, Action plan, role modeling, newsletter, advocacy , Frequency, discussion, checking quality, assist use for decision-making , Complexity of forms, information technology, integration ,

RHIS overview, office/facility checklist for Mapping, Data collection and transmission, Information flow chart, Availability of equipment, Availability of human resource,

RHIS organizational and behavioral assessment tool for Self-efficacy, RHIS tasks competence, Motivation, Knowledge of RHIS rationale, Problem-solving skills,

RHIS management assessment tool for Governance, planning, training, supervision, quality, finance".

1.2 Expectation and Satisfaction

Almost in all of the proposed evaluation frameworks user satisfaction is measured in user dimension. There is no interest to the user expectations from an information system. We begin with some definitions to clearly understand what we talk about, intend to do and measure.

Cyert and March [46] are the first to propose the concept of user satisfaction as an element of system success.

Collins dictionary defines satisfaction as [5]:

- ✓ the act of satisfying or state of being satisfied;
- ✓ the fulfillment of a desire;
- ✓ the pleasure obtained from such fulfillment; and
- ✓ a source of fulfillment.

Geer et al. define expectation as a belief about the probabilities associated with a future state of affairs [47].

In Maes&Poels [48] article we found some definitions about user satisfaction. Seddon [49] defines user satisfaction as ‘‘a subjective evaluation of the various consequences evaluated on a pleasant –unpleasant continuum’’. Gelderman [50] defines user satisfaction as ‘‘the extent to which information requirements are met’’. Similarly, Ives et al.’s [51] definition is ‘user information satisfaction’ as ‘‘the extent to which users believe the information system available to them meets their information requirements’’.

After having the definitions we have learned that satisfaction and expectation does not have the exactly same meanings and evaluating one does not necessarily means evaluating the other.

When we talk about expectation and satisfaction we found disconfirmation and dissonance theory dealing with these two concepts. The dissonance theory states that unmet IS expectations create dissonant (unharmonious) ideas. Disconfirmation theory states there is a negative correlation between user satisfaction and disconfirmed expectations. In the disconfirmation theory, a user with poor expectations about a product is satisfied if it reaches his expectations [5,52]. Another study states just the opposite, because of negative previous experiences, if the expectations of a user are poor then he won’t be satisfied [5,53].

Computer user expectations are known to influence user satisfaction with computer systems. In a survey of information systems about the factors that affects user satisfaction [53], "user expectations" is found as second in 33 items. This is consistent with earlier research that found that user expectations have a strong effect on overall satisfaction with IS [54].

According to Despont et al. [5] users' beliefs and attitudes are constituted based on their current and past experiences. The current interaction with the evaluated IS, the past interactions with other IS, and individual characteristics constitute the user's attitude to an IS [5]. The individual characteristics can be attitude towards innovation in general, IS expertise and demographic data [5].

In IS research, user satisfaction is widely used as an indicator of user perception of the effectiveness of an IS [55]. The disconfirmation of expectations construction is widely accepted as being a dimension of end-user satisfaction, user expectations are important factor on the usage of information systems [55]. Users are becoming more demanding about what they want from their information systems and managers try to determine how to establish realistic expectations [55]. Advances in technology cause higher user expectations [55]. Users that have advanced computer knowledge are now expecting appropriate state-of-the-art technology while users having lower knowledge are in the demand of user- friendliness with simple user interfaces [55]. Managers should not oversell the benefits of future systems to get user support for new projects [55]. Although difficult it is, managing user expectations became essential.

Steplas et al. determined [55], only two field-based studies that have examined the effect of expectations before and after implementation of an IS on perceived user benefits: Ginzberg in 1981 [56] and Marcolin in 1994 [57]. According to these studies, unrealistic high expectations result in lower user satisfaction.

User satisfaction is one of the most used success indicators in the research of information system. The level of users' satisfaction have direct impact on system usage, meaning that if IS cannot satisfy its users, the users will not use the system effectively. In reality a "good" information system that is considered by its users as a "poor" system is a poor system, it is not important whatever good virtues it has.

1.3 Overview on Fuzzy Logic

Fuzzy sets are presented to the literature by Zadeh [58]. Dadone has stated in his PHD work that although fuzzy logic the concept of multi value logic was first introduced in 1965 to handle vagueness, it was present in the beginning of the

century. He gives some sayings to validate his claim. In 1905 Pierce “I have worked out the logic of vagueness with something like completeness” [59].

The values the Fuzzy logic deals with are not certain but approximate. While the certain values are cold-hot fuzzy logic values can be cold-a little cold-warm-a little hot-hot. Than we can say exactly theory of fuzzy set extends the classic sets such that while the digital world works on 0 and 1 Fuzzy logic works between 0 and 1.

Today practical fuzzy systems are used in many areas. Washing machines, elevators, electric razors, subways, medical devices, bond-rating systems, risk analysis systems for bank credit applicants are good examples of fuzzy systems.

1.3.1 Fuzzy sets

Sets first described by George CANTOR. He defines a set as a collection of objects that can be treated as a whole. You can specify a set by its members. Let X be a set and “1,2,3” are the members of this set. You can show this as X = {1, 2, 3}.

Fuzzy sets have more than 0-1 approach for membership. For example consider the set of tall people. The man having 110 cm height belongs to this set and the man with 200 cm height does not but what about the people with 150,160,165 cm height? Zadeh’s “grade of membership” solves this issue. According to this concept a set has members belonging to it partially. Then we can say a fuzzy set can be defined by the grade of membership for all its members.

Fuzzy sets are subjective and depend on the case or problem. In another word, fuzzy logic memberships depend on the context. Considering the tall men set everyone can make different fuzzy sets with different members. According to the man with 110 cm 160 cm is tall whereas it is not for the man with 190 cm.

There is an important difference between crisp sets and fuzzy sets. Table 1 is a good example for this difference [60]. Figure 1 is another way of representing the difference between crisp and fuzzy sets [60]. The world is not binary thus Fuzzy logic is a tool for modeling human knowledge and understanding and the world. There is an infinite number of numbers between 0 and 1; suppose you are advising to wear his coat to your son. Would your advice be “wear your coat when it is 15 C” or

would it be better "wear your coat when the weather is cold". Classical compute approach like *yes-no* or 0-1, should be improved to cover vague concepts, and situations to fit the real world applications.

Especially in medical science, it is impossible to give exact definitions or descriptions of medical concepts and relationships between concepts in most of the cases. For instance, normality of laboratory test results or pathological ranges is arbitrary in borderline cases and depends on the subjective estimation of the physician. In addition, precise descriptions of relationships between findings and diseases can rarely be given.

Table 1. Difference between crisp and fuzzy sets [60]

Crisp Sets	***Fuzzy Sets***
Either or	And
Bivalent	Multivalent
Yes or No	More or less

In control engineering, decision making, pattern recognition, image processing, information retrieval systems, robotics, transportation, and many other areas successful applications of fuzzy set theory have been developed. Fuzzy sets are useful to represent ideas as linguistic variables rather than exact numerical definitions.

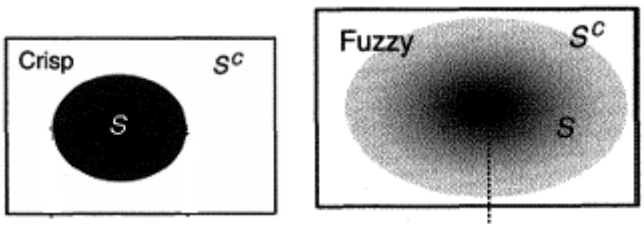

Figure 1.Difference of crisp sets and fuzzy sets[60].

In a crisp set an element is ether member or not (the left figure in Figure 1), but in fuzzy set. Black part is the complete member whereas Gray part is degree of membership [60].

One of the most important characteristics of fuzzy sets theory is the ability to operate with linguistic variables [61]. Linguistic variable are the words or sentences

that replace numbers [60]. Height can be an example of linguistic variable if it has the values like “short, medium, tall, very tall”. Linguistic variable can be stated as a label of fuzzy set.

1.3.2 Membership Function

The function that assigns a number to each element x of the input space, is called the membership function and represented as μ(x). The membership function maps an input value to its membership value. More clearly membership function of x shows the degree of its membership in a fuzzy set. The values given by the membership function have to be in [0, 1] interval.

The fuzzy set A, where A = {(5, 0.4), (7, 0.1), (9, 1), (8, 0.2)} is to be notated as A = {0.4/5, 0.1/7, 1/9, 0.2/8} by fuzzy notation. Notice that membership value of zero does not appear in the set. The standard notation for the membership grade of the fuzzy set A at 5 is

$$\mu A(5) = 0.4.$$

According to the interpretation of the fuzziness, the meaning associated with the membership function changes [62].

Consider the example “Murat (z) is young(Y)”

$$\mu Y\ (z) = 0.2.$$

Then what is the meaning of the equation μY (z) = 0.2?

Bilgic, Taner & Turksen [63], answers this question differently in five views:

Likelihood view 20% of a given population declared that Murat is young.

Random set view 20% of a given population described “young” as an interval containing Murat’s age.

Similarity view Murat’s height is away from the prototypical object which is truly “young” to the degree 0.8.

Utility view 0.2 is the *utility* of *asserting* that Murat is young.

Measurement view When *compared* to others, Murat is younger than some and this fact can be stated as 0.2 on some scale.

Although the type of membership function to represent is still a research issue, the most commonly used shapes for representing the membership functions are triangular, trapezoidal, linear and Gaussian.

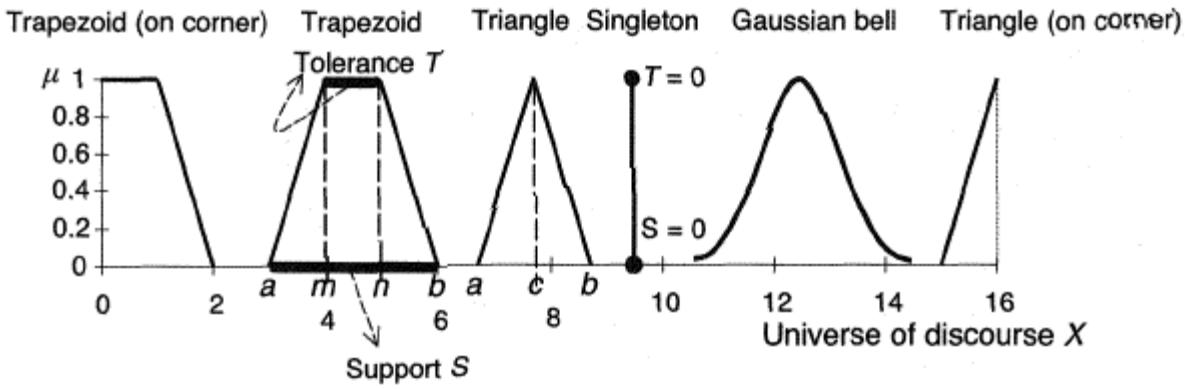

Figure 2**.** The most commonly used fuzzy sets [64]

Automatic Methods

These types of methods are employed when expert do not exist or when there are so many data impossible to process manually [65]. Neural networks-genetic algorithms are the most common methods [65]. The handicap is they deal with only numerical data. The advantage of Automatic Method is that the expert's opinion is not crucial to for the definition of the membership function [66].

Statistical Methods

In the statistical methods data are expressed in the form of probability curves to construct the membership function [65]. There are many membership construction methods, having strengths and weaknesses [65,67]; but membership functions are not probability densities, but possibility distributions [65,68].

Psychological Methods

In Psychological Methods the related experts are asked to draw othe membership diagram or select from the choices given to him [65]. Because there is a large number of possible functions, the set must be shortened to make the method simpler [65].

1.3.3 Fuzzification

Fuzzification is the process that translates a crisp number to a fuzzy set for linguistic variables of fuzzy sets. In Figure 3 an example of fuzzifiying the crisp value *70* into the linguistic variables *low* and *medium is given.*

According to the Figure 3

$$\mu A(70) = 0.75$$

$$\mu B(70) = 0.25$$

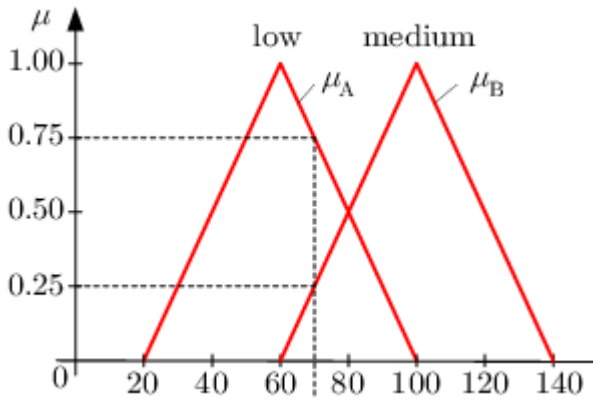

Figure 3. Membership functions of the “low” and” medium”

1.3.4 Defuzzification

A fuzzy set is not useful in real world. Thus it needs translating into the crisp value to be used. The output which is the crisp equivalent of the fuzzy output should take into consideration of all the points in the the fuzzy output, like a gravity operation shown in Figure 4[69].

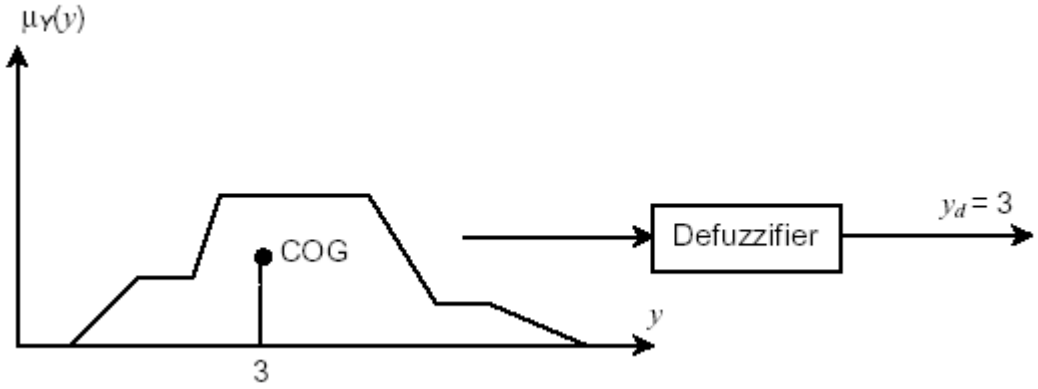

Figure 4. Example of defuzzification[65]

The are three main approaches of `defuzzification' as [70];

The *max criterion* method finds the point at which the membership function is a maximum.

The *mean of maximum* takes the mean of those points where the membership function is at a maximum.

The *centre of area* method which finds the centre of gravity of the solution fuzzy sets. One of the most popular defuzzifiers is the center of area (COA) defuzzifier [69].

1.3.5 Fuzzy Triangular numbers

A fuzzy number *F* on *K* is defined to be a fuzzy triangular number (l,m,u) if its membership function $\mu f : K \rightarrow [0,1]$ is equal to [71,72] *:*

$$\mu f = (1 / (m-l)) \, x - (l / (m-l)) \quad x \in [l,m]$$

$$\mu f = (1 / (m-u)) \, x - (l / (m-u)) \quad x \in [m,u] \text{ otherwise} \qquad l \leq m \leq u$$

where l = lower value, m = mean value and u = upper value of the fuzzy number F

The membership function of the fuzzy triangular number is shown in Figure 5.

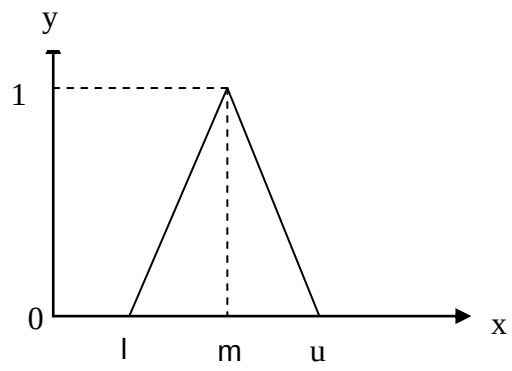

Figure 5. Fuzzy triangular function membership

1.3.6 Best Nun-fuzzy Performance

After giving the Notion of the fuzzy triangular number, we can give the defuzzification of triangular fuzzy numbers. Best Nun-fuzzy Performance, BNP [73] based on the COA method is used for defuzzifiying triangular fuzzy numbers.

BNP for a fuzzy number *F* = (l,m,u) can be calculated by;

$$BNP = l + \frac{(u-l) + (m-l)}{3} \qquad \text{(Equation 1)}$$

Fuzzy triangular numbers and BNP is widely used in fuzzy decision making applications, because they are simpler and very suitable for likert type scales [73-80].

1.4 Aim of the Study

As seen in the literature review user expectations are of great importance for user satisfaction, system usage, HIS success. So they must be studied and managed. To manage the expectations, first we should measure the extent of meeting by the HIS. We have seen none of the existing frameworks focus on it. To measure the expectations first we must know what they are. There is no study in the literature about what an end user expects from HIS.

The aim of the study is to introduce an expectation based evaluation framework which will evaluate the clinical user's expectation meeting grade by HIS. To evaluate the expectation, first aim is to put forth the end users' expectations from HIS. The focus of the framework is on HIS user's expectations and for this purpose an evaluation framework is developed. In this framework a different approach on both scope and evaluation technique is introduced. Fuzzy logic methodologies are used first time in the literature in HIS evaluation framework. The result of the evaluation will be a concrete, comparable output in the form of percentage.

CHAPTER 2

METHODS

2.1. Evaluation Methods

The study can be both formative and summative evaluation study, although running systems are evaluated. In any case it will give the evaluator feedback about the system for improvement. The study employs quantitative evaluation methods. “Expectation Questionnaire” is used to collect data.

