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ITIL-based IT service management maturity model design in health-based organizations (Case Study: City of Tehran)

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Abstract

Today, Information Technology services are considered as valuable resources in all areas. For making Information Technology Management Processes purposeful and efficient in different organizations – as a competitive and strategic advantage (especially in organizations responsible for health care services) – it is necessary to recognize the level of maturity of the organization and review its processes in the field of Information Technology Services. On the other hand, finding the relations between main components of maturity and Information Technology Standards are essential to make them functional. In this paper, in addition to recognizing the present IT Management Services and prioritize them; we reviewed the gap between processes and compare them to provide related maturity levels for introducing a localized model in Information Technology Services maturity in organizations responsible for health care services. Therefore, with the help of health experts and professionals working in health organizations; we categorized indicators in 10 management processes and 9 criteria related to it. In addition, we evaluated overlapping levels of maturity and ITIL management processes by using experts opinions that have a high percentage of consensus in the field of selecting criteria. The aim of deriving these indicators was creating a functional tool in health organizations and paying attention to its main differences with other methods in addition to inspiring from CMMI and entering effective components on Information Technology Infrastructures Standard (ITIL) framework according to functional views in Information Technology Management Services at the Tehran University of Medical Sciences. The present study can be recognized an applied research in accordance with its goal. In this research, a proposed instrument is used for gathering data (ITILRA questionnaire) from health care centers of Tehran University of Medical Sciences. The aim was determining the gap between current organizations management processes with an optimal one in the field of IT services (which are at different levels of maturity) with respect to the ITIL.V3 framework. For this reason, leveling joint processes between ITIL and CMMI and approving corresponding indicators at Information Technology Services Maturity Model levels were done and each criteria and processes were compared with ideal and standard situation separately. Then, we determined the highest and lowest differences rates and standard deviation for creating a localized maturity model based on ITIL. In management process, Service Desk has the most close and overlapped situation with ideal condition. In Configuration Management, the highest differences and gap was recognized, so, it should be closer to optimal condition. Service Desk belongs to Service Operations phase and it indicates the maturity level of the organization. As it was expected, it was in a very desirable condition. Configuration Management Process belongs to Translating Service Phase which stood in third place (predetermined processes) of maturity level in CMMI Model. It shows that improving maturity level of the organizations needs more efforts for reducing or omitting any gap between the current situation of the organization and a desirable condition. All these scores (by mean and standard deviation tests) obtained using SPSS software.

Key Words: *Information Technology Infrastructure, assessment indicators, University of Medical Sciences, Information Technology maturity,CMMI - ITIL*

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Introduction

The question that has occupied the minds of scholars in the field of information systems is: Is it possible to execute all processes of a standard information system successfully regardless of the conditions and characteristics of an organization (no matter how standardized this organization is)?"If the answer is "yes", then you must expect setbacks that are mentioned in global data. But if the answer is "no", then the answer is how we can implement information system successfully in a variety of organizations. It seems using ITIL framework which is a common language for organizations and individuals whose job is to provide better and faster service is very appropriate because the purpose of this framework is automating the behavior of a system. But the maturity level of Information Technology Services in health care services is not suitable and that's the main problem. We intend to provide an ITIL standard and framework and taking the following steps for establishing this framework successfully in health care system is indispensable:

1.Finding corresponding measuring indicator for showing the affinity of this health care system with standard ITIL: the effects of discourses and different criteria must be determined.

2.Determining health system maturity model in the field of standard ITIL: the effective level of maturity with successful implementation in health care organizations must be recognized (for example: what criteria (characteristics) are necessary for each organization – from first level of maturity to the end – to be put in the same level)

3.Determining successful steps in implementing ITIL in each level of maturity model: after determining a maturity level; you must act like a doctor to diagnose which process must be implemented in each level to ensure their success.

