

Health Information System Critical Success Factors (HISCSFs): A Systematic Literature Review

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Abstract This study attempts to identify, refine and group Critical success factors for healthcare information system (HISCSFs) in the last twenty years related literature (1996-2015). A protocol for the systematic review was developed, specifying in advance the process and methods that would be applied; the study used frequency-based selection technique to identify HISCSFs frequencies and categories from related literature. The main results obtained from the study included: total number of HISCSFs derived from related literature is (80), most discussed HISCSFs dimensions in the studies are: firstly: Human factors (15) out of (40), which representd 37.5%. Secondly, Technical factors (14) out of (40), which representd 35% and thirdly is the Management/ Organizational Factors (6) out of (40), which representd 15%. Most of HISCSFs were process-awar factors, which reflect the significant role of processes in HIS success. The results of the HICSFs dimensions analysis indicates that HIS planners and executives must take into account specific influential main factors in addition to processes focusing, even though it is understood that the all CSFs identified are important for HIS to succeed to achieve HIS success.

Keywords: Health/Hospital information system, Health information technology, Health informatics, Information System and Critical success factors.

1. INTRODUCTION

The health information system (HIS) provides the underpinnings for decision-making and has four key functions: data generation, compilation, analysis and

synthesis, and communication and use. The health information system collects data from the health sector and other relevant sectors, analyses the data and ensures their overall quality, relevance and timeliness, and converts data into information for health-related decision making(Chan et al., 2010). HIS served a critical domain in our life and considered as a complex IS, the complexity comes from its nature in dealing with different service levels and stakeholders (Primary, Secondary and Tertiary level) of services providing, big data generated every day and a lot of processes are maintained(Carrin et al., 2010).

The study introduces all HIS critical success factors (CSFs) through systematic review, because of its significant role in overall healthcare domain improvement. Many studies support the importance of CSFs for system success and improvement (Poon and Wagner, 2001, Ringim et al., 2012, Gortzis, 2011, Ram et al., 2013a). Talking about success means prevent of failure, failure in healthcare is too costly and generates a lot of problems, many problems still facing healthcare domain needs more efforts to be solved. The aim of this section is to highlight, identify and categorize HISCSFs; answering these questions (Why Identifying CSFs is significant for HIS domain? What are the most common HISCSFs in the last twenty years? How can we categorize the investigated HISCSFs?).

2. BACKGROUND

Information and communication technology (ICT) in healthcare domain is expected to facilitate continuous quality of care in aging societies taking in account the HIS complexity nature (Lenz and Kuhn, 2001, Haux, 2006, Alvarez, 2011, Spetz et al., 2012, Sultan et al.,

2014). In spite of the many advantages that information systems (IS) bring to organizations, many studies have found that IS project failures are very common. Only 32 per cent of IS projects succeed (delivered on time, on budget, with required features and functions), according to a Standish Group study, it is estimated that around 44 per cent of IS projects partially fail with time and /or cost overruns and /or other problems. Around 24 per cent of IS projects are total failures and abandoned (Altuwaijri et al., 2011, Heeks et al., 1999). Healthcare information system succeeds or fails – it is argued here – dependent on the degree of mismatch between the conceptions in that system’s design and the realities into which it is introduced (Heeks et al., 1999, Reichert, 2011, Axelsson et al., 2011). (Heeks et al., 1999) states that “Future work must answer the question “What Innovative Techniques Can be Adapted to Support HCIS Initiatives”.

There is a lack in CSFs studies in HIS and HIT (Heeks, 2006, Porta, 2004, Tierney and McDonald, 1996, Adesola et al., 2015). Previous literature addressed individual crucial attributes as individual strengths or weaknesses (Chawla et al., 2010), e.g. some of related literature argued that human factor in term of users especially physicians and nurses is critical for success (Suhonen and Paasivaara, 2011, Jos Aarts, 2010, Esmailzadeh et al., 2015, Villalba-Mora et al., 2015, Martikainen et al., 2014, Liu and Cheng, 2015), also ‘socio-technical approaches that stressed the importance of job satisfaction, workers’ needs, and skill enhancement (Berg, 1999, Cucciniello et al., 2015, Heeks et al., 1999). However, few studies addressed HISCFS as multidimensional view or a set of SFs or multidimensional view of SFs in specific area of practice e.g. (chronic disease, IS as general, specific clinical department....etc), and most of studies addressed this issue as Single dimension views of SFs e.g. (organizational or social or humanetc), Therefore, in this study through a systematic literature review of peer reviewed publications attempts to identify, refine and group HISCFS in the related literature.