2.2 Sampling

Different types of hospitals are evaluated for the application of the framework. Information system users of the hospitals are visited for collecting data. Different clinical user profiles from each hospital are visited. The users using the system for decision support and operational clinical tasks as a tool for doing their work such as Physicians, nurses and patient admission crew are asked to participate in the study. Volunteered HIS end users in these hospitals participated in the study.

2.3 Expectation Questionnaire

“Expectation Questionnaire” is formed and used for data collection. In the “Expectation Questionnaire” there are fifty two questions for seventeen evaluation variables (Table 3) to evaluate the expectation. For each of the variable, one additional importance question is asked to capture the weight of that variable. Users are asked to express their expectation rating using 5-point Likert scale (strongly agree, moderately agree, not sure, moderately disagree, strongly disagree), and importance weights using 5-point Likert scale (very important, important, average important, not so important, not important) which are our linguistic variables and

values (Figure 6-7) in fuzzy logic operations. “Expectation Questionnaire” is given in Appendix**.**

2.4 Evaluation Model

The user types differ for many assets. Analyzing the data gathered from non-comparable users will cause a bias in the research. Grouping the users according to assets that will change their expectation will be suitable. Table 2 gives the user assets that may affect HIS expectations.

Table 2. User assets that can affect user expectations

Education
IS Experience
Age
Attitude towards Change
Business Title
Sex
Working Unit

Although many studies in literature states that one of the failure reason for (hospital) information systems is being short to meet the user expectations, there is no clear explanation or list about what are the user expectations of HIS, so we first try to model the user expectations of HIS to evaluate.

Table 3. Possible user expectations from HIS.

Usage Expectations	System and Data Expectations	Improvement Expectations	Managerial Expectations
Ease-of-use	Consistency	Improve service Quality	Reporting Facilities
Need For Training	Privacy	Decreasing work Load	Decision Support
Help Manuals	Security	Bringing Positive Change	Function Sufficiency
Speed	Availability	Research Facilities	
User Support	Interoperability		

Hospital information systems specifications, computer support centers' experiences and interviews with user are used to constitute what can be the possible user expectations from a HIS. Then these possible expectations are grouped to make them more comprehendible which constitute our framework dimensions. Table 3 lists what an end user may expect from a HIS. Table 3 also constitutes our proposed framework variables.

The users are asked to express their importance of the variables using 5 point Likert scale, called as importance weight, given in Figure 6.

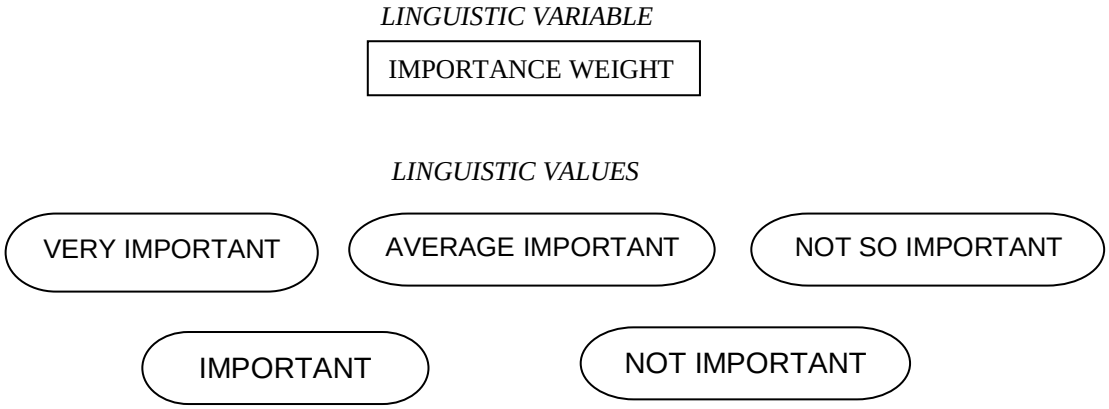

Figure 6. The importance fuzzy linguistic variable and its values

The users are asked to express their expectations using 5 point likert scale, called as expectation rating, given in Figure 7.

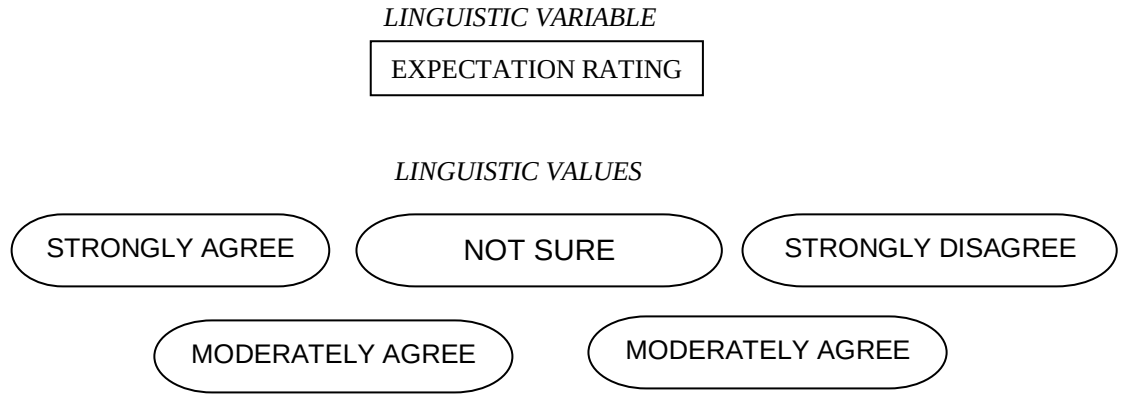

Figure 7. The expectation rating fuzzy linguistic variable and its values

Expectation ratings and importance weights are converted into fuzzy triangular numbers (fuzzified). Fuzzy numbers are used to compute the expectation meeting ratio (EMR). The linguistic values and the fuzzy numbers used in evaluation are given in Table 4. The importance fuzzy numbers are determined by the approach "Very important" is the maximum (1) and "Not important" is minimum (0) and the distance between them are equal. The expectation rating fuzzy numbers are determined by the approach "strongly agree" is the maximum (1) and "strongly disagree" is minimum (-1) and the distance between them are equal. The fuzzy numbers of the rating is between -1 and 1 while the fuzzy numbers of the importance is 0 and 1, the reason for the difference is negativeness of the disagreement ratings in the rating scales.

Table 4. Linguistic values and their corresponding fuzz numbers

Linguistic values for importance	**Fuzzy number**	**Linguistic values for rating**	**Fuzzy number**
Very important(W1)	0.75,1,1	strongly agree (R1)	0.5,1,1
Important (W2)	0.5,0,75,1	moderately agree (R2)	0, 0.5,1
Average important (W3)	0.25, 0.5,0.75	not sure (R3)	-0.5, 0, 0.5
Not so important (W4)	0, 0.25, 0.5	moderately disagree (R4)	-1, 0.5,0
Not important(W5)	0, 0, 0.25	strongly disagree (R5)	-1,-1,-0.5

The final importance weight, Wi , of an expectation variable i can be given as

$$W_i = \frac{1}{n} \sum_{k=1}^{n} W_k$$ where n is the number of users (Equation 2)

By aggregating the rating answers given by the users, the final rating of the expectation variable can be given as

$$R_i = \frac{1}{n} \sum_{k=1}^{n} R_k$$ where n is the number of users (Equation 3)

The expectation meeting ratio (EMR) can be obtained by the weighted average formula

$$EMR = \sum_{k=1}^{n} W_k R_k \Big/ \sum_{k=1}^{n} W_k \qquad \text{(Equation 4)}$$

In equations 1, 2, and 3 the addition and divisions are fuzzy operations.

Because the weights and the ratings are fuzzy numbers, the resulting EMR obtained by the formula 3 is also a fuzzy number. We need a crisp number to make a conclusion, so we need to defuzzify this fuzzy number. We obtain the crisp EMR by using Best Nun-fuzzy Performance, BNP given before in equation 1; to remember;

$$BNP = l + \frac{(u-l) + (m-l)}{3} \qquad \text{(Equation 1)}$$

The crisp EMR which we obtain by BNP do not mean anything to us with this form. So we must convert it to a form that will give us an idea. By using formula 2, 3 and 4 again we will determine the upper and lower BNP to convert the EMR into a %. The lower bound will be determined by what would be the BNP if all the ratings were the lowest (Strongly disagree) and the upper bound be determined by what would be the BNP if all the ratings were the highest (Strongly agree). Then we will ratio the EMR and get a number represented as %.

2.5 Analysis

SPSS 19.0 (Statistical Package for Social Sciences, SPSS Inc, Chicago, Illinois, USA) was used for statistical analysis.

The internal consistencies of the scales in the "Expectation Questionnaire" are measured by Cronbach´s Alpha coefficient. Cronbach´s Alpha greater than 0.70 is considered reliable.

Kolmogorov-Smirniv goodness of fit test is used for the fitness of variables to normal distribution. To examine the relation between nominal variables chi square test is used. For pairwise comparisons Mann Whitney U test, for comparison of three

or more groups Kruskal Wallis test is used. For Post-hoc test Mann Whitney U test is used and Bonferroni correction is made. The relation between numerical variables is examined by Spearman rho correlation test.

CHAPTER 3

RESULTS

3.1 Expectation Questionnaire

The distribution of users according to their assets, participating in the study in military hospital is given in Table 5-7.

In the military hospital 504 out of 660 questionnaires are returned by the users (response rate is 76.4%). The titles of the users in the military hospital participating in the study are 13.3% office workers, 7.3% laboratory technician, 3% biologist, 33.7% nurse, 35.7% physician and 6.4% other. Three users did not answer this question.

Table 5. The distribution of participant assets in the military hospital

Military Hospital				**Total: 504**	
Title		**Education**		**IS Experience**	
Officer workers	67	Primary	1	None	0
Laboratory Technician	37	Secondary	31	Inadequate	23
Biologist	15	University	459	Average	200
Nurse	170			Good	243
Physician	180			Advanced	30
Other	32				

Table 5(Cont.). The distribution of participant assets in the military hospital

Working Unit		**Attitude Towards change**		**Sex**	
Basic medicine	65	conservative	12	Women	255
Surgical medicine	164	open to change	319	Men	222
Internal medicine	223	depends	172		
Administrative	38				

The distribution of users according to their assets, participating in the study in the public hospital is given in Table 6. In the private hospital turnout number is 96 out of 100 (response rate is 96.0%). In private hospital these ratios are 5% officer workers, 27.1% nurse, 19.8 % Physician and 45.8% other.

Tha age interval in military hospital is between 21 and 59, mean is 34.15 and standart deviation is 6.74. In private hospital 17 and 70, mean is 32.61 and standart deviation is 10.49. In the university hospital 23 and 63, mean is 35.74 and standart deviation is 9.91.

Table 6. The distribution of participant assets in the private hospital

Private Hospital				**Total: 96**	
Title		**Education**		**IS Experience**	
Officer workers	5	Primary	1	None	0
Laboratory Technician	1	Secondary	29	Inadequate	3
Biologist	1	University	57	Average	27
Nurse	26			Good	51
Physician	19			Advanced	15
Other	44				
Working Unit		**Attitude Towards change**		**Sex**	
Basic medicine	11	conservative	2	Women	63
Surgical medicine	37	open to change	64	Men	23
Internal medicine	16	depends	30		
Administrative	19				

The distribution of users according to their assets, participating in the study in the university hospital is given in Table 7. In the university hospital turnout number is 65 out of 120 (response rate is 54.2%). In private hospital these ratios are 3.1 % officer workers, 12.3% nurse, 73.8 % Physician and 9.2% other.

In all hospitals majority of the users are university graduates (91.0 % in public hospital, 59.4% in private hospital and 100% in university hospital). Most of the users define themselves as having average and good IS experience.

Table 7. The distribution of participant assets in the university hospital

University Hospital					**Total: 96**
Title		**Education**		**IS Experience**	
Officer workers	2	Primary	-	None	0
Laboratory Technician	0	Secondary	-	Inadequate	10
Biologist	0	University	57	Average	36
Nurse	8			Good	17
Physician	48			Advanced	2
Other	6				
Working Unit		**Attitude Towards change**		**Sex**	
Basic medicine	0	conservative	3	Women	15
Surgical medicine	31	open to change	34	Men	40
Internal medicine	30	depends	26		
Administrative	0				

Table 8. Cronbach´s Alpha coefficients

	Importance	**Ratings**
Military	0.871	0.966
Private	0.942	0.959
University	0,907	0.972
Total	0.885	0.969

The Cronbach's alpha values of the questionnaires according to the hospitals are given in Table 8. All the Cronbach's alpha values are apparently high and greater than 0.700, showing the answers to questions are internally consistent.

3.2 EMR results

EMR results are examined in 3 stages: General EMR (Table 9), EMR result for Expectation Dimensions (Table 10) and EMR results for each of the expectation variable (Table 11-17). These results are given on different base such as user assets.

3.2.1 General EMR Results

Table 9. General EMRs

	Military	**Private**	**University**
Hospital general	**40.36**	**62.65**	**45.88**
TITLE			
Office worker	43.45	74.31	-
Nurse	39.07	60.30	51.08
Physician	36.12	68.75	45.17
Other	47.41	54.75	33.03
EDUCATION			
Secondary	55.17	63.74	42.54
University	39.04	61.42	44.69
IS EXPERIENCE			
Inadequate	46.21	75.32	46.69
Average	40.72	64.28	50.98
Good	38.97	64.88	36.42
Advanced	35.35	60.03	27.68
ATTITUDE TOWARDS CHANGE			
Conservative	49.89	-	-
Open	39.10	66.18	51.04
Depends	40.60	60.02	41.17
WORKING UNIT			
Basic medicine	43.81	74.09	-
Surgical medicine	38.90	60.15	41.03
Internal medicine	39.38	63.32	52.32
Administrative	38.52	65.17	-
SEX			
Men	38.72	67.61	43.57
Women	40.96	61.26	48.94

Table 9 gives the general EMR results. Table 10 gives EMR results for expectation dimensions and EMR results for each of the expectation variable. In the military hospital, System and Data Expectations dimension has the highest EMR by 48.65% whereas the highest is the Improvement Expectations in the private hospital by 67.94% and university hospital by 56.65%. Usage Expectations dimension has the lowest EMR ratios in all; 27.89% in the military, 56.77% in the private and 40.36% in the university. Expectation variable Speed has the lowest EMR in both military and private by 20.86% and 49.95% respectively. Interoperability is the lowest in the university by 35.02%. Whereas Security has the highest EMR by 62.96% in the military; Improve Service Quality has the highest EMR by 76.47% in the private hospital; Decreasing Work load is the highest in the university by 61.84%.

Table 10. EMR results for expectation dimensions

	Military		Private		University	
	BNP	EMR (%)	BNP	EMR(%)	BNP	EMR(%)
Usage Expectations	**-0.37**	**27.89**	**0.11**	**56.77**	**-0.16**	**40.36**
Ease of Use	-0.21	48.77	0.15	59.00	-0.53	46.79
Need for training	-0.01	49.63	0.20	62.20	0.12	56.92
Help Manuals	-0.06	46.63	0.14	58.12	-0.04	47.44
User support	-0.31	31.72	0.18	60.88	-0.06	46.11
Speed	-0.49	20.86	-0.01	49.95	-0.19	38.73
System and Data Expectations	**-0.02**	**48.65**	**0.23**	**63.91**	**-0.14**	**41.41**
Consistency	-0.28	48.28	0.23	63.52	-0.12	42.94
Privacy	0.14	58.07	0.24	64.11	-0.01	49.45
Security	0.22	62.96	0.34	70.63	-0.11	43.67
Availability	-0.20	38.23	0.19	61.12	-0.15	41.11
Interoperability	-0.19	38.42	0.17	60.04	-0.25	35.02

Table 10(cont). EMR results for expectation dimensions

	Military		Private		University	
	BNP	EMR (%)	BNP	EMR(%)	BNP	EMR(%)
Improvement Expectations	**-0.22**	**36.56**	**0.30**	**67.94**	**0.11**	**56.65**
Improve Service Quality	-0.53	46.83	0.44	76.47	-0.20	38.25
Decreasing work load	- 0.27	33.82	0.31	68.39	0.20	61.84
Bringing Positive Change	-0.35	28.82	0.15	58.66	0.10	55.76
Managerial Expectations	**-0.10**	**44.29**	**0.18**	**61.01**	**-0.16**	**40.36**
Reporting Facilities	0.08	54.65	0.28	66.73	0.04	52.30
Decision support	-0.03	47.98	0.25	65.19	-0.03	49.80
Function Sufficiency	-0.17	40.05	0.13	57.81	0.08	54.96
Research Facilities	-0.26	34.28	0.07	54.08	-0.04	47.57
General	**-0.16**	**40.36**	**0.21**	**62.65**	**-0.06**	**45.88**

3.2.2 Detail EMR Results

Table 11-16 give the distribution of EMRs according to expectation variables for the user profiles given in Figure 2 where A is military hospital, B is private hospital and C is university hospital.