In recent years, the importance of strategic information technology in increased dramatically and information technology has turned into a business line for organization. Many organizations use information technology as a competitive advantage over competitors. In this regard, it is necessary for organizations to have proper investments approach in the field of logistics, delivery and management of Information and Communication Technology services. Information Technology Services Management is a tool that can help organizations to achieve their goals. However, according to studies, only seventeen percent of organizations believe that IT Service Management has a leading role in their organizations and support it. Different types of frameworks and standards to be used in Information Technology Services are presented in the followings:

1.Excellence Model (EFQM);

2.FAVA Organizational Governance Framework (IT Governance);

3.Organizational Architecture;

4.Service Oriented Architecture (SOA);

5.Information Technology Services Management Framework (ITIL);

6.Information Security Management Standard (ISMS);

7.2Prince Project Management Standard.

Information Technology Services Management Framework (ITIL)

For having an effective information Technology, Computer Department of British government provided a framework entitled ITIL (Information Technology Infrastructure Library) about two decades ago. This framework is a comprehensive set of best practices and experiences from companies, organizations and experts in the field of information technology.

This standard was welcomed in the world. Data shows that most of the valid and reputable companies and organizations active in the field of IT services are eager to use ITIL processes in their IT management services. Table 1 summarizes the different approaches that deal with management issues and areas of focus in the field of services and service

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Standards and frame-works	Different approaches for dealing with issues	Main criteria
ITIL	Focuses on Information Technology Services Management and a set of Best Practices	Process-oriented and continuation of services
COBIT	Using a powerful tool in information goals control and related technologies	Control and focus on goals
SIX SIGMA	A disciplined approach, a stimulus data and a method for removing defects in every process and product	Process-oriented
CMMI	Software production process which is known as "software production lifecycle". It is a structure which is applied on development and production of software products	Development and production of a product
PRINCE 2	This standard has provided two definitions for "project": project goals and projects features. A temporary organization which must create a unique result in a predetermined period and by using predetermined resources	Goals and features
BSC	A framework for describing organizational strategies as a set of measurable goals in terms of owners, external shareholders and the organization itself. Its focus is on management for reaching strategic goals	Goals
ISO 20000	The first international comprehensive standard and deals with Information Technology Services Management. It explains a set of integrated management processes for better servicing the customers.	Processes
ISO 27001	Ensuring business stability and reducing damages and threats by securing information, compatibility with information security standards and preserving data by decision makings	Information security
COSO	This framework is used for ensuring: 1) effectiveness and efficiency of operations, 2) reliability of financial reporting and 3) observing all indispensable laws and regulations	Controlling environment and activities

Table 1. Standards and frameworks

Year of issue	Subject
1980	Forming ITIL in British Government because of lack of quality of IT services
1990	Using by large companies and public agencies in Europe
2000	Microsoft used ITIL as main basis of its products –MOF (Microsoft Operations Framework)
2001	The second version of ITIL was released in 2001. In this version, two main subjects in first version (support and servicing) were put under more emphasis.
2007	The third version of ITIL was released in 2007. It was developed from a method for guiding life-style to a method for service management
Now	Used by many valid and reputable European and American companies

Table 2. completion process of ITIL framework

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standards that it has been identified.
So far, three versions of this successful experience (note that ITIL is not a standard) are provided and in each version there are improvements over the previous versions. ITIL covers all the management issues of an IT company. Today, all IT companies in the UK are bound to adhere to it. For example, this successful experience has shown that for better communication with customers, it is necessary to have a Help Desk or Service Desk plan. Table (2) shows the process of completing ITIL framework.
In fact, ITIL is a set of concepts and techniques for managing IT infrastructure, implementation and use of them. ITIL is published as a set of books and each book covers a topic of IT Service Management. ITIL is a framework of guidelines for IT managers to manage and optimize IT infrastructures in their organization. ITIL allows administrators to be sure services provided by the organization are good and prepare infrastructures in accordance with a predetermined program. ITIL is considered as an informal global standard since the late 1980s. This standard was first presented as a guideline for British Government but later they noticed that it can be useful for all organizations in all departments. All IT services providers accepted it as a base for giving advice, training and software support. Today, ITIL is recognized and applied worldwide.

The introduction of software ITILRA

In studies conducted by researchers in previous researches, there is no software for analyzing gap between the situation of organization and ITIL. The only software related to this issue is ITILRA. This software is used for feasibility studies and not for gap analysis. After consultation with scholars and experts, information about this software was obtained through correspondence with its manufacturer. Gained data show that questions used in this software are in connection with the subject of this research but they are more focused on the feasibility. This tool with ease of use tries to cover all aspects of ITIL for feasibility studies. The original version of this tool is not available for public and only its base version is for sale on the institute site. This tool is used by the researcher according to the professionals' recommendations for preparing initial questions of the research. In basic version of this tool, there are questions for feasibility studies that are arranged in seven areas. There is no information about its original version.