2.1 CSFs Definition

There is a subjective evaluation variation in terms of success and failure. These terms can be viewed from different perspectives. One person’s failure may be another’s success (Haux, 2006). Rockart (1979) stated that “For any business, the limited number of areas in which results, if they are satisfactory, will ensure successful competitive performance for the organization. They are the few key areas where ‘things must go right’ for the business to flourish “(Ram et al., 2013a). Williams and Ramaprasad (1996) clarified identification or criteria of CSFs: factors linked to success by a known causal mechanism, factors necessary and sufficient for success, factors necessary for success; and factors associated with success (Panda and Sahu, 2012). It is important to say CSFs is not a key performance indicator (KPI). CSFs are elements that are vital for a strategy to be successful.

KPI’s are measures that quantify objectives and enable the measurement of strategic performance (Hübner-Bloder and Ammenwerth, 2009). Despite these views, several researchers in the field of HIS still argue that the success (S) estimation of HIS or HIT is still a vague undertaking (Gortzis, 2011, Bradley, 2008, Heeks, 2006).

3. METHOD

A systematic review used in research method, offering answers to the research questions, identification of research, selection process, appraisal, synthesis, and inferences.

3.1 Planning the review

A protocol for the systematic review was developing, specifying in advance the process and methods that the study would apply. The research questions specified through this protocol, the search strategy, criteria for inclusion and exclusion, and method of synthesis. The main objective of the study is to identify, refine and group HISCFS in the related literature, answering the research questions.

3.2 Search terms:

The study performed three scanned search terms; firstly it is applied the general related terms, which were necessary to perform systematic literature review (SLR), and required obtaining the highest possible number of studies in the field, the keywords includes (Health/Hospital information system, Health information technology, Health informatics, Information System and Critical success factors). Our second scanned included titles and abstract. Lastly our third scanned included titles, abstract and full text

3.3 Resources searched:

The main sources of the research include: ACM Digital library, Google Scholar, IEEE Explore, Web of Science, Science Direct, BMJ, Sage and Medline database.

3.4 Identification of research

The study used general search terms, which were necessary to perform systematic literature review (SLR), and required obtaining the highest possible number of studies in the field. moreover, performed the search in September 2015. The identification process yielded 358 articles. This represents the basis for the next step in the selection process.

3.5 Selection of primary studies

In total number, 358 papers were scanned. Once these were filtered, the process yielded a total of 150 articles.

Next we obtained the abstract of these articles and read through all abstracts using the following exclusion criterion. We included texts that directly answered any one or more of our research questions, published from 1996 through September 2015, focused on HISSFs and those focused on HIS or HIT in terms of its success in different countries. We excluded texts that not: focused of topics other than HISSFs or focused on topics other than HIS and lessons learned from other countries or those which were not from related conference or impact factor journals as well as those which did not focus on domain of HIT, HIS or IS. After we reviewed the papers, the number of articles was reduced to 98. The full text of all 98 papers was obtained and reviewed, using the same criteria for exclusion. The final number of papers selected for inclusion was 92, all of which had directly related topics to IS, HIS or HIT SFs

3.6 Data extraction and synthesis

The paper applied the Endnote version X7, to record reference details for each study. How each study answers the research question(s) was recorded on a separate results form. The data is synthesized by identifying themes emanating from the findings reported in each accepted paper. These identified themes provided the study with the categories reported in our results section.

4. RESULTS

Total refining numbers of HISSFs derived from related literature are (80) SFs, (see appendix (A)). Number of studies discussed the HISCsFs were (80) papers out of (92), which represent 87 %. Few studies addressed HISCsFs as multidimensional view or a set of factors were only (22) out of (80), which represented 27.5 %

Most of studies addressed HISCsFs as single dimension or category e.g. (organizational, social, human, and management factors ...Etc) were (40) out of (80), which represented 50%. Few studies addressed HISCsFs in specific area of practice e.g. (chronic disease, IS as general, specific clinical department...etc) were (18) out of (80), which represented 22.5%. The results of the HISCsFs dimensions/sub dimensions analysis indicates that HIS planners and executives must take into account the pervious influential dimensions/sub dimensions and factors in order to achieve HIS success.