Table 11. Distribution of EMRs according to expectation variables for education asset

EDUCATION						
	Secondary			University		
	A	B	C	A	B	C
Ease of Use	59.04	56.77	-	48.22	58.40	45.55
Need for training	61.43	61.11	-	49.08	58.33	56.32
Help Manuals	64.71	59.43	-	45.59	56.47	47.11
User support	42.91	57.79	-	31.16	60.13	45.62
Speed	36.13	46.03	-	19.85	49.74	38.21
Function Sufficiency	58.87	57.59	-	39.17	55.44	42.95
Consistency	54.83	62.35	-	47.95	62.02	49.39
Privacy	65.00	65.00	-	57.65	61.84	42.45
Security	69.08	76.29	-	62.61	67.63	40.05
Availability	47.75	60.49	-	37.62	58.73	34.00
Interoperability	47.38	61.48	-	38.07	57.10	37.09
Improve Service Quality	60.89	80.93	-	46.24	73.20	60.40
Decreasing work load	54.00	65.74	-	32.28	66.43	54.77
Bringing Positive Change	47.25	51.77	-	27.61	58.64	50.79
Research Facilities	45.09	53.02	-	33.82	49.48	48.36
Reporting Facilities	63.12	65.28	-	54.47	64.07	53.68
Decision support	58.05	69.38	-	47.28	60.36	45.39

Table 12. Distribution of EMRs according to expectation variables for title asset

TITLE												
	Officer			Nurse			Physician			Other		
	A	B	C	A	B	C	A	B	C	A	B	C
Ease of Use	50.29	63.33	70.00	50.16	56.54	52.47	45.12	64.37	44.57	52.74	53.84	45.56
Need for training	54.19	54.00	80.00	47.16	65.60	65.00	43.91	61.76	55.00	64.15	65.11	46.67
Help Manuals	49.95	69.50	61.25	46.59	57.32	51.88	42.74	57.63	46.19	52.48	54.98	37.50
User support	31.52	73.00	76.25	31.69	55.67	45.31	29.71	70.13	45.33	36.13	46.03	46.25
Speed	28.21	62.00	65.00		37.12	43.75	18.91	64.47	36.06	25.39	36.44	41.50
Function Sufficiency	41.87	62.00	72.50	37.91	50.58	42.50	40.17	67.37	42.72	42.56	50.59	39.17
Consistency	43.33	72.00	72.50	50.04	64.42	55.63	46.34	62.89	49.68	52.45	56.58	36.67
Privacy	58.89	72.00	57.50	61.51	64.04	55.63	53.45	66.58	43.44	60.60	62.37	27.83
Security	63.18	75.50	66.25	61.34	71.15	48.75	63.31	64.87	40.27	65.76	67.91	32.50
Availability	38.82	50.00	36.67	34.73	51.15	38.33	36.25	72.98	35.48	48.88	54.50	28.89
Interoperability	38.69	74.00	60.00	38.45	55.90	35.00	35.63	64.56	39.13	44.86	51.54	31.67
Improve Service Quality	57.86	82.00	85.00	48.00	76.92	72.50	38.83	72.89	62.05	54.23	61.93	32.33
Decreasing work load	44.77	86.00	80.00	28.14	61.54	63.75	31.52	66.32	55.00	41.75	55.90	39.17
Bringing Positive Change	36.15	73.00	68.75	27.32	56.76	53.12	24.17	64.47	52.67	36.96	45.85	35.00
Research Facilities	39.74	73.00	80.00	33.29	48.81	53.75	30.45	56.45	48.80	40.83	46.76	37.08
Reporting Facilities	52.36	80.00	80.00	54.76	66.83	54.69	54.56	68.16	54.67	57.45	61.16	45.42
Decision support	47.44	70.67	80.00	48.30	62.95	48.33	45.67	70.53	48.33	53.50	56.29	29.44

Table 13. Distribution of EMRs according to expectation variables for IS Experience asset

IS EXPERIENCE												
	Inadequate			Average			Good			Advanced		
	A	B	C	A	B	C	A	B	C	A	B	C
Ease of Use	51.04	71.67	50.67	47.59	61.00	47.98	49.57	57.02	42.69	46.94	59.40	38.33
Need for training	52.86	70.00	53.00	50.36	62.31	58.06	47.82	62.50	58.82	55.67	59.29	40.00
Help Manuals	53.69	70.00	47.50	47.49	56.70	53.00	44.79	57.88	38.28	46.59	59.11	23.75
User support	39.08	58.33	50.75	32.77	61.76	50.29	30.48	61.26	36.87	27.33	58.50	23.75
Speed	21.48	60.00	32.50	22.34	50.00	45.11	19.92	48.14	27.21	15.17	54.00	55.00
Function Sufficiency	45.48	63.33	46.50	41.03	57.96	45.57	38.62	57.35	37.19	39.83	58.00	25.00
Consistency	55.93	83.33	58.00	49.14	63.33	52.00	47.74	64.09	41.18	37.33	58.00	32.50
Privacy	57.84	83.33	48.33	60.86	62.59	46.14	56.50	65.00	37.23	51.00	60.00	30.00
Security	67.37	77.50	48.33	62.36	70.37	44.29	63.02	71.67	32.79	62.67	66.17	23.75
Availability	48.67	77.78	34.81	37.79	60.86	38.29	38.33	61.32	29.61	33.78	57.38	25.00
Interoperability	42.55	75.00	46.67	38.96	58.52	41.48	38.29	61.88	27.29	30.95	54.52	30.00
Improve Service Quality	61.25	86.67	60.56	47.76	77.04	67.35	45.71	77.48	53.29	35.69	69.64	40.00
Decreasing work load	39.76	76.67	48.33	34.42	70.00	63.52	32.76	69.39	46.56	33.67	60.00	25.00
Bringing Positive Change	38.10	78.33	50.00	28.67	58.92	57.93	28.47	58.11	44.38	22.00	55.77	27.50
Research Facilities	40.25	52.50	45.00	33.83	51.50	55.49	34.42	54.99	42.19	28.41	55.96	30.00
Reporting Facilities	57.12	65.00	51.67	56.20	68.41	59.31	53.94	68.70	47.66	52.67	57.74	50.00
Decision support	47.14	56.67	51.11	48.63	66.91	54.26	47.40	67.85	32.08	49.66	55.08	35.00

Table 14. Distribution of EMRs according to expectation variables for Attitude Towards Change asset

ATTITUDE TOWARDS CHANGE									
	conservative			open			depends		
	A	B	C	A	B	C	A	B	C
Ease of Use	53.89	-	-	48.85	58.66	48.53	53.89	70.00	37.22
Need for training	52.50	-	-	51.52	64.59	62.94	52.50	65.00	40.00
Help Manuals	58.75	-	-	46.85	57.05	51.33	58.75	67.50	47.50
User support	36.04	-	-	30.28	62.23	47.34	36.04	67.50	50.00
Speed	35.19	-	-	20.32	52.27	43.59	35.19	65.00	31.67
Function Sufficiency	50.00	-	-	38.95	59.14	44.06	50.00	65.00	23.33
Consistency	54.17	-	-	46.83	65.38	50.15	54.17	75.00	53.33
Privacy	59.17	-	-	57.33	65.94	44.20	59.17	75.00	35.00
Security	64.58	-	-	61.89	71.13	43.18	64.58	65.00	36.67
Availability	50.83	-	-	37.84	62.89	37.30	50.83	50.00	32.22
Interoerability	40.30	-	-	38.09	63.22	40.00	40.30	68.33	56.67
Improve Service Quality	60.42	-	-	45.02	79.06	70.82	60.42	75.00	65.00
Decreasing work load	45.83	-	-	33.22	71.15	65.08	45.83	75.00	40.00
Bringing Positive Change	48.96	-	-	27.99	60.06	61.67	48.96	61.25	52.50
Research Facilities	48.13	-	-	33.23	56.51	55.76	48.13	65.00	40.00
Reporting Facilities	54.91	-	-	53.94	68.73	60.98	54.91	50.00	37.50
Decision support	48.61	-	-	47.10	64.32	50.20	48.61	51.67	43.33

Table 15. Distribution of EMRs according to expectation variables for Working Unit asset

	WORKING UNIT											
	Basic medicine			Surgical medicine			Internal medicine			Administrative		
	A	B	C	A	B	C	A	B	C	A	B	C
Ease of Use	53.26	61.33	-	48.83	56.35	43.08	48.04	61.47	50.36	43.53	59.66	-
Need for training	62.19	58.00	-	48.31	63.33	49.35	45.97	61.25	65.67	51.94	57.37	-
Help Manuals	50.31	70.75	-	46.03	52.85	48.08	45.53	58.91	49.07	48.00	55.69	-
User support	35.24	69.32	-	30.23	56.22	43.25	32.14	69.55	48.88	27.43	56.97	-
Speed	23.11	67.27	-	20.86	39.05	33.14	19.59	59.38	45.19	24.87	52.89	-
Function Sufficiency	42.33	68.18	-	41.59	54.05	34.83	38.86	59.06	51.38	35.00	56.32	-
Consistency	50.62	73.64	-	49.70	60.49	44.35	48.19	58.75	56.72	38.06	62.89	-
Privacy	60.00	74.55	-	57.78	62.57	45.17	58.42	57.81	42.33	53.60	60.53	-
Security	64.53	75.45	-	62.44	67.77	41.92	62.85	67.50	40.27	62.16	76.32	-
Availability	45.79	62.73	-	36.01	59.07	31.56	37.56	54.58	39.89	38.61	69.22	-
Interoperability	39.94	70.30	-	37.27	54.91	35.40	39.67	57.29	42.00	34.68	63.75	-
Improve Service Quality	51.00	79.09	-	42.74	77.92	56.30	46.88	66.56	68.53	55.71	78.24	-
Decreasing work load	37.62	77.27	-	30.31	63.19	49.46	33.29	69.56	64.00	40.26	75.00	-
Bringing Positive Change	31.42	66.36	-	25.13	57.34	47.59	29.59	57.66	58.88	30.27	59.56	-
Research Facilities	33.65	70.68	-	32.75	50.28	44.14	34.28	46.56	57.75	36.39	53.38	-
Reporting Facilities	54.62	75.45	-	56.51	63.82	52.67	54.53	68.67	58.83	47.69	68.33	-
Decision support	45.77	70.91	-	49.28	61.94	44.48	49.10	70.00	52.89	40.18	62.41	-

Table 16. Distribution of EMRs according to expectation variables for Sex asset

SEX						
	Men			Women		
	A	B	C	A	B	C
Ease of Use	47.75	58.12	44.48	50.27	57.50	51.16
Need for training	47.48	60.00	55.00	51.90	62.83	57.33
Help Manuals	45.87	55.98	43.62	47.22	57.71	53.81
User support	29.80	59.67	45.06	33.40	59.91	47.50
Speed	21.56	55.87	36.03	19.90	44.76	36.33
Function Sufficiency	39.91	64.13	42.95	39.27	54.84	43.67
Consistency	46.76	65.22	46.88	50.22	60.67	60.00
Privacy	55.05	63.91	42.25	61.10	63.41	43.00
Security	62.64	63.00	40.26	62.98	71.63	38.17
Availability	38.75	70.00	33.51	37.96	56.34	37.11
Interoperability	36.26	67.88	37.81	39.80	55.14	38.22
Improve Service Quality	43.57	79.09	57.57	49.78	74.67	68.21
Decreasing work load	35.17	70.23	52.63	32.33	66.37	61.33
Bringing Positive Change	27.90	67.73	51.01	29.26	52.71	53.33
Research Facilities	33.90	67.98	47.11	34.49	48.54	56.00
Reporting Facilities	54.30	65.87	56.38	55.07	64.67	51.83
Decision support	47.60	65.80	44.47	48.48	64.29	52.44

Table 17-22 give the EMRs for expectation variable dimension which are Usage Expectations (UE), System and Data Expectations (SDE), Improvement Expectations (IE), Managerial Expectations (ME), and general EMRs according to user assets that may affect user expectations where

Table 17. Distribution of Expectation Dimension EMRs according to title asset

TITLE		Military	Private	University
Office worker	UE	33.68	64.12	-
	SDE	48.06	68.95	-
	IE	46.45	80.18	-
	ME	33.69	61.12	-
	General	45.56	74.31	-
Nurse	UE	26.40	51.83	46.90
	SDE	48.94	61.36	46.65
	IE	34.47	65.15	63.24
	ME	43.51	57.33	49.62
	General	39.07	60.30	51.08
Physician	UE	22.65	63.74	37.26
	SDE	46.06	66.42	41.52
	IE	31.58	68.00	56.58
	ME	42.72	65.58	48.68
	General	36.12	68.75	45.17
Other	UE	38.16	55.28	34.92
	SDE	54.27	63.85	31.42
	IE	44.41	68.17	35.56
	ME	48.64	59.94	38.02
	General	47.41	54.75	33.03

Table 18. Distribution of Expectation Dimension EMRs according to education asset

EDUCATION		**Military**	**Private**	**University**
Secondary	UE	48.85	54.27	-
	SDE	56.70	65.24	-
	IE	54.29	66.20	-
	ME	56.70	61.41	-
	General	55.17	63.74	-
University	UE	26.70	54.83	39.50
	SDE	48.20	61.48	40.52
	IE	35.43	66.21	55.32
	ME	43.71	57.39	47.63
	General	39.04	61.42	44.69

Table 19. Distribution of Expectation Dimension EMRs according to sex asset

SEX		**Military**	**Private**	**University**
Women	UE	29.13	54.76	33.89
	SDE	50.08	61.47	43.13
	IE	37.19	64.69	61.06
	ME	44.34	58.14	50.96
	General	40.96	61.26	48.94
Men	UE	26.87	56.62	36.10
	SDE	47.20	66.23	40.09
	IE	35.61	72.46	53.70
	ME	43.99	65.99	47.81
	General	38.72	67.61	43.57

Table 20. Distribution of Expectation Dimension EMRs according to IS Experience asset

IS EXPERIENCE		**Military**	**Private**	**University**
Inadequate	UE	32.79	66.45	37.89
	SDE	54.14	79.52	46.87
	IE	46.62	80.57	52.76
	ME	47.66	59.14	48.57
	General	46.21	75.32	46.69
Average	UE	29.15	57.22	46.29
	SDE	49.39	63.20	44.32
	IE	37.07	68.75	63.04
	ME	44.99	61.19	53.57
	General	40.72	64.28	50.98
Good	UE	26.23	55.906	29.12
	SDE	48.22	64.81	33.75
	IE	35.67	68.50	48.04
	ME	43.60	62.31	39.93
	General	38.97	64.88	36.42
Advanced	UE	25.28	56.74	28.51
	SDE	41.83	59.18	27.99
	IE	30.70	61.79	31.17
	ME	42.77	56.66	34.59
	General	35.35	60.03	27.68

Table 21. Distribution of Expectation Dimension EMRs according to Working Unit asset

WORKING UNIT		**Military**	**Private**	**University**
Basic medicine	UE	35.81	71.41	-
	SDE	51.87	74.30	-
	IE	40.09	71.23	-
	ME	44.13	65.54	-
	General	43.81	74.09	-
Surgical medicine	UE	27.70	50.46	33.49
	SDE	48.13	60.99	39.63
	IE	32.79	66.33	51.08
	ME	45.00	57.50	43.97
	General	38.90	60.15	41.03
Internal medicine	UE	25.50	62.14	47.86
	SDE	48.66	59.25	44.53
	IE	36.63	63.63	63.86
	ME	44.26	61.14	55.28
	General	39.38	63.32	52.32
Administrative	UE	27.93	54.39	-
	SDE	44.97	66.64	-
	IE	42.32	71.20	-
	ME	39.94	60.35	-
	General	38.52	65.17	-

Table 22. Distribution of Expectation Dimension EMRs according to Attitude Towards Change(ATC) asset

ATC		**Military**	**Private**	**University**
Conservative	UE	41.22	66.74	28.75
	SDE	53.92	67.12	42.18
	IE	51.83	69.88	51.40
	ME	50.32	57.97	35.31
	General	49.89	68.60	38.57
Open	UE	27.96	58.02	45.90
	SDE	47.80	65.72	42.99
	IE	35.45	70.21	65.89
	ME	43.34	62.24	52.83
	General	39.10	66.18	51.04
Depends	UE	26.93	52.90	28.75
	SDE	49.75	60.01	42.18
	IE	37.33	63.14	51.40
	ME	45.59	58.69	35.31
	General	40.60	60.02	38.57

3.3 Examining the user assets that affect EMR

3.3.1 Results for General EMR

The relationship between the user assets and the general expectation is analyzed. The results of the analysis are given in Table 23.

Table 23. Results for General EMRs

User Asset	Groups	Median	25th-75th percentile	p
Education	Secondary	53.00	43.75 - 66.00	**0.000**
	University	46.00	40.00 - 53.00	
IS Experience	Inadequate	48.00	43.25 - 55.75	0.090
	Average	48.00	42.00 - 54.00	
	Good	46.00	40.00 - 53.00	
	Advanced	45.00	37.00 - 57.00	
Attitude Towards Change	Conservative	49.00	44.50 - 64.50	0.239
	Open to change	47.00	40.00 - 55.00	
	Depends	46.50	42.00 - 52.00	
Business Title	Office worker	48.00	42.00 - 57.00	**0.000***
	Laboratory Technician	47.50	43.75 - 57.25	
	Biologist	48.00	39.25 – 58.25	
	Nurse	47.00	42.00 - 52.00	
	Physician	44.00	38.00 - 64.00	
	Other	51.00	45.00 - 61.25	
Sex	Male	48.00	43.00 - 54.00	**0.011**
	Female	46.00	39.00 - 54.00	
Working Unit	Basic medicine	49.00	41.00 - 58.75	0.060
	Internal medicine	46.00	42.00 - 52.00	
	Surgical Medicine	46.00	40.00 - 53.00	
	Administrative Unit	50.00	42.00 – 57.25	

* Other's EMR is greater than nurse's and Physician's EMR ($p<0.05$).

It is seen in Table 23 there is a statistically significant difference for Education, Business Title and Sex ($p<0.05$). Secondary graduate users' EMR are

greater than University graduate users', Other's EMR is greater than Nurse's EMR, Other's EMR is greater than Physician's EMR and Men's EMR is greater than Women's EMR.