Types of maturity methods

The above mentioned models are a limited selection among 1000 models for maturity in different fields. Today, most of the organizations and financial institutes have a set of Best Practices in any fields of activity. Choosing the best model or proper models align with their business help them for improving their organization. In most of these models, 5 levels for maturity are described. We presented them in the following Table as levels 1 to 5. In each model and in each level, there is a unique title for criteria that are similar in terms of achievements. Using these 5 levels is not a rule; for example, in some models such as KM3, eight levels are considered. Table (3) shows process maturity evaluation criteria in an organization (from the book: Evaluating an Organization's Business Process Maturity).
Capability Maturity Model for software development (CMMI for development)
It provides a framework for improving software organization processes. Any software organization can improve its processes in a step by step manner by using it. Software organizations can improve their processes for developing and maintaining quality of their products. The three dimensions that each organization must focus on them are as follow:
-Process
-Human resources
-Technology and tools
Among these three important dimensions, the one which keeps everything in an integration manner in an organization is processes

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Title	Symbol description	Symbol	Considerations
Capability maturity model	Capability maturity model	CMM	It is used for developing organizational process and a framework for organizational processes optimization in which the organization tries to implement developments in gradual and step by step manner. This model is used widely in software development organizations
Project management maturity model	Organizational project management maturity model	OPM3	The aim of this model is helping organizations in understanding organizational project management and measuring their maturity level in comparison with some standards that are known as Best Practices in organizational project management
Personnel capability maturity model	Personnel capability maturity model	P-CMM	This model is a road map and guideline for determining, designing and implementing processes related to human resources that will lead to continuous improvement of human resources' capabilities
Knowledge management maturity model	Knowledge management maturity model	KM3	The aim of this model is sharing knowledge, ensuring a secure top-down information flow, measuring system, organizational learning, having a knowledge-based organization, being process-oriented in sharing knowledge, continuous improvement of processes and organization self-actualization
Process maturity model	Process maturity framework	PMF	This model provides a framework for organizational processes maturity
Service-oriented architecture maturity model	Service-oriented architecture maturity model	SOAMM	The aim of this model is providing a gradual process for accepting SOA and presenting sample methods in this process. This model is focused on services maturity in SOA
Service integration maturity model	Service integration maturity model	SIMM	The aim of this model – the same as SOAMM- is supporting SOA gradual acceptance process and providing sample methods for this process. But the important point is that this model does not talk about SOA but its focus is on service integration maturity.

Table 3. types of maturity methods (from the book: Organizational Project Management Maturity Model)

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Level	Criteria
Level 1: primary	Processes are not defined
Level 2: repeatable	Processes are defined. Objectives and expectations of the processes are specified
Level 3: standard	Processes are defined Sub-processes and activities are defined Financial resources for each activity are designated Human resources for each process are defined Processes are performed Companies keep the processes in their memory
Level 4: quantitative management	Processes have defined measures which are integrated vertically Data are used for analyzing processes measures and explaining future results Process pathology is done to identify deviations Necessary actions are done for modification and corrections
Level 5: optimal	Company's processes are measured and managed. There are some process improvement teams that are working continuously for developing effectiveness and efficiency and conformity of existing processes. The company has a process improvement program

Table 4. Maturity Evaluation Criteria

of that organization. Processes can align and organize all organizational activities in order to move toward business objectives. Organizational processes provide the ability of proper use of resources and they provide the necessary conditions for the application of new technologies. That's why the significant role of efficient and effective processes in producing products with high quality in manufacturing industry has long been known. Processes with high-quality help human resources of the organization to work with greater convergence toward the goals of the organization. Efficient processes are driving engines for using new technologies in an organization.