3.3.2 Results for Expectation Dimension's EMR

Table 24. Results for Usage Expectations EMRs

User Asset	Groups	Median	25th-75th percentile	p
Education	Secondary	48.50	42.80 - 61.50	**0.000**
	University	44.91	36.12 - 51.86	
IS Experience	Inadequate	46.82	42.51 - 53.14	0.352
	Average	45.32	38.01 - 54.41	
	Good	44.73	35.06 - 53.52	
	Advanced	44.98	32.51 - 53.58	
Attitude Towards Change	Conservative	50.00	39.02 - 63.12	0.205
	Open to change	45.45	35.95 - 55.16	
	Depends	44.87	37.82 - 50.35	
Business Title	Office worker	45.21	41.27 – 55.09	**0.002***
	Laboratory Technician	48.05	40.76 – 55.54	
	Biologist	45.23	39.50 – 57.84	
	Nurse	45.69	37.25 – 50.39	
	Physician	44.44	32.12 – 53.52	
	Other	48.64	41.49 – 58.95	
Sex	Male	45.76	38.84 – 53.61	**0.036**
	Female	44.50	33.53 – 52.97	
Working Unit	Basic medicine	46.74	41.21 – 57.02	0.120
	Internal medicine	45.52	36.96 – 52.42	
	Surgical Medicine	44.57	34.60 – 52.02	
	Administrative Unit	45.39	41.56 – 55.79	

* Other's Usage Expectations EMR is greater than nurse's and Physician's ($p<0.05$).

The second analysis about the relationship between the user assets and the Expectation dimensions' EMRs, which are Usage Expectations, System and Data Expectations, Improvement Expectations, Managerial Expectations.

The results of the analysis for Usage Expectations EMR are given in Table 24. It is seen in Table 24 There is a statistically significant difference for Education, Business Title and Sex ($p<0.05$). Secondary graduate users' Usage Expectations EMR are greater than University graduate users', Other's Usage Expectations EMR is greater than Nurse's EMR and Physician's EMR, Men's Usage Expectations EMR is greater than Women's EMR.

Table 25. Results for System and Data Expectations EMRs

User Asset	**Groups**	**Median**	**25th-75th percentile**	**p**
Education	Secondary	53.82	46.44 – 66.60	**0.000**
	University	47.92	42.69 – 58.21	
IS Experience	Inadequate	47.63	42.44 – 64.27	0.447
	Average	49.11	43.61 – 59.47	
	Good	48.37	42.89 – 58.14	
	Advanced	47.62	41.22 – 57.00	
Attitude Towards Change	Conservative	51.07	45.06 – 67.29	0.204
	Open to change	48.89	43.27 – 59.00	
	Depends	47.73	42.68 – 58.46	
Business Title	Office worker	49.11	43.28 – 58.57	**0.034***
	Laboratory Technician	49.00	44.32 – 64.62	
	Biologist	46.51	41.06 – 68.37	
	Nurse	48.26	43.27 – 57.86	
	Physician	47.65	41.90 – 57.59	
	Other	52.05	45.01 – 62.68	
Sex	Male	48.66	43.21 – 59.74	0.164
	Female	48.16	42.39 – 57.75	

Table 25(cont). Results for System and Data Expectations EMRs

Working Unit	Basic medicine	50.59	44.31 – 65.04	0.141
	Internal medicine	48.16	43.54 – 55.48	
	Surgical Medicine	48.07	42.38 – 59.27	
	Administrative Unit	50.51	42.72 – 59.13	

* Other's System and Data Expectations EMR is greater than nurse's and Physician's ($p<0.05$).

The results of the analysis for System and Data Expectations EMR are given in Table 25. It is seen in Table 25 There is a statistically significant difference for Education, and Business Title ($p<0.05$). Secondary graduate users' System and Data Expectations EMR is greater than University graduate users', Other's System and Data Expectations EMR is greater than Nurse's EMR and Physician's EMR.

Table 26. Results for Improvement Expectations EMRs

User Asset	**Groups**	**Median**	**25th-75th percentile**	**p**
Education	Secondary	58.90	44.60 – 68.25	**0.000**
	University	43.29	32.12 – 54.20	
IS Experience	Inadequate	46.59	41.20 – 61.74	0.154
	Average	45.25	36.49 – 57.02	
	Good	43.96	32.12 – 57.01	
	Advanced	41.85	28.90 – 61.39	
Attitude Towards Change	Conservative	51.07	41.71 – 69.00	0.107
	Open to change	44.51	32.27 – 61.18	
	Depends	44.05	34.87 – 54.34	
Business Title	Office worker	49.09	39.64 – 63.75	**0.000***
	Laboratory Technician	45.98	39.21 – 59.76	

Table 26(cont.). Results for Improvement Expectations EMRs

	Biologist	41.83	27.43 – 57.95	
	Nurse	44.48	35.69 – 49.66	
	Physician	41.31	29.68 – 55.01	
	Other	53.31	41.81 – 67.70	
Sex	Male	45.02	37.03 – 55.79	0.111
	Female	42.71	30.67 – 57.51	
Working Unit	Basic medicine	43.87	33.46 – 63.59	**0.012**
	Internal medicine	44.09	34.87 – 54.04	
	Surgical Medicine	43.91	32.12 – 55.01	
	Administrative Unit	51.07	40.29 – 65.14	

* Other's Improvement Expectations EMR is greater than nurse's and Physician's ($p<0.05$).

The results of the analysis for Improvement Expectations EMR are given in Table 26. It is seen in Table 26 There is a statistically significant difference for Education, and Business Title and Working Unit ($p<0.05$). Secondary graduate users' Improvement Expectations EMR is greater than University graduate users', Other's Improvement Expectations EMR is greater than Nurse's EMR and Physician's EMR, Administrative Unit users' Improvement Expectations EMR are greater than Surgical Medicine users' and Internal medicine users'.

The results of the analysis for Managerial Expectations EMR are given in Table 27. It is seen in Table 27 There is a statistically significant difference for Education ($p<0.05$). Secondary graduate users' Managerial Expectations EMR is greater than University graduate users'.

Table 27. Results for Managerial Expectations EMRs

User Asset	**Groups**	**Median**	**25th-75th percentile**	**p**
Education	Secondary	56.94	48.00 – 71.53	**0.000**
	University	48.12	41.93 – 59.42	
IS Experience	Inadequate	48.70	42.49 – 61.06	0.050
	Average	49.41	43.92 – 63.59	
	Good	48.12	42.02 – 59.46	
	Advanced	49.11	41.26 – 63.94	
Attitude Towards Change	Conservative	44.98	40.06 – 62.59	0.229
	Open to change	48.21	41.75 - 60.49	
	Depends	49.50	44.92 – 63.19	
Business Title	Office worker	50.85	43.07 – 62.53	0.464
	Laboratory Technician	52.48	42.02 – 63.59	
	Biologist	48.01	38.60 – 64.56	
	Nurse	48.12	44.34 – 58.11	
	Physician	48.29	41.27 – 62.37	
	Other	51.47	43.82 – 63.94	
Sex	Male	49.15	53.74 – 59.42	0.341
	Female	48.43	41.36 – 62.11	
Working Unit	Basic medicine	50.57	41.93 – 63.59	0.951
	Internal medicine	48.66	44.04 – 59.22	
	Surgical Medicine	48.89	41.93 – 62.43	
	Administrative Unit	50.27	42.81 – 60.68	

3.3.3 Results for Expectation Variables' EMR

The results of the analysis for Ease of Use Expectations EMRs are given in Table 28.

Table 28. Results for Ease of Use Expectations EMRs

User Asset	**Groups**	**Median**	**25th-75th percentile**	**P**
Education	Secondary	59.00	39.50 – 76.25	**0.008**
	University	50.00	32.00 – 70.00	
IS Experience	Inadequate	52.50	34.00 – 70.00	0.934
	Average	50.00	35.00 – 70.00	
	Good	50.00	33.00 – 70.00	
	Advanced	50.00	30.00 - 76.25	
Attitude Towards Change	Conservative	55.00	32.50 – 77.50	0.785
	Open to change	50.00	32.00 – 70.00	
	Depends	50.00	35.00 – 68.00	
Business Title	Office worker	55.00	35.00 – 71.50	0.076
	Laboratory Technician	56.50	39.50 – 70.00	
	Biologist	60.00	37.00 – 70.00	
	Nurse	54.00	35.00 – 70.00	
	Physician	48.00	27.00 – 68.00	
	Other	55.00	37.00 – 70.00	
Sex	Male	55.00	37.00 – 70.00	0. 053
	Female	50.00	30.00 – 70.00	
Working Unit	Basic medicine	57.00	37.00 – 75.00	0. 311
	Internal medicine	50.00	35.00 – 65.00	
	Surgical Medicine	50.00	30.00 – 70.00	
	Administrative Unit	55.00	31.50 – 70.00	

It is seen in Table 28 there is a statistically significant difference for Education ($p<0.05$). Secondary graduate users' Ease of Use Expectations EMR is greater than University graduate users'.

The results of the analysis for Need for training Expectations EMR are given in Table 29.

Table 29. Results for Need for training Expectations EMRs

User Asset	**Groups**	**Median**	**25th-75th percentile**	**p**
Education	Secondary	80.00	50.00 – 80.00	0.223
	University	50.00	20.00 – 80.00	
IS Experience	Inadequate	65.00	20.00 – 80.00	0.190
	Average	50.00	20.00 – 80.00	
	Good	50.00	20.00 – 80.00	
	Advanced	80.00	50.00 – 80.00	
Attitude Towards Change	Conservative	50.00	20.00 – 80.00	0. 480
	Open to change	80.00	20.00 – 80.00	
	Depends	50.00	20.00 – 80.00	
Business Title	Office worker	50.00	20.00 – 80.00	**0.001***
	Laboratory Technician	80.00	20.00 – 80.00	
	Biologist	80.00	80.00 – 95.00	
	Nurse	50.00	20.00 – 80.00	
	Physician	50.00	20.00 – 80.00	
	Other	80.00	50.00 – 80.00	
Sex	Male	80.00	20.00 – 80.00	0. 216
	Female	50.00	20.00 – 80.00	
Working Unit	Basic medicine	80.00	50.00 – 80.00	0. 199
	Internal medicine	50.00	20.00 – 80.00	
	Surgical Medicine	50.00	20.00 – 80.00	
	Administrative Unit	80.00	20.00 – 80.00	

* Biologists' Need for training Expectations EMR is greater than Nurse and Physician ($p<0.05$).

It is seen in Table 29 There is a statistically significant difference for Business Title ($p<0.05$). However, no statistical significance could be found by pair wise comparisons.

Table 30. Results for Help Manuals Expectations EMRs

User Asset	**Groups**	**Median**	**25th-75th percentile**	**p**
Education	Secondary	63.00	46.00 – 80.00	**0.000**
	University	50.00	35.00 – 65.00	
IS Experience	Inadequate	50.00	36.75– 65.00	0.485
	Average	50.00	35.00 – 65.00	
	Good	50.00	27.00 – 65.00	
	Advanced	50.00	35.00 – 78.25	
Attitude Towards Change	Conservative	50.00	50.00 – 76.50	0. 343
	Open to change	50.00	35.00 – 73.00	
	Depends	50.00	35.00 – 65.00	
Business Title	Office worker	54.00	42.00 – 73.00	**0.046***
	Laboratory Technician	50.00	38.50 – 65.00	
	Biologist	37.00	20.00 – 80.00	
	Nurse	50.00	35.00 – 65.00	
	Physician	50.00	27.00 – 65.00	
	Other	50.00	42.00 – 73.00	
Sex	Male	50.00	35.00 – 65.00	0. 402
	Female	50.00	27.50 – 65.00	
Working Unit	Basic medicine	50.00	35.00 – 74.75	0. 208
	Internal medicine	50.00	35.00 – 65.00	
	Surgical Medicine	50.00	27.00 – 65.00	
	Administrative Unit	50.00	37.00 – 73.00	

* There is no statistically significance in pair-wise comparison for title. The smallest p is between Physician and other (0.105)

The results of the analysis for Help Manuals Expectations EMR are given in Table 30. It is seen in Table 30 there is a statistically significant difference for Education ($p<0.05$). Secondary graduate users' Help Manuals Expectations EMR is greater than University graduate users'.

Table 31. Results for User support Expectations EMRs

User Asset	**Groups**	**Median**	**25th-75th percentile**	**p**
Education	Secondary	50.00	35.00 – 65.00	**0.004**
	University	35.00	20.00 – 76.50	
IS Experience	Inadequate	36.00	21.75 – 68.75	0.847
	Average	35.00	20.00 – 58.00	
	Good	35.00	20.00 – 65.00	
	Advanced	30.00	20.00 – 50.00	
Attitude Towards Change	Conservative	47.50	20.00 – 69.25	0. 658
	Open to change	35.00	20.00 – 58.00	
	Depends	42.00	20.00 – 58.00	
Business Title	Office worker	27.50	20.00 – 65.00	**0.041***
	Laboratory Technician	35.00	20.00 – 56.00	
	Biologist	20.00	20.00 – 63.25	
	Nurse	35.00	20.00 – 50.00	
	Physician	35.00	20.00 – 65.00	
	Other	50.00	20.00 – 80.00	
Sex	Male	20.00	20.00 – 50.00	**0. 011**
	Female	25.00	20.00 – 62.50	
Working Unit	Basic medicine	35.00	20.00 – 80.00	0. 510
	Internal medicine	25.00	20.00 – 50.00	
	Surgical Medicine	20.00	20.00 – 50.00	
	Administrative Unit	35.00	20.00 – 65.00	

* Other's User support Expectations EMR is greater than nurse's and Physician's ($p<0.05$)

The results of the analysis for User support Expectations EMR are given in Table 31. It is seen in Table 31 there is a statistically significant difference for Education, Business Title and Sex ($p<0.05$). Secondary graduate users' User support Expectations EMR is greater than University graduate users', Other's User support Expectations EMR is greater than nurse's, Women's User support EMR is greater than Men's EMR.

Table 32. Results for Speed Expectations EMRs

User Asset	**Groups**	**Median**	**25th-75th percentile**	**p**
Education	Secondary	50.00	20.00 – 80.00	**0.001**
	University	20.00	20.00 – 50.00	
IS Experience	Inadequate	20.00	20.00 – 50.00	0.329
	Average	35.00	20.00 – 65.00	
	Good	20.00	20.00 – 50.00	
	Advanced	37.50	20.00 – 52.50	
Attitude Towards Change	Conservative	50.00	20.00 – 65.00	0. 695
	Open to change	25.00	20.00 – 50.00	
	Depends	35.00	20.00 – 50.00	
Business Title	Office worker	35.00	20.00 – 52.50	**0.007***
	Laboratory Technician	20.00	20.00 – 57.50	
	Biologist	35.00	20.00 – 50.00	
	Nurse	20.00	20.00 – 50.00	
	Physician	20.00	20.00 – 65.00	
	Other	50.00	20.00 – 80.00	
Sex	Male	42.00	20.00 – 58.00	0. 413
	Female	32.50	20.00 – 58.00	

The results of the analysis for Speed Expectations EMR are given in Table 32. It is seen in Table 32 there is a statistically significant difference for Education and Business Title ($p<0.05$). Secondary graduate users' Speed Expectations EMR is

greater than University graduate users', Other's Speed Expectations EMR is greater than nurse's.

Table 32 (cont.) Results for Speed Expectations EMRs

Working Unit	Basic medicine	42.00	20.00 – 71.00	0. 366
	Internal medicine	35.00	20.00 – 58.00	
	Surgical Medicine	35.00	20.00 – 58.00	
	Administrative Unit	42.00	20.00 – 67.00	

* Other's Speed Expectations EMR is greater than nurse's ($p<0.05$)

Table 33. Results for Consistency Expectations EMRs

User Asset	**Groups**	**Median**	**25th-75th percentile**	**p**
Education	Secondary	65.00	35.00 – 80.00	**0.038**
	University	50.00	35.00 – 50.00	
IS Experience	Inadequate	65.00	50.00 – 80.00	0.428
	Average	50.00	35.00 – 80.00	
	Good	50.00	25.00 – 80.00	
	Advanced	50.00	35.00 – 26.75	
Attitude Towards Change	Conservative	60.00	35.00 – 80.00	0. 824
	Open to change	50.00	35.00 – 80.00	
	Depends	50.00	35.00 – 80.00	
Business Title	Office worker	50.00	20.00 – 80.00	0. 200
	Laboratory Technician	65.00	20.00 – 80.00	
	Biologist	80.00	32.50 – 80.00	
	Nurse	50.00	35.00 – 80.00	
	Physician	50.00	20.00 – 65.00	
	Other	65.00	35.00 – 80.00	
Sex	Male	50.00	35.50 – 80.00	0. 278
	Female	50.00	32.50 – 80.00	

Table 33 (cont.) Results for Consistency Expectations EMRs

Working Unit	Basic medicine	65.00	25.00 – 80.00	0. 500
	Internal medicine	50.00	35.00 – 80.00	
	Surgical Medicine	50.00	20.00 – 80.00	
	Administrative Unit	50.00	35.00 – 80.00	

The results of the analysis for Consistency Expectations EMR are given in Table 33. It is seen in Table 33 there is a statistically significant difference for Education ($p<0.05$). Secondary graduate users' Consistency Expectations EMR is greater than University graduate users'.

Table 34. Results for Privacy Expectations EMRs

User Asset	**Groups**	**Median**	**25th-75th percentile**	**p**
Education	Secondary	75.00	50.00 – 80.00	**0.009**
	University	50.00	50.00 – 80.00	
IS Experience	Inadequate	55.00	50.00 – 76.25	0.460
	Average	65.00	40.00 – 80.00	
	Good	50.00	40.00 – 80.00	
	Advanced	50.00	50.00 – 80.00	
Attitude Towards Change	Conservative	65.00	35.00 – 80.00	0. 897
	Open to change	62.50	40.00 – 80.00	
	Depends	50.00	50.00 – 80.00	
Business Title	Office worker	65.00	40.00 – 80.00	**0.004***
	Laboratory Technician	50.00	45.00 – 80.00	
	Biologist	72.50	57.50 – 80.00	
	Nurse	65.00	50.00 – 80.00	
	Physician	50.00	40.00 – 80.00	
	Other	50.00	50.00 – 80.00	

Table 34 (cont.) Results for Privacy Expectations EMRs

Sex	Male	65.00	50.00 – 80.00	**0. 001**
	Female	50.00	40.00 – 80.00	
Working Unit	Basic medicine	65.00	50.00 – 80.00	0. 171
	Internal medicine	50.00	50.00 – 80.00	
	Surgical Medicine	50.00	40.00 – 80.00	
	Administrative Unit	55.00	40.00 – 80.00	

* Nurse's Privacy Expectations EMR is greater than Physician's ($p<0.05$)

The results of the analysis for Privacy Expectations EMR are given in Table 34. It is seen in Table 34 there is a statistically significant difference for Education and Business Title and Sex ($p<0.05$). Secondary graduate users' Privacy Expectations EMR is greater than University graduate users', Other's Privacy Expectations EMR is greater than nurse's and Men's Privacy Expectations EMR is greater than Women's

The results of the analysis for Security Expectations EMR are given in Table 35.

Table 35. Results for Security Expectations EMRs

User Asset	**Groups**	**Median**	**25th-75th percentile**	**p**
Education	Secondary	80.00	65.00 – 83.50	**0.000**
	University	65.00	50.00 – 80.00	
IS Experience	Inadequate	67.50	50.00 – 80.00	0.753
	Average	65.00	50.00 – 80.00	
	Good	65.00	50.00 – 80.00	
	Advanced	70.50	50.00 – 83.50	
Attitude Towards Change	Conservative	73.00	34.50 – 80.00	0. 915
	Open to change	65.00	50.00 – 80.00	
	Depends	65.00	50.00 – 80.00	

Table 35 (cont.) Results for Security Expectations EMRs

Business Title	Office worker	65.00	50.00 – 80.00	0.160
	Laboratory Technician	73.00	58.00 – 80.00	
	Biologist	65.00	55.00 – 78.25	
	Nurse	70.00	50.00 – 80.00	
	Physician	65.00	50.00 – 75.00	
	Other	73.00	50.00 – 80.00	
Sex	Male	70.00	50.00 – 80.00	**0. 021**
	Female	65.00	50.00 – 75.00	
Working Unit	Basic medicine	73.00	58.00 – 80.00	0. 099
	Internal medicine	65.00	50.00 – 80.00	
	Surgical Medicine	65.00	50.00 – 80.00	
	Administrative Unit	73.00	52.25– 80.00	

It is seen in Table 35 there is a statistically significant difference for Education and Sex ($p<0.05$). The differences can be summarized as; Secondary graduate users' Security Expectations EMR is greater than University graduate users' and Men's Security Expectations EMR is greater than Women's

Table 36. Results for Availability Expectations EMRs

User Asset	**Groups**	**Median**	**25th-75th percentile**	**p**
Education	Secondary	60.00	33.00 – 80.00	**0.001**
	University	40.00	23.00 – 60.00	
IS Experience	Inadequate	50.00	33.00 – 60.00	0.537
	Average	40.00	27.00 – 60.00	
	Good	40.00	20.00 – 60.00	
	Advanced	40.00	27.75 – 67.50	
Attitude Towards Change	Conservative	50.00	28.50 – 75.00	0. 887
	Open to change	40.00	23.00 – 60.00	
	Depends	40.00	27.00 – 60.00	

Table 36 (cont.) Results for Availability Expectations EMRs

Business Title	Office worker	40.00	20.00 – 60.00	**0.000***
	Laboratory Technician	56.50	40.00 – 75.25	
	Biologist	55.00	28.50 – 80.00	
	Nurse	33.00	50.00 – 80.00	
	Physician	40.00	20.00 – 50.00	
	Other	50.00	23.00 – 60.00	
Sex	Male	40.00	23.00 – 60.00	0. 692
	Female	40.00	23.00 – 60.00	
Working Unit	Basic medicine	50.00	33.00 – 70.00	**0. 002****
	Internal medicine	40.00	23.00 – 60.00	
	Surgical Medicine	40.00	21.50 – 60.00	
	Administrative Unit	50.00	30.00 – 70.00	

*There is statistically significant difference between other and office workers, nurses, Physicians ($p<0.05$). Lab technicians are different from office workers ($p<0.05$).

** There is statistically significant difference between users working in basic medicine and surgical medicine, users working in internal medicine ($p<0.05$). Administrative unit users' Availability Expectations EMR is greater than Surgical Medicine users' ($p<0.05$).

It is seen in Table 36 there is a statistically significant difference for Education and Business Title and Working Unit ($p<0.05$). Secondary graduate users' Availability Expectations EMR is greater than University graduate users', Other's Availability Expectations EMR is greater than Office Worker's, Laboratory Technician's Availability Expectations EMR is greater than Nurse's, Other's Availability Expectations EMR is greater than nurse's and Physician's ($p<0.05$), Basic medicine users' Availability Expectations EMR is greater than Surgical Medicine users', Basic medicine users' Availability Expectations EMR is greater than Internal Medicine users', Administrative unit users' Availability Expectations

EMR is greater than Surgical Medicine users'.

The results for Interoperability Expectations EMR are given in Table 37.

Table 37. Results for Interoperability Expectations EMRs

User Asset	**Groups**	**Median**	**25th-75th percentile**	**p**
Education	Secondary	50.00	32.25 – 80.00	**0.000**
	University	41.50	23.00 – 50.00	
IS Experience	Inadequate	50.00	30.00 – 57.50	0.879
	Average	50.00	30.00 – 60.00	
	Good	43.00	23.00 – 60.00	
	Advanced	43.00	23.00 – 50.00	
Attitude Towards Change	Conservative	50.00	30.00 – 77.50	0. 496
	Open to change	50.00	23.00 – 60.00	
	Depends	40.00	30.00 – 50.00	
Business Title	Office worker	40.00	33.00 – 60.00	**0.009***
	Laboratory Technician	50.00	26.00 – 60.00	
	Biologist	50.00	30.00 – 70.00	
	Nurse	43.00	20.00 – 53.00	
	Physician	40.00	23.00 – 50.00	
	Other	50.00	40.00 – 70.00	
Sex	Male	50.00	23.00 – 60.00	0. 194
	Female	40.00	23.00 – 50.00	
Working Unit	Basic medicine	50.00	30.00 – 60.00	0. 163
	Internal medicine	41.50	20.00 – 52.25	
	Surgical Medicine	50.00	30.00 – 57.00	
	Administrative Unit	50.00	33.00 – 60.00	

* Other's Interoperability Expectations EMR is greater than Nurse's and Physician's ($p<0.05$)

It is seen in Table 37 there is a statistically significant difference for Education and Business Title ($p<0.05$). Secondary graduate users' Interoperability Expectations EMR is greater than University graduate users', Other's Interoperability Expectations EMR is greater than Nurse's and Physician's.

Table 38. Results for Improve Service Quality Expectations EMRs

User Asset	**Groups**	**Median**	**25th-75th percentile**	**p**
Education	Secondary	80.00	50.00 – 80.00	**0.000**
	University	50.00	35.00 – 80.00	
IS Experience	Inadequate	65.00	50.00 – 80.00	0. 239
	Average	65.00	40.00 – 80.00	
	Good	50.00	35.00 – 80.00	
	Advanced	62.50	42.50 – 80.00	
Attitude Towards Change	Conservative	65.00	50.00 – 80.00	0. 614
	Open to change	65.00	35.00 – 80.00	
	Depends	50.00	40.00 – 80.00	
Business Title	Office worker	65.00	50.00 – 80.00	**0. 016***
	Laboratory Technician	65.00	50.00 – 80.00	
	Biologist	50.00	20.00 – 80.00	
	Nurse	50.00	38.75 – 80.00	
	Physician	50.00	25.00 – 80.00	
	Other	65.00	50.00 – 80.00	
Sex	Male	60.00	50.00 – 80.00	0. 341
	Female	50.00	35.00 – 80.00	
Working Unit	Basic medicine	65.00	35.00 – 80.00	0. 078
	Internal medicine	50.00	35.00 – 80.00	
	Surgical Medicine	50.00	35.00 – 80.00	
	Administrative Unit	65.00	50.00 – 80.00	

* Other's Improve Service Quality Expectations EMR is greater than Physician's ($p<0.05$)

The results of the analysis for Improve Service Quality Expectations EMR are given in Table 38. It is seen in Table 38 there is a statistically significant difference for Education and Business Title ($p<0.05$). Secondary graduate users' Improve Service Quality Expectations EMR is greater than University graduate users', Other's Improve Service Quality Expectations EMR is greater than Physician's.

The results of the analysis for Decreasing work load Expectations EMR are given in Table 39.

Table 39. Results for Decreasing work load Expectations EMRs

User Asset	**Groups**	**Median**	**25th-75th percentile**	**p**
Education	Secondary	80.00	50.00 – 80.00	**0.000**
	University	50.00	20.00 – 80.00	
IS Experience	Inadequate	50.00	20.00 – 72.50	0. 489
	Average	50.00	20.00 – 80.00	
	Good	50.00	20.00 – 80.00	
	Advanced	50.00	25.00 – 80.00	
Attitude Towards Change	Conservative	50.00	20.00 – 80.00	**0. 012***
	Open to change	50.00	20.00 – 80.00	
	Depends	50.00	20.00 – 72.50	
Business Title	Office worker	50.00	20.00 – 80.00	**0. 000****
	Laboratory Technician	50.00	20.00 – 80.00	
	Biologist	50.00	23.75– 80.00	
	Nurse	35.00	20.00 – 65.00	
	Physician	50.00	20.00 – 80.00	
	Other	65.00	50.00 – 80.00	
Sex	Male	50.00	20.00 – 80.00	0. 083
	Female	50.00	20.00 – 80.00	

Table 39 (cont.) Results for Decreasing work load Expectations EMRs

Working Unit	Basic medicine	50.00	20.00 – 80.00	**0. 007*** **
	Internal medicine	50.00	20.00 – 80.00	
	Surgical Medicine	50.00	20.00 – 80.00	
	Administrative Unit	75.00	50.00 – 80.00	

*Users who describe themselves as open to change has greater Decreasing work load Expectations than that of who describe themselves as open depending on the change ($p<0.05$)

** Office Worker's Decreasing work load Expectations EMR is greater than Nurse's, Biologist's Decreasing work load Expectations EMR is greater than Physician's Other's Availability Expectations EMR is greater than Nurse's, ($p<0.05$)

** Administrative unit users' Decreasing work load Expectations EMR is greater than Surgical Medicine users', Administrative unit users' Decreasing work load Expectations EMR is greater than Internal Medicine users' ($p<0.05$)

It is seen in Table 39 there is a statistically significant difference for Education, Attitude Towards Change, Business Title and Working Unit ($p<0.05$). Secondary graduate users' Decreasing work load Expectations EMR is greater than University graduate users'.

The results of the analysis for Bringing Positive Change Expectations EMR are given in Table 40.

Table 40. Results for Bringing Positive Change Expectations EMRs

User Asset	**Groups**	**Median**	**25th-75th percentile**	**p**
Education	Secondary	58.00	29.25– 80.00	**0.001**
	University	35.00	20.00 – 58.00	
IS Experience	Inadequate	50.00	20.00 – 73.00	0. 322
	Average	42.00	20.00 – 58.00	
	Good	35.00	20.00 – 62.25	
	Advanced	50.00	25.00 – 73.00	

Table 40 (cont.) Results for Bringing Positive Change Expectations EMRs

Attitude Towards Change	Conservative	50.00	20.00 – 76.50	0. 108
	Open to change	42.00	20.00 – 65.00	
	Depends	35.00	20.00 – 53.00	
Business Title	Office worker	50.00	20.00 – 67.00	**0. 0012***
	Laboratory Technician	27.00	17.50 – 72.50	
	Biologist	42.00	23.75– 80.00	
	Nurse	35.00	20.00 – 50.00	
	Physician	42.00	20.00 – 65.00	
	Other	50.00	26.00 – 79.00	
Sex	Male	35.00	20.00 – 58.00	0. 411
	Female	42.00	20.00 – 65.00	
Working Unit	Basic medicine	35.00	20.00 – 78.00	0. 326
	Internal medicine	42.00	20.00 – 58.00	
	Surgical Medicine	35.00	20.00 – 58.00	
	Administrative Unit	50.00	21.50 – 73.00	

* Other's Bringing Positive Change Expectations EMR is greater than Nurse's ($p<0.05$).

It is seen in Table 40 there is a statistically significant difference for Education and Business Title ($p<0.05$). Secondary graduate users' Bringing Positive Change Expectations EMR is greater than University graduate users' and Other's Bringing Positive Change Expectations EMR is greater than Nurse's.

The results of the analysis for Research Facilities Expectations EMR are given in Table 41.

Table 41. Results for Research Facilities Expectations EMRs

User Asset	**Groups**	**Median**	**25th-75th percentile**	**p**
Education	Secondary	50.00	30.00 – 80.00	**0.016**
	University	50.00	20.00 – 50.00	
IS Experience	Inadequate	50.00	20.00 – 65.00	0. 322
	Average	50.00	20.00 – 50.00	
	Good	50.00	20.00 – 58.00	
	Advanced	50.00	25.00 – 65.00	
Attitude Towards Change	Conservative	50.00	20.00 – 80.00	0. 697
	Open to change	50.00	20.00 – 60.00	
	Depends	50.00	20.00 – 50.00	
Business Title	Office worker	50.00	20.00 – 59.50	**0. 035***
	Laboratory Technician	50.00	20.00 – 50.00	
	Biologist	50.00	20.00 – 61.25	
	Nurse	50.00	20.00 – 50.00	
	Physician	42.00	20.00 – 58.00	
	Other	50.00	42.00 – 73.00	
Sex	Male	50.00	20.00 – 50.00	0. 643
	Female	50.00	20.00 – 58.00	
Working Unit	Basic medicine	50.00	20.00 – 65.00	0. 414
	Internal medicine	42.00	20.00 – 50.00	
	Surgical Medicine	50.00	20.00 – 50.00	
	Administrative Unit	50.00	20.00 – 58.00	

* Other's Research Facilities Expectations EMR is greater than Nurse's and Physician's ($p<0.05$).

It is seen in Table 41 there is a statistically significant difference for Education and Business Title ($p<0.05$). Secondary graduate users' Research

Facilities Expectations EMR is greater than University graduate users' and Other's Research Facilities Expectations EMR is greater than Nurse's and Physician's.

Table 42. Results for Reporting Facilities Expectations EMRs

User Asset	**Groups**	**Median**	**25th-75th percentile**	**p**
Education	Secondary	65.00	50.00 – 80.00	**0.014**
	University	58.00	50.00 – 73.00	
IS Experience	Inadequate	50.00	42.00 – 70.00	0. 467
	Average	65.00	50.00 – 76.75	
	Good	58.00	50.00 – 78.00	
	Advanced	58.00	46.00 – 80.00	
Attitude Towards Change	Conservative	50.00	36.75– 73.00	0. 569
	Open to change	58.00	50.00 – 80.00	
	Depends	58.00	50.00 – 73.00	
Business Title	Office worker	58.00	50.00 – 73.00	0. 916
	Laboratory Technician	65.00	50.00 – 78.25	
	Biologist	59.00	50.00 – 73.00	
	Nurse	58.00	42.00 – 80.00	
	Physician	58.00	50.00 –80.00	
	Other	61.50	42.00 – 73.00	
Sex	Male	58.00	50.00 – 73.00	0. 919
	Female	58.00	50.00 – 78.00	
Working Unit	Basic medicine	58.00	50.00 – 75.75	0. 980
	Internal medicine	58.00	50.00 – 73.00	
	Surgical Medicine	58.00	42.00 – 80.00	
	Administrative Unit	58.00	44.25– 78.50	

The results of the analysis for Reporting Sufficiency Expectations EMR are given in Table 42. It is seen in Table 42 there is a statistically significant difference

for Education ($p<0.05$). Secondary graduate users' Reporting Facilities Expectations EMR is greater than University graduate users'.

Table 43. Results for Decision support Expectations EMRs

User Asset	**Groups**	**Median**	**25th-75th percentile**	**p**
Education	Secondary	70.00	50.00 – 80.00	**0.000**
	University	50.00	30.00 – 70.00	
IS Experience	Inadequate	50.00	40.00 – 57.50	0. 335
	Average	50.00	46.50 – 80.00	
	Good	50.00	30.00 – 72.50	
	Advanced	50.00	33.00 – 80.00	
Attitude Towards Change	Conservative	50.00	35.00– 55.00	0. 399
	Open to change	50.00	30.00 – 80.00	
	Depends	50.00	50.00 – 77.50	
Business Title	Office worker	50.00	40.00 – 73.00	0. 131
	Laboratory Technician	50.00	50.00 – 80.00	
	Biologist	50.00	20.00 – 80.00	
	Nurse	50.00	40.00 – 70.00	
	Physician	50.00	30.00 – 70.00	
	Other	55.00	50.00 – 80.00	
Sex	Male	50.00	40.00 – 80.00	0. 132
	Female	50.00	30.00 – 70.00	
Working Unit	Basic medicine	50.00	30.00 – 80.00	0. 844
	Internal medicine	50.00	40.00 – 70.00	
	Surgical Medicine	50.00	40.00 – 80.00	
	Administrative Unit	50.00	50.00– 73.00	

The results of the analysis for Decision support Expectations EMR are given in Table 43. It is seen in Table 43 there is a statistically significant difference for

Education (p<0.05). Secondary graduate users' Decision support Expectations EMR is greater than University graduate users'.