CMMI Maturity Model has been created by using knowledge and experiences in process management and based on this principle: "the quality of a system or product is highly influenced by the process that is used to develop and maintain it". This model can lead an organization for reaching its business goals by a systemic and comprehensive approach. CMMI Capability Maturity Model is a framework for processes maturity and is a roadmap showing the way for continuous improvement of process in an organization. In addition to improvement, CMMI model can be used in evaluating and comparing organizations.

Studies and surveys show that information technology as a mighty tool is the most important factor in increasing the efficiency and effectiveness of organizations. So, different industries have taken steps in using these technologies in order to survival in today's highly competitive environment. Health care industry is not exception from this rule. Many countries consider information technology for improving and developing information in relation with health care services because they are well aware of its significant direct or indirect influences on different dimensions of the society (4). In addition, now day information is considered as the most important element in development of organizations and information systems are the most appropriate tools for managers in decision-making and planning. On the other hand, providing proper access

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	Research title / year	Name of the researcher	Main factors in the research	Conclusions
Theses	Knowledge management maturity level measuring framework with the emphasis on technology systems factors (Faculty of Engineering, 1392)	Meysam Hayat Supervisor Professor: Reza Baradaran Kazemzade	A comprehensive study on knowledge management maturity level measuring, CMMI framework, ITIL framework, ITIL maturity measurement model, reviewing critical success elements in ITIL library and its theoretical basis	According to the results, a reference and improved framework for knowledge management maturity measurements is presented. For this reason, all statistical methods and experts' polling is used
	Presenting a model for implementing Information Technology Infrastructure Library (ITIL) (a case study: Refah Bank, 1391)	Forough Soleymani	IT Infrastructure Library (ITIL) is the most popular framework for IT service management. Reference of IT infrastructure is an operational framework and is a set of Best Practices IT service by IT services providers in organizations with complex IT structures.	In addition to helping to appropriate decision making, provide the possibility of assessing changes on the required services, so that the changes are useful for both sides. The aim of this thesis was proposing a new model for evaluating and implementation ITIL in banks on the basis of priorities and dependencies and it provides guidelines for banks.
Research projects and national plans	Review the status of Information Technology Services Management in health care systems (ITIL), 2011	Horbest et al	This research is done in some European countries. They addressed this issue: "how Information Technology Services Management in health care system (ITIL) is known by health care organizations or other institute related to them in Austria, how they accept it or how they use it." Also, the impact of organizational maturity has been studied by them. This study is performed in Austria, Germany, Italy and Switzerland.	Results collected through this study show that this idea is primarily not only a technology provider, but also a service provider as well. But it is not yet widely used and recognized in hospitals in these countries. This particular importance is increasingly considered in treatment of patients (for example, evaluating cross information of organizations that are related to health care and clinical and decision makings and support, etc.)
	Information system development standard	Lapono (2007)	Organizational and technical maturity is for developing such systems. Some of the main points that Lapono (2008) has mentioned are as follows: lack of professional forces, lack of successful experiences in project management, unbalanced budget designation for information technology, management of fragile information technology, lack of data protection, lack of leadership and information technology strategies	Considering organizational maturity is for systems development. The results gained by Hawks (2009) confirmed the results provided by Lapono.

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	Reviewing the reasons for ITIL success or failure in information technology governance	Van-Gebergen and Dihous (2009)	Considering the failure reasons and factors in such methods in other information systems governance	Limitations caused by ignoring such standards are presented.
Research & scientific articles	ITIL implementation restructuring by knowledge management framework	Mirghani et al (2008)	This model is presented for strengthening the implementation of second version of ITIL by separated knowledge management in engineering framework of organization management	It improved the implementation process of ITIL by using knowledge effectiveness and improving competitiveness core and encouraging a customer-based approach with separating different kinds of knowledge
	Aligning SIX SIGMA standards with ITIL for improvement	Chan et al (2010)	When a project is created and described in ITSM to implement by ITIL; there is no better way than ITIL for quality measurement or increasing quality	So, they mixed ITIL with SIX SIGMA in this article to find a methodology and tool for measuring quality and enhancing the process to IT managers
	Implementing Information Technology Service Management	Carter Style et al (2007)	In this article, CSFs that are effective in correct implementation of ITIL are provided	CSFs such as senior managers' support of implementing information technology services management are one of the priorities.

Table 5. The past of research

to information can increase processing ability of the organizations in addition to facilitating the ongoing operations. So, managers in different levels of an organization will be more powerful for supervising and controlling the organizational activities (5). Therefore, information technology is introduced as a major element in development and improvement of today's world and its achievements have influenced on people's lives in different ways (6). It has the capability for solving many of the problems in today's cities as one of the new and emerging methods (7).

Review of the literature and research background

The following study is one of the examples of research studies in the field of ITIL in different organizations.

•Horbest et al (2011) studied the status of Information Technology Services Management in health care system (ITIL) in some European countries (Horbest et al, 2011). They addressed this issue: "how Information Technology Services Management in health care system (ITIL) is known by health care organizations or other institute related to them in Austria, how they accept it or how they use it." Also, the impact of organizational maturity has been studied by them.

Research Method: the present research is an applied research in terms of goals. In this research, a proposed instrument is used for gathering data (ITILRA questionnaire) from health care centers of Tehran University of Medical Sciences. The aim was determining the gap between current organizations management processes with an optimal one in the field of IT services (which are at different levels of maturity) with respect to the ITIL. V3 framework. At first, all kinds of maturity models and Information Technology Services Management standards are reviewed and then commonalities between the two domains and their reconciliation in health-focused organi-

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Maturity level	Maturity level	Commonalities of ITIL, CMMI	Phases ITIL
5	optimizing		
4	Quantity Managed	Financial Management	sterateghy
3	defiend	Release Management	tranlate
		Availability Management	design
		IT Service Continuity	design
		Capacity Management	design
		Problem Management	operation
2	managed	Change Management	tranlate
		Configuration Management	tranlate
		Service Level Management	design
1	initial	Service Desk	operation

Table 6. Maturity level

zations were studied.

General research method

This article is the result of a systematic, controlled and experimental study in the field of information technology services management in health care systems. All of its possible structural and organizational relations are conducted by theories and three point of views are considered in it. Kinds and methods of research: The research method is selected according to the purpose of research and is an applied and developmental research. The methodology with regard to data collections methods which is a descriptive method (non-experimental) can be considered in the group of segmental surveys.

Society-location territory of the research

In this study, the location territory is Department of Health in University of Medical Sciences, Tehran (including five municipal districts of Tehran 10-11-15-17-19 and Eslam-Shahr network, Shahr-e-Ray which include a total number of 20 health centers in the health care system).

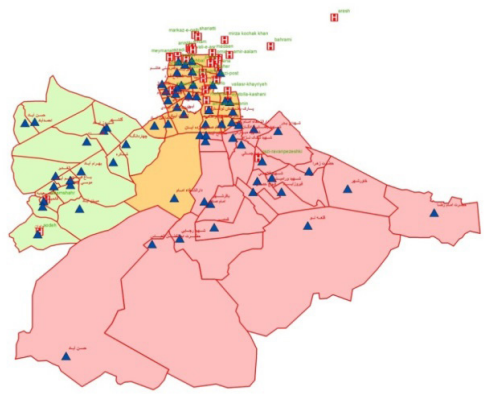


Figure 1. location territory of University of Medical Sciences, Tehran

Data collection methods and tools used for this purpose:

We used library method for data collection; the tools were questionnaires and interviews; questionnaires are derived from ITILRA software and are considered as standard question-

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naires.

Time territory

Due to the fact that researcher had a particular time period to review the issues; so, this is a cross-sectional study (18 months).

Population, sample, sampling method

The population in this study includes the following four groups:

1.Managers and decision makers

2.Doctors and other health professionals working at the University of Medical Sciences

3.Informatics professionals

The number of departments of organizations and the percentage of respondents of questionnaires and also the number and percentages of people and their positions are specified. In Figure 4.1 the percentage of respondents are mentioned according to their positions.

Units of the organization and the number and percentage of respondents who are engaged questionnaire in each unit as well as the number and percentage of patients according to specified positions. And Figure 4.1 percent of respondents had been identified in work unit.

Theoretical Framework: Infrastructure and theoretical framework of each research is formed based on its theoretical bases history. Research literature can be considered as resources and studies that are related to subject and nature of research directly or indirectly. It can create a deep insight in relation to subject or nature of research in readers' minds.