Table 44. Results for Function Sufficiency Expectations EMRs

User Asset	**Groups**	**Median**	**25th-75th percentile**	**p**
Education	Secondary	65.00	35.00 – 80.00	**0.000**
	University	50.00	20.00 – 65.00	
IS Experience	Inadequate	50.00	20.00 – 80.00	0. 199
	Average	50.00	20.00 – 65.00	
	Good	50.00	20.00 – 65.00	
	Advanced	50.00	27.50 – 80.00	
Attitude Towards Change	Conservative	50.00	20.00– 80.00	0. 798
	Open to change	50.00	20.00 – 65.00	
	Depends	50.00	20.00 – 65.00	
Business Title	Office worker	50.00	20.00 – 80.00	**0. 019***
	Laboratory Technician	35.00	20.00 – 65.00	
	Biologist	50.00	20.00 – 80.00	
	Nurse	45.00	20.00 – 50.00	
	Physician	50.00	20.00 – 80.00	
	Other	50.00	23.75– 80.00	
Sex	Male	50.00	20.00 – 65.00	0. 227
	Female	50.00	20.00 – 80.00	
Working Unit	Basic medicine	50.00	20.00 – 80.00	0. 283
	Internal medicine	50.00	20.00 – 65.00	
	Surgical Medicine	35.00	20.00 – 65.00	
	Administrative Unit	50.00	20.00– 80.00	

* Other's Function Sufficiency Expectations EMR is greater than Nurse's (p<0.05).

The results of the analysis for Function Sufficiency Expectations EMR are given in Table 44. It is seen in Table 44 there is a statistically significant difference

for Education ($p<0.05$). Secondary graduate users' Function Sufficiency Expectations EMR is greater than University graduate users', Other's Function Sufficiency Expectations EMR is greater than Nurse's.

3.3.4 Examining the user asset AGE

Table 45. Age vs Expectation correlations

EMRs	p	r
Usage Expectations	0.678	-0.016
Ease of Use	0.448	-0.030
Need for training	0.347	-0.039
Help Manuals	0.135	0.060
User support	0.731	-0.014
Speed	**0.020***	0.110
System and Data Expectations	0.915	0.004
Consistency	0.425	0.032
Privacy	0.836	0.008
Security	0.511	-0.026
Availability	0.981	-0.001
Interoperability	0.393	-0.035
Improvement Expectations	0.679	0.016
Improve Service Quality	0.801	0.010
Decreasing work load	0.399	0.037
Bringing Positive Change	0.614	0.022
Research Facilities	0.751	-0.013
Managerial Expectations	0.262	-0.044
Reporting Sufficiency	0.506	-0.027
Decision support	**0.007***	-0.110
Function Sufficiency	0.709	-0.105
General	0.702	0.015

*Correlation is significant ($p<0.05$)

Table 45 gives the correlation table of the expectation vs AGE. In Table 45 it is seen that there is statistically significant correlation in Decision Support EMR and

Speed EMR for age. In Speed EMR there is positive correlation, as the age increases EMR increases, whereas in Decision support EMR there is negative correlation, as the age increases EMR decreases.

3.3.5 Summary of Section 3.3

In the research of "what user assets affect HIS EMR" we have found that there is no difference between users' working unit (WU), Attitude Towards Change (ATC) and IS Experience and Age. On the contrary users' sex, education and business title affect HIS EMR. We have seen that Men's expectations are met more than women's and secondary graduate users' expectations are met more than university graduate users'. As to title, we have six groups which are; Office workers, laboratory technicians, biologists, nurses, Physicians and others. The results show us "other" group differs from nurses and Physicians in the positive way, that is; other users' expectations are met more than nurses and Physicians. There is no difference between other groups.

When we examine the EMR ratios for the expectation dimensions (Usage Expectations, System and Data Expectations, Improvement Expectations and Managerial Expectations) in section 3.3.2, we have found differences;

- for *education* in all expectation dimensions;
- for *title* in Usage Expectations (UE), in System and Data Expectations (SDE), Improvement Expectations(IE);
- for *sex* in Usage Expectations (UE);
- for *working unit* in Improvement Expectations(IE);

In all dimensions EMRs for education secondary graduate users' expectations are met more than university graduate users'.

As in the general EMR, men's expectations are met more than women's in Usage Expectations EMR.

AS to *title*, "other" group differs from nurses and Physicians in the positive way in Usage Expectations, System and Data Expectations, Improvement Expectations that is; other users' expectations are met more than nurses and Physicians in EMR.

For *working unit,* Administrative Unit users' Improvement Expectation EMR are greater than Surgical Medicine users' and Internal medicine users'.

Table 46. Expectation differences on variable base (education)

User Asset	Relation	Proposed Framework variables
Education		
	secondary > university	
		Ease of Use
		Help Manuals
		User support
		Speed
		Consistency
		Privacy
		Security
		Availability
		Interoperability
		Improve Service Quality
		Decreasing work load
		Bringing Positive Change
		Research Facilities
		Reporting Sufficiency
		Decision support
		Function Sufficiency

The user assets affecting the expectations research in the base of framework variables given in section 3.3.3 can be summarized as follows.

- for education in all the variables' EMR except Need for training,
- for *ATC* in Decreasing work load,
- for *title* in Need for training, Help Manuals, User support, Speed, Consistency, Privacy, Availability, Interoperability, Improve Service Quality, Decreasing work load, Bringing Positive Change , Research Facilities;

- for *sex* in User support, Privacy, Security;
- for *working unit* in Availability, Decreasing work load there are differences.

The comparison of the groups for the expectation differences on variable base is given in Table 46-48.

Table 47. Expectation differences on variable base (title)

User Asset	**Relation**	**Proposed Framework variables**
Title		
	Other > Nurse	Need for training
		User support
		Speed
		Availability
		Interoperability
		Decreasing Work Load
		Bringing Positive Change
		Research Facilities
	Other > Physician	Need for training
		User support
		Availability
		Interoperability
		Improve Service Quality
		Research Facilities
	Biologist > Physician	Need for training
		Decreasing Work Load
	Biologist > Nurse	Need for training
	Nurse > Physician	Privacy
	Other > Office worker	Availability
	Laboratory t. > Nurse	Availability
	Office worker > Nurse	Decreasing work load

There is statistically significant correlation in Decision support EMR and Speed EMR for age. In Speed EMR there is positive correlation, as the age increases EMR increases, whereas in Decision support EMR there is negative correlation, as the age increases EMR decreases.

Table 48. Expectation differences on variable base (sex, WU,ATC)

User Asset	**Relation**	**Proposed Framework variables**
Sex		
	Men > Women	User support Privacy Security
Working unit		
	Adminisrative > Surgical	Decreasing Work Load Availability
	Adminisrative > Internal	Decreasing Work Load
	Basic > Surgical Basic > Internal	Availability Availability
ATC		
	Open > depends	Decreasing Work Load

CHAPTER 4

DISCUSSION

The importance of evaluation studies for HIS can be summarized by the word "You can't manage it, if you can't measure it" [81]. To improve the HIS, it must/should be evaluated from the time being started to be developed to the time taken out of operation, in short during the system's life cycle iteratively [10,82,83]. HIS evaluation also helps eliminate implementation problems by means of on-time interventions [29].

The literature seems to be aware of this importance by discussing the HIS evaluation frameworks largely. One can ask why many evaluation frameworks are proposed. The literature gives the answer by the definition of evaluation. Almost all the definitions of evaluation express that the evaluation takes place in a specified context, that is, it must focus on and evaluate it in great detail. When the managers, researchers and/or stakeholders cannot find answers to their questions about the HIS they want to evaluate in the existing frameworks, they develop their own goal specific framework as in our case.

Some of the existing frameworks are in the claim to be a generic and a whole system evaluation framework. As stated above, the definition of evaluation suggests the specified context should make the frameworks differ from each other. The more you become general, the more you miss the details. While trying to be generic, they fail to recognize situation and context specific factors of success and failure. For this reason our claim is evaluation should be more specific and done in very clearly defined borders. In this study we propose a new framework with a different approach

in scope. Instead of evaluating all the aspects of HIS, it focuses on one issue, user expectations from HIS, and evaluates it deeply.

User satisfaction is one of the most widely used indicators of success in IS research. DeLone and McLean's IS success model defines six dimensions of the IS success which are; organizational impacts, system quality, user satisfaction, information quality, system use, individual impacts [84]. The level of users' satisfaction has direct impact on system usage. So HIS end users must be the central part of the system. Evaluation must take into account their feelings, reactions and behavior. It is its users that make the system fully operational and again it is its users that make the system unfunctional. If the IS cannot satisfy its users, the users will not use the system anymore. If they think the system is "poor", it is not important whatever good virtues it has. Evaluation of information systems is in vane if the human factors are not in the center of the evaluation process [85].

Geer et al. define expectation as a belief about the probabilities associated with a future state of affairs [86]. In a survey of information systems about the factors that affects user satisfaction [53], "user expectations" is found as second in 33 items. Additionally, three (system quality, system use, user satisfaction) of the six dimensions of DeLone and McLean's IS success model are directly related with the user expectations from an IS. Szajna and Scamell set forth that unmet expectations create psychological discomfort concluding with the dissatisfied users and unused system [87].

The existing frameworks do not evaluate the extent that expectation of healthcare users are met by HIS. Some evaluates as a variable in the section of "user satisfaction" but we do not know to what extent a HIS meets the satisfied or dissatisfied user's expectations from a HIS. The purpose of the proposed framework is evaluating to what extent a HIS meets the end user expectations from a HIS.

The existing frameworks analyze the systems rather than evaluate them. There is no ratio or a grade or something concrete to make a decision on evaluated system. They do not give the opportunity to compare the systems because of the lack of previously mentioned comparable concrete output. The evaluation result in the proposed framework is a concrete numerical value. This numerical value can be

calculated for the whole HIS as well as for the each variable and for each end user assets. The evaluator can get the answer of the question "What is my HIS' expectation meeting ratio for nurses/Physicians/surgical medicine workers etc.?" by using our proposed evaluation framework.

Existing frameworks are criticized for not having been thoroughly tested [2]; some are conceptual, several of them have been used for pilot evaluations. Most of these were applied to one health information system as a case study. Our framework is applied to three HIS and to see the difference, it is applied to the HIS in different stages, that is one is newly deployed whereas two others are in routine use. All three hospitals are different types to see if the framework is applicable different types of hospitals.

Table 49. Existing Frameworks vs Proposed Framework variables

Framework	**Proposed Framework variables**
HOT-fit [44]	Decision support, Security, Speed, Availability
CHEATS [32]	Ease of use
TEAM [31]	Research Facilities
FITT [2]	Ease of use, Availability, Function Sufficiency
HTA [29]	Ease of use
Kushniruk SDLC [33]	Ease of use
Televaluation [26]	Decision support, Ease of use, Speed, Need for training
Design-reality gap model [39]	Decision support, Interoperability
ICT [40]	Ease of use, Decreasing workload, User support
PHR framework [41]	Decision support
CDS Framework [43]	Decision support
Interoperability Framework [42]	Interoperability
PRISM [45]	Interoperability

Our variables given in Table 1 are partly examined by the existing frameworks. Table 49 gives the existing frameworks vs. proposed framework intersection-comparison information. As we have given above, the dimensions and scope of the frameworks are different, that is they do not examine these variables in our scope and point of view. Our variables Help Manuals, Consistency, Privacy, Security, Improve service quality, Bringing Positive Change, Reporting Facilities are not evaluated and examined in any scope by evaluation frameworks.

The turnout is 76.4% for the military hospital and 96% for the private hospital. These ratios are considerably high. It can be interpreted as the evaluations are a great opportunity for users to express their feelings and problems to the management and IS staff. This can also be interpreted as because the framework is generated from the actual expectations of users, the evaluation process become more effective. In addition, users think that their ideas and thoughts are important for management. These ideas are taken into account for improving the system. This message given to the users also may help increase user acceptance and attention to the information system. This explains why the attendance to the evaluation is so high. If the evaluation is user centric, the number of users participating in the study becomes high as in our study.

All the frameworks treat equally to the dimensions and the variables they define. The importance or priority to the users/stakeholders/managers is not taken into consideration. This is a real handicap. Variables or dimensions should not be treated equally. This will cause a deviation in the study and evaluation. They should be represented in the result as the weight they have. In our proposed framework, each evaluation variable (Table 1) is represented in the evaluation result by the degree of its importance to the end users.

The difference of using weights in evaluation can be seen in the results easily. When we look at the "Usage Expectations", if the variables reflected equally in the result then the "Usage Expectation" EMR would be 39.52%, System and Data Expectations would be 49.19 %, Managerial Expectations would be 58.98% for the military hospital. When the weights are employed the values are 27.89%, 48.65%,

44.29 respectively. In the University Hospital "Usage Expectation" EMR would be 56.77%, Improvement Expectations would be 51.95%, Managerial Expectations would be 51.16 %. When the weights are employed the values are 40.36%, 56.65% and 40.36 respectively.

Although fuzzy logic applications/methodologies are used in HIS, they are not used while evaluating them in the evaluation frameworks. None of the existing frameworks employed fuzzy logic methodologies. The evaluated context in HIS is very appropriate for fuzzy logic methodologies. In the proposed framework, fuzzy logic methodologies are used, as a different approach and evaluation technique in HIS evaluation, to give us elasticity. Fuzzy logic is used when the boundaries are not clear. In linguistic variables such as Likert scale ratings, the context is very suitable for fuzzy logic operations, because they have ambiguity and multiplicity in meaning. So they are represented as a range of fuzzy numbers instead of crisp values. In rating based evaluations it is easier to express the ratings linguistically rather than using numbers. In that case problem of ambiguity could emerge as in the rating "Not sure", which has negative meaning as "a little Disagree", neutral meaning as "No idea" and also positive meaning as "a little Agree". This detail will be missed if we use crisp rating values. Fuzzy logic gives us the opportunity to take these blurred boundaries into consideration [78]. With this approach, we think that the framework become more realistic by covering uncertainty of the weights and ratings.

In the Military hospital, it is seen that the EMR's are considerably low. The HIS has been used for five months (newly deployed) when the framework was applied. This hospital is intentionally selected for case study to see the early post deployment evaluation results if the framework works when there are problems in HIS implementation. The literature tells us there are many difficulties in implementing a new HIS [88]. Some may be technical (frequent outages, speed problems etc.), some may be organizational or user centric (poor implementation planning, resistance to change etc.). With respect to these problems the expectations may be poorly met in a new adopted HIS at the beginning. These results can be interpreted as the framework works as intended.

The highest EMRs according to hospitals in expectation variable base give us another proof about the success of the framework. In the results it is seen that Security has the highest EMR by 62.96% in the military; Improve Service Quality has the highest EMR by 76.47% in the private hospital; Decreasing Work load is the highest in the university by 61.84%. The highest EMRs are compatible with the type of hospitals, where military has the security priority, private hospital has the service priority and university has the decrease in workload priority to save time for research.

Reliability is the degree of measurement being consistent and reproducible that shows the internal consistency. The results of tests in the hospitals show that the framework has a high reliability with 0.87-0.97 Cronbach´s Alpha coefficients, which is commonly used as a measure of the internal consistency or reliability of likert type studies. These results show that the framework is reliable.

The proposed framework can give detailed information to the evaluator. While it can be evaluated for a whole HIS, it can also be filtered according to user profiles. This elasticity gives us different opportunities. With these filtering options, new studies such as "What user characteristics can affect the expectations" may be performed as we have done and give the results as an another contribution of this study to the literature which is missing. The framework can also be customized according to evaluator's evaluation context. The expectations can be grouped differently (Table 1 gives our grouping). The EMR's can be computed for these new groups. Additionally it also enlightens the evaluator about lack of communication with user. If a variable is expected to give high EMR but the result is opposite, then we must seek the answer in communication. It means that either the users are not well aware of the systems that virtue or the information about that variable is faulty. The results can be used to give feedback to improve the HIS. They also can be used to trace the improvement of the system by applying the evaluation several times periodically by using the proposed framework. The weak and strong sides of the HIS can be analyzed on user expectations base.

Because there is no similar study in the literature, there is no acceptable threshold about the EMR for HIS. We do not propose either to the evaluators. This is left for the evaluator. This threshold depends on the context and situation. As in the military hospital example, for a newly adopted system it can be 40 something while 50 or 70 for another hospital management and maybe 90 for a high standard-like management. There can be a set of EMR targets such as for titles, for expectations dimensions, variables etc. For the military hospital security can be the highest target wheras privacy or improving service quality for the private hospital, research facilities for the University hospital. Sex appears to be another determinant in Usage Expectations dimension. The women want HIS to be more easy to use and functional.

Using proposed framework, determinants of user expectations that affect expectation meeting ratios is examined. With this study we examined seven user assets that can affect HIS user expectations, *Education, IS Experience, Age, Attitude towards change, Business title, Sex, Working Unit.* Education is examined as a nominal variable as primary, secondary, university graduate. Is Experience is examined as an ordinal variable as None, Inadequate, Average, Good and Advanced. Age is examined as numerical value. *Attitude towards change* is examined as nominal variable as Conservative, Open to change, Open depending on the change. Business title is examined as a nominal variable as Office workers, Nurse, Physician, Biologist, Laboratory Technician and Other. Other group is the titles that are other than the five values which are not many in number to be statistically significant such as dieticians, patient consultants(especially in private hospital), different types of technicians, physiotherapists etc. Sex is examined as nominal variable as men and women. Working unit is again examined as nominal variable as Administrative unit, Surgical Medicine, Internal Medicine and Basic Medicine which are four main departments of a hospital. The findings from this study are given in Conclusions part.

Using the newly developed and proposed framework in this study, we have tried to analyze the determinants of user expectations from HIS. By using the elasticity of the framework, beginning with the general EMR, the study is detailed by deepening into the, first user expectation dimensions, and then variables. To be

clearer, the framework can give detail to the each variable level. We can say that "education is a determinant of user expectation from HIS in general EMR. It is also a determinant in all expectation dimensions EMR. It is also a determinant for each of the expectation variables except for need for training". Because these results are just a photo of the current situation, a deeper analysis of these findings must be done for further information about the causes of these results.

The result of the statistical analysis shows us; Nurses and Physicians expect more than the group Other. These two groups of users are the main personnel in charge on the patient care. They want HIS to be more helpful for them while doing their work. Some functions maybe sufficient and suitable for many users, but it seems it is not for Nurses and Physicians. They expect more virtues from HIS. These comments also can be made for university graduate users. The results tell us the university graduate users expectations are poorly met when compared to secondary school graduate users.

The study of determinants of user expectations is an example of a wide array of studies that can be performed using such evaluation frameworks. The results of this study can be used for many purposes.

These results can be used both for improvement of the HIS evaluated as well as designing and implementing the new HIS'. The weak sides, that are the variables that have the lower/lowest EMRS, can be taken care of more carefully not to give users these handicaps again. The user groups that have lower EMRs can be thought and by examining the causes that makes them less happy can be eliminated by the true steps in the HIS.

By determining the user assets that affect expectations, managers can take some measures for the users that have lower EMRs. By examining the results carefully, the assets that give way to worsely met expectations can be treated more carefully. The expectations of this group can be tried to be managed. The factors that cause this situation can be studied more deeply. This can be both a new area of academic research and organizational target. The virtues and functions that can address these user groups of the HIS can be improved to make the EMRs higher for

these groups. These kinds of efforts and measures also will affect the overall EMR for all variables.

Nevo and Chan find in their study that managers are able to generate realistic expectations [89]. As the Ryker et al. put forth, if these groups' expectations from HIS are found unrealistic (very relative issue, so the management must be very careful to make this decision), the management can organize some committees and arrange interviews with these users to set realistic expectations [90]. As we have stated above, if there is problem with the communication (if a variable is expected to give high EMR but the result is low) then IS staff can organize on-site trainings and improve the communication channels with users.

Staples et al. state that for implementing a new information system, managing expectations is an important issue [56]. Their study showed us the adverse effects of unrealistically high expectations on success of the implementation of a new system. In the military hospital case study, unmanaged expectations that are unrealistically high may result in these low EMRs. Staples et al. recommend that managements develop strategies to keep the expectations in a realistic level [56].

As we have stated before, our study is the first to use fuzzy logic in HIS evaluation frameworks. In this study we have seen that use of fuzzy logic gives elasticity for evaluating the results. Using crisp values causes the loss of information for evaluation because of vagueness the Likert scales have. By using fuzzy logic, we use intervals that give us more realistic approach.

This framework is not a rival but might be an alternative or complementary to the existing frameworks. This is a different approach and a different point of view on the evaluation of Healthcare Information systems. It can be used as a complementary with the one or more existing frameworks to strengthen their deficiency about user expectations or it can be used as stand alone.

In conclusion, we developed a new framework to evaluate a HIS based on user expectations. It gives detailed information on each dimension of user expectations and it is supported by fuzzy logic on the background. Its application in some hospitals is promising and we believe that the framework will be a useful evaluation tool for HIS. Although we developed the framework for use in Hospitals

for HIS, it can easily be used for any other IS evaluation beyond health sector. It is flexible and with minor modifications, can be modified and can be a generic user expectation evaluation framework for any IS. The proposed framework promises us to provide with valuable data about HIS user expectations which can be used for many other studies.

Significance of the Study:

With this study we have contributed to the literature by;

- Possible user expectations from HIS,
- Determinants of medical user expectations from HIS,
- First use of Fuzzy logic in HIS evaluation frameworks,
- First user expectation focus in HIS evaluation frameworks,
- First concrete comparable output of HIS evaluation frameworks,
- A new HIS evaluation framework

Scope and Limitations:

User expectation is a hard and relative issue. It is not easy to study with user expectations. It can be changed from user to user and when the people change, the EMR of the HIS can be changed oppositely (especially possible for military hospital because of mandatory assignments of the personnel). The user's expectations are the determinant of the result. As stated above there is a wide array of things that would affect expectations. It is impossible to find the user's that have the same level of expectation. The expectation meeting extent can differ as the expectation level differs as the literature tells.

To make the EMR comparable, the same type of hospitals focusing on the same service, using exactly the same system should be selected. Otherwise we could compare the wrong items that cause a great deviation and completely wrong results. To compare the different types of hospitals a set of competent HIS users can be employed. By this application we can evaluate the same level of hospital's systems and then the comparison would be possible.

To apply the framework to see the site results, we had difficulties to get the necessary permissions. Especially for public hospitals of Ministry of health, there is a

long and hard way to go for this permission. There must be some regulations for academic researches in the governmental instutions.

Future Work:

To improve this study as a future work, the framework can be used to analyze if the hospital types makes any difference in the user expectations. To make this study, different types of hospitals using the same system must be examined. Otherwise if the systems are different, we can't make this study because it misleads us and gave way to wrong findings.

Another improvement can be made by the same set of competent users to evaluate different HIS'. This time the thing we must be careful about must be the systems should be different to these set of users. Otherwise the system that is familiar to the users most probably be the first to meet the expectations.

The possible user expectations from HIS can be extended according to the evaluator. For example, another dimension such as "Organizational Expectations" can be added to evaluate if the organizational expectations are met.

The possible user expectations from HIS can be ranked to determine the most important and less important expectations. Then the developers can show special interest to the utmost important expectations.

There is no proof that using fuzzy logic methods changes the evaluation result in this study. Using five point likert scale or seven point likert scale can be futherly analyzed if it makes any difference in the study. The results can be analyzed with and without using fuzzy logic methods and the change (if any) can be another further study subject.

CHAPTER 5

CONCLUSIONS

Using weights for variables changes the evaluation results. If we use mean values of variables to determine the expectation dimensions' EMR and general EMR, the result will be different from the model weights are used. The result can be affected both in negative or positive way depending on the weights assigned by the users.

Using concrete output, we easily see the weak and strong sides of the HIS. By determining the context suitable threshold, we can more easily spot the low percentages for EMRs than the existing frameworks' evaluation results.

In the study of the determinants of user expectations, results show us education, and business title is the determinant of user expectation from HIS. Education is found statistically different in general EMR and all of the expectation dimensions EMR whereas business title is different in general EMR and in three of the four expectation dimensions EMR. In business title, especially other group has differences over nurses and Physicians. Sex can be counted as another determinant by differing in general EMR and two of the four expectation dimensions. Working Unit is significantly different just for one expectation dimension EMR. Results also show us IS experience, age and ATC is not a determinant of user expectations by not differing statistically for any of the expectation dimension EMR and general EMR. As to expectation variable level, we have also statistically differences that can be useful for examining each variable one by one and for taking the steps for improvement of the HIS.

REFERENCES

[1] N.F. Keizer, E. Ammenwerth, "The quality of evidence in health informatics: How did the quality of healthcare IT evaluation publications develop from 1982 to 2005?", Int J Med Inf, 77, pp. 41–49, 2008.

[2] E. Ammenwerth, C. Iller, C. Mahler, "IT-adoption and the interaction of task, technology and individuals: a fit framework and a case study", BMC Medical Informatics and Decision Making, 6, pp. 1-13, 2005.

[3] Editorial,"Quantitative and qualitative approaches to information systems evaluation", European Journal of Operational Research 173, pp 951–956, 2006.

[4] C.A. Voss, "Managing advanced manufacturing technology", International Journal of Operations and Production Management, 6 (5), pp. 4–7,1986.

[5] C. Despont-Gros, H. Mueller, C. Lovis, "Evaluating user interactions with clinical information systems: A model based on human–computer interaction models", Journal of Biomedical Informatics, 38, pp. 244–255, 2005.

[6] M. Alshawi, "Rethinking IT in construction and engineering: organisational readiness", New York, Taylor & Francis, 2007.

[7] B. Hochstrasser, "Justifying IT investments". In: Wilcocks L. editor. Information management: The evaluation of information systems investments, London, Chapman&Hall, pp.151-171, 1994.

[8] J.E. Furubo, R. Sandahl, "A Diffusion Perspective on Global Developments in Evaluation", International Atlas of Evaluation, pp. 1–26. London:

[9] P. A Turunen, "Framework for evaluation of medical information systems", Studies in Health Technology and Informatics, 95, pp. 611–6, 2003.

[10] E. Ammenwerth, S. Gräber, G. Herrmann, T. Bürkle, J. König," Evaluation of health information systems—problems and challenges", International Journal of Medical Informatics 71, pp.125-135, 2003.

[11] E. Ammenwerth, J. Brender, P. Nykanen, H.-U. Prokosch, M. Rigby, J. Talmon, HIS-EVAL workshop participants. “Visions and strategies to improve evaluation of health information systems: reactions and lessons based on the HIS-EVAL workshop in Innsbruck.”, International Journal of Medical Informatics, 73(6), pp. 479-491,2004.

[12] R. Margoluis, C. Stem, N. Salafsky, M. Brown, “Using conceptual models as a planning and evaluation tool in conservation”, Evaluation and Program Planning 32, pp. 138–147, 2009.

[13] N.F. de Keizera, E. Ammenwerth,”The quality of evidence in health informatics: How did the quality of healthcare IT evaluation publications develop from 1982 to 2005?”, international journal of medical informatics 77, pp. 41–49, 2008.

[14] G. Phillips-Wren, M. Mora, G.A. Forgionne, J.N.D. Gupta,” An integrative evaluation framework for intelligent decision support systems”, European Journal of Operational Research, 195, pp.642–652, 2009.

[15] R. Stockdale, C. Standing,” An interpretive approach to evaluating information systems: A content, context, process framework”, European Journal of Operational Research, 173, pp. 1090–1102, 2006.

[16] M. Mohd. Yusof, R.J. Paul, L. Stergioulas, “Health information systems evaluation: a focus on clinical decision supports system”, in: Proceedings of the XIX International Congress of the European Federation for Medical Informatics (MIE2005), Geneva, Switzerland, pp. 855–860, 2005.

[17] C.P. Friedman, J.C. Wyatt, “Evaluation Methods in Medical Informatics“, Springer,pp.,89-117, 2005.

[18] M. Scriven, “Beyond formative and summative evaluation”, in: M.W. McLaughlin, E.C. Phillips (Eds.), Evaluation and Education: A Quarter Century, University of Chicago Press, Chicago, 1997

[19] P.B. Seddon, S. Staples, R. Patnayakuni, M. Bowtell, “Dimensions of Information Systems Success”, Commun Assoc Inform Syst 2(20), pp.1-20,1999.

[20] M.J. Succi, Z.D. Walter, ”Theory of user acceptance of information technologies: an examination of health care professionals”. 32nd ed. Maui Hawaii: Hawaii International Conference on System Science; 1999.

[21] E. Ammenwerth, F. Ehlers, R Eichstadter, R Haux, U Pohl, F Resch, ”Systems analysis in health care: framework and example.” , 41(2),pp.134-40,2002.

[22] C. Despont-Gros, H.Mueller, C. Lovis, "Evaluating user interactions with clinical information systems: A model based on human–computer interaction models", Journal of Biomedical Informatics 38, pp.244–255, 2005.

[23] F. Gremy, J.M. Fessler, M. Bonnin, "Information systems evaluation and subjectivity",International Journal of Medical Informatics, 56, pp. 13–23, 1999.

[24] M.Berg, "Patient care information systems and health care work: a sociotechnical approach", International Journal of Medical Informatics, 55, pp. 87–101, 1999.

[25] D.L. Goodhue, R.L. Thompson, "Task-technology fit and individual performance", MIS Quarterly, 19, pp. 213-236, 1995.

[26] A. Kushniruk, C. Patel, V.L. Patel, J.J. Cimino,"'Televaluation' of clinical information systems: an integrative approach to assessing Web-based systems", International Journal of Medical Informatics 61, pp. 45–70, 2001.

[27] B.Kaplan,"Evaluating informatics applications- some alternative approaches: theory, social interactionism, and call for methodological pluralism", International Journal of Medical Informatics, 64, pp. 39-56, 2001.

[28] J. G. Anderson, "Evaluation in health informatics: social network analysis", Computers in Biology and Medicine, 32, pp.179–193, 2002.

[29] A. Kazanjian, C.J. Green,"Beyond effectiveness: the evaluation of information systems using a comprehensive health technology assessment framework", Computers in Biology and Medicine, 32, pp. 165–177, 2002.

[30] D.R. Dixon, "The behavioral side of information technology International Journal of Medical Informatics", 56, pp. 117–129, 2002.

[31] A. Grant, I.Plante, F.Leblanc."The TEAM methodology for the evaluation of information systems in biomedicine", Computers in Biology and Medicine, 32, pp.195-207, 2002.

[32] N.T. Shaw, "CHEATS: a generic information communication technology (ICT) evaluation framework", Computers in Biology and Medicine, 32, pp. 209-220, 2002.

[33] A. Kushniruk,"Evaluation in the design of health information systems: application of approaches emerging from usability engineering", Computers in Biology and Medicine, 32 pp. 141–149, 2002.

[34] J.A. Effken, "Different lenses, improved outcomes: a new approach to the analysis and design of healthcare information systems", International Journal of Medical Informatics, 65, pp. 59–74, 2002.

[35] P.Littlejohns, J.C. Wyatt, L. Garvican, ”Evaluating computerised health information systems: hard lessons still to be learnt”, BMJ 326, pp. 860-863,2003.

[36] J.I. Westbrook, J. Braithwaite, R. Iedema, E.W. Coiera, “Evaluating the impact of information communication technologies on complex organizational systems: a multi-disciplinary, multi-method framework”, MEDINFO 2004,

[37] C. Despont-Gros, H. Mueller, C. Lovis,”Evaluating user interactions with clinical information systems: A model based on human-computer interaction models”, Journal of Biomedical Informatics, 38, pp. 244-255, 2005.

[38] M. Y. Yi, J. D. Jackson, J. S. Park, J. C. Probst, “Understanding information technology acceptance by individual professionals: Towards an integrative view”, Information and Management, 43, pp. 350-363, 2006.

[39] R.Heeks,”Health information systems: Failure, success and improvisation”, International Journal of Medical Informatics, 75, pp. 125-137,2006.

[40] L.K. Schaper, G.P. Pervan,”ICT and OTs: A model of information and communication technology acceptance and utilisation by occupational therapists”, International Journal of Medical Informatics, 76, pp 212-221, 2007.

[41] D. Johnston, D. Kaelber, E.C. Pan, D. Bu, S.Shah, J.M. Hook, B. Middleton,”A framework and approach for assessing the value of personal health records (PHRs)”, AMIA Annu Symp Proc. Pp. 374-378, 2007.

[42] J.A. Mykkanen, M.P. Tuomainen, “An evaluation and selection framework for interoperability standards”, Information and Software Technology, 50, pp. 76–197, 2008.

[43]A. Wright, D.F. Sittig ,”A framework and model for evaluating clinical decision support architectures”,,J Biomed Inform,41(6),pp.982-990,2008.

[44] M.M.Yusof, J.Kuljis, A. Papzafeiropoulou, L.K. Stergioulas,”An evaluation framework for Health Information Systems: human, organization and technology-fit factors (HOT-fit)”, International Journal of Medical Informatics, 77, pp.386-398, 2008.

[45] A. Aqil, T. Lippeveld, D. Hozumi, “PRISM framework: a paradigm shift for designing, strengthening and evaluating routine health information systems”, Health Policy and Planning 24(3), pp. 217-228, 2009.

[46] R. Cyert, J. March,” A behavioural theory of the 4rm”, Englewood Cli8s, NJ: Prentice-Hall, 1963

[47] A.L. Geers, P.E. Weiland, K. Kosbab, S.J. Landry, S.G. Helfer, "Goal activation, expectations, and the placebo effect", Journal of Personality and Social Psychology 89 (2) pp. 143–159, 2005.

[48] M. Maes, G. Poels," Evaluating quality of conceptual modelling scripts based on user perceptions", Data & Knowledge Engineering, 63, pp. 701–724, 2007.

[49] P. Seddon, "A respecification and extension of the DeLone and McLean model of IS success", Information Systems Research, 8 (3), pp. 240–253, 1997.

[50] M. Gelderman, "The relation between user satisfaction usage of information systems and performance", Information and Management, 34 (1), pp 11–18, 1998.

[51] B. Ives, M.H. Olson, J.J. Baroudi, "The measurement of user information satisfaction", Communications of the ACM 26 (10), pp 212-224, 1983.

[52] C. Safran P C Jones D. Rind, B. Bush , C N Cytryn , V L Patel, "Electronic communication and collaboration in a health care practice". Artif Intell Med,12(2), pp.137–51, 1998.

[53] D.W. Conrath, O.P. Mignen, "What is being done to measure user satisfaction with EDP/MIS", Information & Management, 9(I), pp. 7-1, 1990.

[54] A. Rushinek, S.E Rushinek, "What makes computer users happy?" Communications of the ACM, 29(7), pp. 594--598. 1986.

[55] D.S. Staples, I. Wong, P.B. Seddon," Having expectations of information systems benefits that match received benefits: does it really matter?" Information & Management, 40, pp.115–131, 2002.

[56] M.J. Ginzberg, "Early diagnosis of MIS implementation failure: Promising results and unanswered questions," Management Science, 27(4), pp. 459-478, 1981.

[57] B. Marcolin, "The impact of users' expectations on the success of information technology implementation", Dissertation Abstracts International, Unpublished Dissertation, The University of Western Ontario, 1994.

[58] L.A. Zadeh, "Fuzzy Sets," Information and Control, 8, pp. 338-352, 1965.

[59] C.S. Peirce, "Collected Papers of Charles Sanders Peirce", C. Hartshorne and P. Weiss Eds., 5-6, Harvard University Press, Cambridge, MA, 1934-1935.