The theoretical framework of a research shows the relationship between the variables that influence on the subject of research.

Joint management processes between ITIL phases and CMMI maturity model and their aspects

Simple average of scores per question in questionnaire

table 8 shows simple average scores per question in questionnaire.

Methods of data analysis

In this study and according to the objectives, questions, and research; the researcher used descriptive statistics to describe the demographic data. As well as, the researcher used inductive statistical methods for analyzing averages and analyzing structural equations. IT-ILRA and SPSS software are used to facilitate data processing. Access Management and Capacity Management and average scoring tables are presented as an example for each criterion and then an average is estimated for managements.

table11 compares the access management with its values. The current values and desired values and excellent values for this management process are specified.

Dependent t-test was used to compare mean values of Access Management and Capacity Management. According to the statistics con-

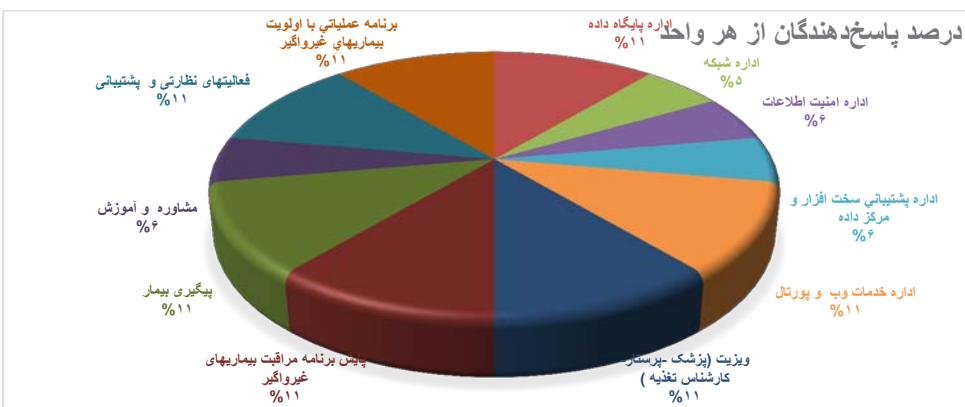


Figure 2. Percentage of respondents according to their working department

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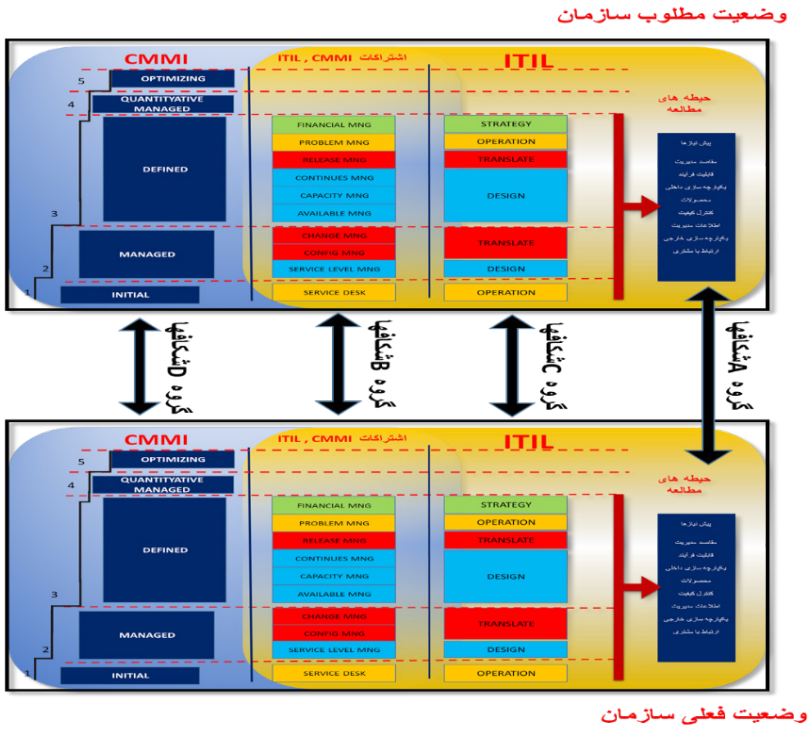