[60]. Vojislav KECMAN,"Learning and Soft Computing", MIT Press, 2001.

[61] A.J.L. Costa, E. Massad, N. R. S. Ortega and A. Q. -C. Araújo," Perception of disability in a public health perspective: a model based on fuzzy logic", International Journal of Medical Informatics, 73(7-8), pp.647-656, 2004.

[62] G.J. Klir, T.A. Folger, “Fuzzy sets: uncertainty and information”, Prentice Hall, New Jersey, 1988.

[63] T. Bilgic, I.B.Turksen, “Measurement of membership functions: Theoretical and Empirical work, Handbook of Fuzzy Sets and Systems”, Fundamentals of Fuzzy Sets, 1, pp.17 – 21, 1999.

[64] J. Mendel, “Uncertain rule-based fuzzy logic systems: Introduction and new directions”, Prentice Hall, New Jersey, 2000.

[65] B. Bouchon-Meunier, "La logique floue et ses applications", Addison-Wesley France, 1995.

[66] B. Bouchon-Meunier, M. Dotoli, B. Maione: "On the Choice of Membership Functions in a Mamdani-Type Fuzzy Controller", WSC1, 1st Online Workshop on Soft Computing, pp.157-162, Nagoya, Japan, 1996

[67] N. Aladenise, "Acquisition de connaissances imparfaites auprès d'un expert: mise en évidence d'une fonction d'appartenance", Rapport D.E.A. I.A.R.F.A. LAFORIA, Université Paris VI, September 1994.

[68] I.B.Turksen,"Measurement of fuzziness: an interpretation of the axioms of measurement", in Fuzzy Information, Knowledge Representation and Decision Analysis, Preprints of the IFAC Symposium, Marseille, 1983, Pergamon Press, 1984.

[69] P.Dadone, “Design Optimization of Fuzzy Logic Systems” , Phd dissertation,1-35,2001.

[70] C.C. Lee, “Fuzzy Logic in Control Systems: Fuzzy Logic Controller”, Part II. IEEE Transactions on Systems, Man and Cybernetics, 20(2), pp.419--435, 1990.

[71] D. Dubios, H. Prade, “When upper probabilities are possibility measures”, Fuzzy Sets and Systems, 49, pp. 65-74, 1999

[72] E. Triantaphyllou, C.T. Lin, “Development and evaluation of five fuzzy multi-attribute decision-making methods”, International Journal of Approximate Reasoning, 14 (4), pp. 281–310, 1996.

[73] M.F. Chen, G.H. Tzeng, C.G. Ding, “Combining fuzzy AHP with MDS in identifying the preference similarity of alternatives”, Applied Soft Computing, 8 (1) pp.110–117, 2008.

[74] P.J.M Laarhoven., W. Pedrycz , “A fuzzy extension of Saaty’s priority theory”, Fuzzy Sets and Systems, 11, pp. 229–241,1983.

[75] A. Lazm, N. Wahab, “A Fuzzy Decision Making Approcah in Evaluating Ferry Service Quality Management Reseacrh and Practice”, 2(1), pp. 94-107, 2010

[76] Y.Chen, K.Chang, "Applying Fuzzy Multi-criteria Decision Method to Evaluate Key Capabilities of Taiwan Motion Picture Companies", In Proceedings of the 2006 Joint Conference on Information Sciences, JCIS 2006, Kaohsiung, Taiwan, ROC, October 8-11, 2006. Atlantis Press, 2006

[77] C. Lin, Y. Chen, "Bid/no-bid decision-making – a fuzzy linguistic approach", International Journal of Project Management, 22, pp. 585–593, 2004.

[78] Y. Chen, Y.K. Richard, A. Fung J. Tang, "Rating technical attributes in fuzzy QFD by integrating fuzzy weighted average method and fuzzy expected value operator",European Journal of Operational Research, 174 , pp. 1553–1566, 2006.

[79] M. S. Lee1, Y.H. San,Y. R. Hsu1, "A study of the key success factors of the ecotourism industry in Taiwan", African Journal of Business Management, 5(2), pp. 627-640, 2011.

[80] P.A. Raj, D. N. Kumar, "Ranking alternatives with fuzzy weights using maximizing set and minimizing set", Fuzzy Sets and Systems, 105,pp.365-375, 1999

[81] D. Protti," A proposal to use a balanced scorecard to evaluate Information for Health: an information strategy for the modern NHS (1998–2005)", Computers in Biology and Medicine, 32, pp.221–236, 2002.

[82] H. Al-Yaseen, S. Al-Jaghoub, M. Al-Shorbaji, M. Salim, "Post-Implementation Evaluation of HealthCare Information Systems in Developing Countries", The Electronic Journal Information Systems Evaluation, 13(1), pp.9-16, 2010.

[83] A. W. Kushniruk, V.L. Patel, "Cognitive and usability engineering methods for the evaluation of clinical information systems" Journal of Biomedical Informatics, 37,pp. 56–76, 2004.

[84] W.H. DeLone, E.R. McLean, "Measuring e-commerce success: applying the DeLone & McLean Information Systems Success Model", International Journal of Electronic Commerce, 9 (1), pp. 31–47, 2004.

[85] F. Gremy, J.M. Fessler, J.M. Bonnin, "Information systems evaluation and subjectivity", Int J Med Inf, 56, pp. 13–23, 1999.

[86] A.L. Geers, P.E. Weiland, K. Kosbab, S. Landry, S.G. Helfer, "Goal activation, expectations, and the placebo effect", J Pers Soc Psychol, 89(2), pp. 143–159, 2005.

[87] B. Szajna, R.W. Scamell, "The Effects of Information System User Expectations on Their Performance and Perceptions", MIS Quarterly, 17(4): pp. 493-525, 1993.

[88] M. Berg, "Implementing information systems in health care organizations: myths and challenges", Int J Med Inf, Vol. 64, pp. 143–156, 2001.

[89] D. Nevo, Y.E. Chan, A temporal approach to expectations and desires from knowledge management systems, Decision Support Systems 44(2007) 298-312.

[90] R. Ryker, R. Nath, J. Henson, “Determinants Of Computer User Expectations And Their Relationships With User Satisfaction: An Empirical Study”, lnformation Processing & Management, 33(4), pp, 529-537, 1997.

APPENDIX

EXPECTATION QUESTIONNARIE

"This is a questionnaire purposing to determine the expectation meeting ratio of the Hospital Information System (HIS) used in your hospital, the distribution of these ratio according to the expectations, strong and weak sides in the expectation meeting. If you accept to participate in this study, you will be asked to answer above questions. These answers will be used for scientific purposes.

If you accept to participate in this study, your personal data will be saved according to the privacy rules and when the results are published they will be held secret. You are approving your answers to be used under these conditions."

Demografic Data			
Your age:.....	**Sex:**	☐ Woman	☐ Man
Education:	☐ primary school	☐ secondary school	☐ University
Working Unit:	☐ Basic Medicine	☐ Surgical Medicine	
	☐ Administrative	☐ InternalMedicine	

How long have you been working in this position:.....

Business Title					
Office worker	Laboratory technician	biologist	nurse	Physician	other
☐	☐	☐	☐	☐	☐

IS Experience	
How long have you been using computer?	How long have you been using current HIS? .....

Attitude Towards Change

☐ I don't like technological changes ☐ I am open to technological changes ☐ It depends on the technological changE

1. Ease of Use

For me HIS' being easy to use is

☐ Very important ☐ important ☐ average important ☐ not so important ☐ not important

In HIS	Strongly agree	Moderately agree	Not sure	Moderately disagree	Strongly disagree
Interfaces are easy to understand	☐	☐	☐	☐	☐
Easy to use	☐	☐	☐	☐	☐
Guidance information is easy to understand	☐	☐	☐	☐	☐
Default data is coming automatically and it can be changed when needed	☐	☐	☐	☐	☐
I can customize my interface	☐	☐	☐	☐	☐
Keyboard use is allowed together with mouse	☐	☐	☐	☐	☐

2. Need for Training

For me HIS' being easy to use learn in a short time is…

☐ Very important ☐ important ☐ average important ☐ not so important ☐ not important

	Strongly agree	Moderately agree	Not sure	Moderately disagree	Strongly disagree
Using HIS easy to learn with a small training	☐	☐	☐	☐	☐

3. Help Manuals

For me availability of the help manuals for users is…

☐ Very important ☐ important ☐ average important ☐ not so important ☐ not important

In HIS	Strongly agree	Moderately agree	Not sure	Moderately disagree	Strongly disagree
There is help manuals for each interface and function	☐	☐	☐	☐	☐
Help manuals are useful	☐	☐	☐	☐	☐
Help manuals are sufficient and conmprehensible	☐	☐	☐	☐	☐
Manuals are easy to access	☐	☐	☐	☐	☐

4. User Support

For me to get user support when I need is …

☐ Very important ☐ important ☐ average important ☐ not so important ☐ not important

In HIS	Strongly agree	Moderately agree	Not sure	Moderately disagree	Strongly disagree
I get support when I need	☐	☐	☐	☐	☐
User support is sufficient	☐	☐	☐	☐	☐
I get support on time	☐	☐	☐	☐	☐
I can access support center when I need	☐	☐	☐	☐	☐

5. Speed

For me HIS' being fast is ….

☐ Very important ☐ important ☐ average important ☐ not so important ☐ not important

	Strongly agree	Moderately agree	Not sure	Moderately disagree	Strongly disagree
Speed is sufficient	☐	☐	☐	☐	☐
HIS does not slow down us	☐	☐	☐	☐	☐

6. Function sufficiency

For me In HIS sufficiency of functions is ….

☐ Very important ☐ important ☐ average important ☐ not so important ☐ not important

HIS	Strongly agree	Moderately agree	Not sure	Moderately disagree	Strongly disagree
Has all the functions I need for doing my job	☐	☐	☐	☐	☐
Has all the functions for performing all the tasks in the hospital	☐	☐	☐	☐	☐

7. Consistency

For me in HIS same data's being consistent in different interfaces is ….

☐ Very important ☐ important ☐ average important ☐ not so important ☐ not important

in HIS	Strongly agree	Moderately agree	Not sure	Moderately disagree	Strongly disagree
Same function gives the same and true result every time	☐	☐	☐	☐	☐
I don't see conflicting data	☐	☐	☐	☐	☐

8. Privacy

For me only authorized personnel's access to private data is …

☐ Very important ☐ important ☐ average important ☐ not so important ☐ not important

in HIS	Strongly agree	Moderately agree	Not sure	Moderately disagree	Strongly disagree
Nobody except authorized personnel access private data	☐	☐	☐	☐	☐
Information access is compatible with the jobs	☐	☐	☐	☐	☐

9. Security

For me security in HIS is….

☐ Very important ☐ important ☐ average important ☐ not so important ☐ not important

In HIS	Strongly agree	Moderately agree	Not sure	Moderately disagree	Strongly disagree
Every user operates with his own username and password	☐	☐	☐	☐	☐
It is logged who does what	☐	☐	☐	☐	☐
There is sanctions for intentional mistakes	☐	☐	☐	☐	☐
User operate with their security level	☐	☐	☐	☐	☐

10. Availability

For me availability in HIS is…

☐ Very important ☐ important ☐ average important ☐ not so important ☐ not important

In HIS	Strongly agree	Moderately agree	Not sure	Moderately disagree	Strongly disagree
I don’t see data loss up to now	☐	☐	☐	☐	☐
Outages is rare	☐	☐	☐	☐	☐
I can access the data I need if I am authorized	☐	☐	☐	☐	☐

11. Interoperability

For me HIS' interoperability with the medical devices and other nformations is …

☐ Very important ☐ important ☐ average important ☐ not so important ☐ not important

HIS	Strongly agree	Moderately agree	Not sure	Moderately disagree	Strongly disagree
Is integrated with the medical devices properly	☐	☐	☐	☐	☐
Can communicate with MEDULA without any problem	☐	☐	☐	☐	☐
Works with PACS and LIS without any problem	☐	☐	☐	☐	☐

12. Improve service quality

For me HIS' improving service quality is …

☐ Very important ☐ important ☐ average important ☐ not so important ☐ not important

HIS	Strongly agree	Moderately agree	Not sure	Moderately disagree	Strongly disagree
Increases the quality of my service	☐	☐	☐	☐	☐
Provides continuity by providing me with the past data of the patient	☐	☐	☐	☐	☐

13. Decrease in workload

For me users' doing more work with less effort by the help of HIS is…

☐ Very important ☐ important ☐ average important ☐ not so important ☐ not important

HIS	Strongly agree	Moderately agree	Not sure	Moderately disagree	Strongly disagree
Eases my work	☐	☐	☐	☐	☐
Using makes me work faster	☐	☐	☐	☐	☐

14. Bringing positive change

Using HIS can bring positive changes in the hospital organization. This is for me …..

☐ Very important ☐ important ☐ average important ☐ not so important ☐ not important

HIS	Strongly agree	Moderately agree	Not sure	Moderately disagree	Strongly disagree
Increases performance of the personnel	☐	☐	☐	☐	☐
Same works can be done by less people	☐	☐	☐	☐	☐
Made work steps decrease	☐	☐	☐	☐	☐
Has a positive effect on personnel's morale	☐	☐	☐	☐	☐

15. Research facilities

For me HIS' having supportive opportunities for scientific researches is ….

☐ Very important ☐ important ☐ average important ☐ not so important ☐ not important

HIS	Strongly agree	Moderately agree	Not sure	Moderately disagree	Strongly disagree
Ease our researches	☐	☐	☐	☐	☐
Decrease our data collecting time	☐	☐	☐	☐	☐
Increased our research productivity	☐	☐	☐	☐	☐
Increased our research desire	☐	☐	☐	☐	☐

16. Reporting facilities

Availability of the qualified reporting facilities in HIS is for me ….

☐ Very important ☐ important ☐ average important ☐ not so important ☐ not important

HIS	Strongly agree	Moderately agree	Not sure	Moderately disagree	Strongly disagree
Report facility is available	☐	☐	☐	☐	☐
Reports meet our needs	☐	☐	☐	☐	☐

There is an elastic report tool for designing our reports	☐	☐	☐	☐	☐
Reports are clear and easy to understand	☐	☐	☐	☐	☐

17. Decision Support

Availability of decision support property of HIS to assist in making decisions is for me …

☐ Very important ☐ important ☐ average important ☐ not so important ☐ not important

In HIS	Strongly agree	Moderately agree	Not sure	Moderately disagree	Strongly disagree
Decision support facility is available	☐	☐	☐	☐	☐
Warnings, suggestions and supportive functions increase the quality and precision of my decisions	☐	☐	☐	☐	☐
Decision support facilities decrease my error risk	☐	☐	☐	☐	☐
Decision support facility is available	☐	☐	☐	☐	☐

Thank you for participating in our study by allowing us your valuable time.

CURRICULUM VITAE

PERSONAL INFORMATION

Surname, Name: Gürsel, Güney

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Date and Place of Birth: 17 June 1972, İzmir

Marital Status: Married

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EDUCATION

Degree	Institution	Year of Graduation
MS	METU Informatik Online	2003
BS	Military Academy systems engineering	1994
High School	Maltepe Military High School	1990

FOREIGN LANGUAGES

Advanced English

PUBLICATIONS

Full Text Proceedings of National Meetings

Kaya Kuru, Hüsamettin Gül, Güney Gürsel, Kemal Arda, Erkan Mumcuoğlu, Nazife Baykal. "Sağlık Hizmetlerinde Kaynakların Doğru Kullanımında Bilgisayar Benzetim Yönteminin Kullanılması: Bir Poliklinik Çalışması". 2. National Medical Informatics Congress (Tıp Bilişimi'05). 17–20 Nov. Belek/ANTALYA. Proceedings Book.pp14-20.

Güney Gürsel, Yıldırım Karslıoğlu, Ali Arifoğlu, Osman Saka. "Viral Hepatitlerin Histopatolojik Değerlendirmesinde Kullanılan Modifiye HAİ Skorlama Yönteminin Güvenirlik Çalışması". 4. National Medical Informatics Congress (Tıp Bilişimi'07). 15–18 Nov. Belek/ANTALYA. Proceedings Book. pp. 92-98.

Güney Gürsel, Yıldırım Karslıoğlu, Ali Arifoğlu, Osman Saka. "Viral Hepatitlerin Histopatolojik Değerlendirmesinde Kullanılan Modifiye HAİ Skorlama Yönteminin Güvenirlik Çalışması". 6. National Medical Informatics Congress (Tıp Bilişimi'09). 19–22 Nov. Belek/ANTALYA. ENVI Vol V(1). pp. 256-257.

HOBBIES

Fishing, Music, Basketball, Football

TEZ FOTOKOPİSİ İZİN FORMU

ENSTİTÜ

Fen Bilimleri Enstitüsü ☐

Sosyal Bilimler Enstitüsü ☐

Uygulamalı Matematik Enstitüsü ☐

Enformatik Enstitüsü ☒

Deniz Bilimleri Enstitüsü ☐

YAZARIN

Soyadı: GÜRSEL
Adı : GÜNEY
Bölümü : Sağlık Bilişimi

TEZİN ADI (İngilizce):

EXPECTATION BASED EVALUATION FRAMEWORK FOR HOSPITAL INFORMATION SYSTEMS

TEZİN TÜRÜ : Yüksek Lisans ☐ Doktora ☒

1. Tezimin tamamından kaynak gösterilmek şartıyla fotokopi alınabilir. ☒
2. Tezimin içindekiler sayfası, özet, indeks sayfalarından ve/veya bir bölümünden kaynak gösterilmek şartıyla fotokopi alınabilir. ☐
3. Tezimden bir bir (1) yıl süreyle fotokopi alınamaz. ☐

TEZİN KÜTÜPHANEYE TESLİM TARİHİ:.....