Diagram 1. Theoretical framework of the research

Management criteria	The name of joint management in CMMI and ITIL	Phase name ITIL	Number of questions
1.Prerequisites 2.Management goals 3.Process capability 4.Internal integration 5.Products 6.Quality control 7.Management data 8.External integration 9.Relations with customers	Financial management	Strategy	9
	Release management	Translate	9
	Availability management	Design	9
	It service continuity	Design	9
	Capacity management	Design	9
	Problem management	Operations	9
	Change management	Translate	9
	Configuration management	Translate	9
	Service level management	Design	9
	Service desk	Operations	

Table 7. the number of questions in each phase and management in ITIL

Question number	Current level score	Desired level score	Question number	Current level score	Desired level score
1	2.26	3.85	31	3.00	5.25
2	0.86	4.38	32	3.00	5.25
3	0.64	4.67	33	3.58	5.25
…	…	…	…	…	…

Table 8. An example of a simple average of scores per questions in questionnaire

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Name of management	Access management									Capacity management								
Name of criteria	Prerequisites	Management goals	Process capabilities	Internal integrations	Products	Quality control	Management data	External integrations	Customer Relations	Prerequisites	Management goals	Process capabilities	Internal integrations	Products	Quality control	Management data	External integrations	Customer Relation
Average	4.79									2.32								

Table 9. Methods of data analysis

Questions	Current value	Desired value	Gap to desired level
Management goals	2.26	3.85	1.59
Internal integration	2.82	4.67	1.84
Quality control	3.02	5.00	1.98
Management data	3.58	5.25	1.67
External integration	3.74	5.83	2.09
Prerequisites	3.89	5.60	1.72
Products	4.08	6.15	2.07
Process capability	4.31	7.00	2.70
Customer relations	4.31	7.00	2.70
Total average	3.53	5.47	1.94

Table 11. the averages for Aaccess Management criteria

Management	Average values	Quantity	Standard deviation	Average standard error
Access	4.79	40	.467	.074
Capacity	2.32	40	.334	.053

Table 10. Descriptive statistics of Access Management and Capacity Management

tained in Table 4-1; it can be concluded that average values of Access Management (M = 4.79, SD = .467) is higher than Capacity Management (M = 2.32, SD = .334).

Conclusion: calculations of these amounts were carried out for all joint managements between the maturity model and Information Technology Infrastructure Library (ITIL). The highest average between managements belongs to SERVICE DESK Management and the lowest average belongs to CONFIGURATION Management in health care centers.This comparison was done for all the 9 areas in which the highest average belongs to information management from access management and the lowest average belongs to configuration management. In total, 90 areas were compared in accordance with obtained averages. Then the gap between the current situation and the average value of total managements was calculated. All levels of managements are calculated to determine the maturity level of the organization.

Research barriers and restrictions

Given the novelty of this framework in comparison to other frameworks or standards; we were faced to some difficulty such as accessing to the accomplished studies or the limited number of studies in the field of health care systems, lack of implementation of this

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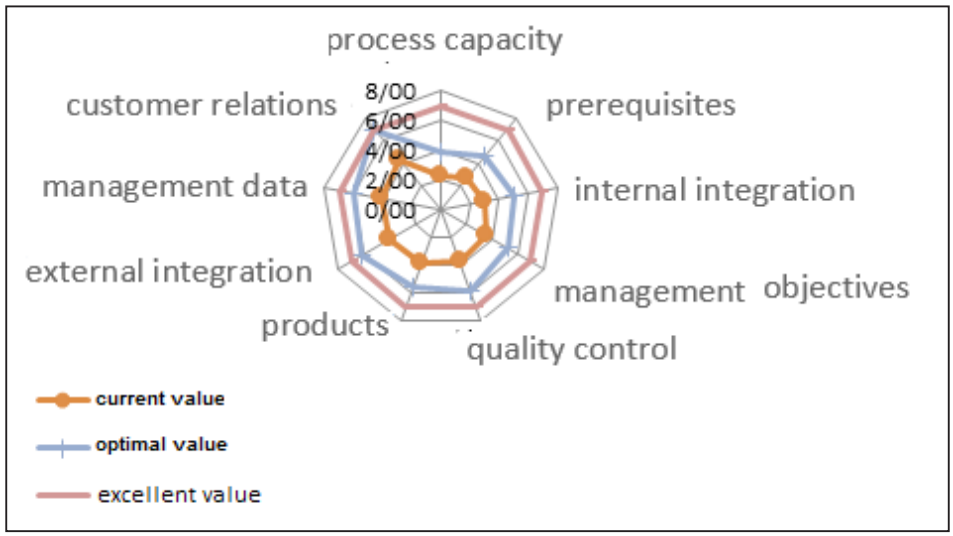


Figure 2. schematic display of Available Management criteria

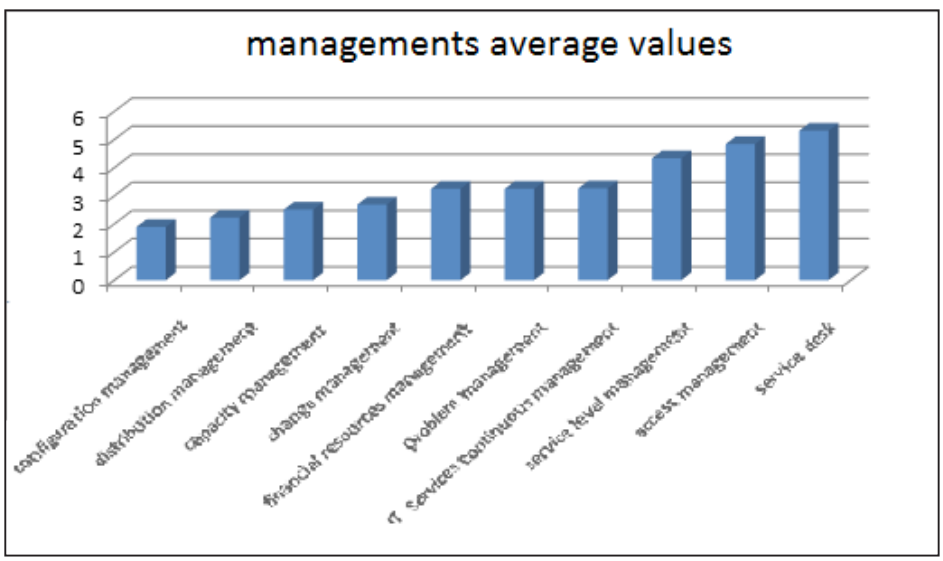


Figure 3. The average values of CMMI and ITIL joint management processes

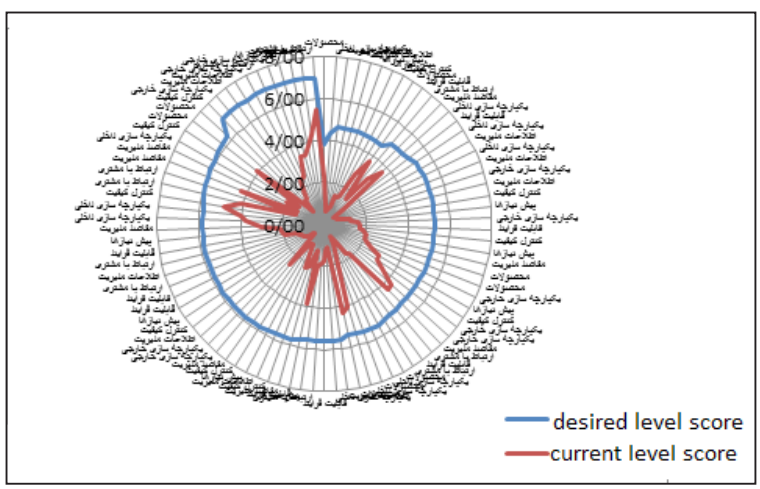


Figure 4. Comparison of the current level of studied processes with desired levels

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framework in health care services even in other countries. In other words, according to a literature review, we have found that there are very limited researches available in this field (no result for inside our country and a limited number of studies from other countries are available). So, there is no particular research in designing, establishing or managing such systems that work based on ITIL standard. Therefore a need for a comprehensive approach to this concept is felt. On the other hand, due to accessing literature concepts and effective indicators in this field caused this research to be an exploratory research.

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