Based on the definition of process "a set of activities or tasks in sequence or in parallel working together to achieve a common purpose, such as a beginning-to-end workflow"(Miller et al., 2008), we noted most of HISCsFs were process-aware factors, which signifies the role of processes in HIS projects.

5. DISCUSSION AND ANALYSIS

In this section the study tries to find answers to these three questions.

5.1 Why Identifying CSFs is Significant for HIS domain?

Investigate CSFs considered as significant approach used to achieve healthcare quality. Many studies support the importance of CSFs for system success and performance improvement (Poon and Wagner, 2001, Ringim et al., 2012, Ram et al., 2013b, Gortzis, 2011, Adesola et al., 2015). A lot of studies mentioned the importance role of the CSFs from many point of view e.g. (customer satisfaction (CS)(Chakraborty and Majumdar, 2011, Otani et al., 2010, Kupfer and Bond, 2012, Ali et al., 2013), other studies argued that CS is treated as a measure of success rather than a dimension of success (Pappu and Quester, 2006, Gill and White, 2009, Bradley, 2008, Chakraborty and Majumdar, 2011).

Healthcare providers need to reduce operational costs while improving the quality of care. Since in various countries the healthcare sector is reorganized on a free-market basis, it makes sense for patients to visit the provider with the shortest access time or the lowest costs. The healthcare domain is responding to this trend with a focus on efficiency and process improvement (Netjes et al., 2010, Reijers, 2005, Vanwersch et al., 2011), accordingly we noted that a lot of HISCsFs can be considered as process improvement inputs, So if we link between specific HISCsFs and healthcare improvement, this will add additional importance to HISCsFs and more focus and accurate improvement in overall healthcare services, which expected to add valuable dimensions to the area of healthcare business process improvement and healthcare quality and reflect the big role of HISCsFs on improvement processes.

Healthcare processes can be classified as medical processes or management processes, booth of processes must be measured to link between models and practices for clinicians (Rebuge and Ferreira, 2012, Reichert, 2011, Haya R.Robin, 2001). Healthcare organizations common areas of concern and major success factors in the patient's satisfaction are the reduction of waiting time, length of stay (LOS) of patients and medical errors (Eskandari et al., 2011, Spedding, 2008, Shei-Ling Ku, 2006, Gupta and Denton, 2008, Stock et al., 2007, Sanmartin et al., 2003, Kohn et al., 2000).

5.2 What Are the Most Common HISCsFs in Last Twenty Years?

After collecting and organizing relevant data from a large collection of literature which discussed the success of HIS, IS and HIT in general, we noted most of HISCsFs in the related literature covered in term of single dimension view e.g. (organizational, social, human, and management factors) or multidimensional view but in specific area of practice e.g. (chronic disease, IS as

general, specific clinical department). Total refining numbers of HISSFs derived from related literature are (80) SFs, (see appendix (A)). We summarized it to 14 HISCFSs. Based on process definition; we noted that most of summarized HISCFSs were process-aware factors, which signifies the role of processes in HIS. Future studies can concern on processes more to achieve HIS success, which will lead to healthcare improvement, these influential HISCFSs includes:

1. Sustainable Political Support.
2. Long and Short Term Strategic planning.
3. Sustainable Finance.
4. Top Management Support
5. Efficiency and effective implementation tools and equipment.
6. Continues Improvement, Maintenance and Support.
7. Organizational Learning.
8. People expert, ethics, training, skills and motivation.
9. Competencies and Rewards System.
10. Legislative Support.
11. Key Indicators Performance Measurement.
12. Healthcare Partners Involvement and Integration.
13. Culture and Resistance to Change.
14. Others.

By analyzing last twenty years related publication, we noted most publications were found in year 2010 and 2011 and 2015. Below are the details.

Table1: Publication year. Number of publications per year from 1996 until 2015 of the 92 papers

SN	Year	Number of References	%
1	1996	2	2
2	1997	0	0
3	1998	0	0
4	1999	4	4
5	2000	2	2
6	2001	3	3
7	2002	1	1
8	2003	4	4
9	2004	2	2
10	2005	2	2
11	2006	6	7
12	2007	2	2
13	2008	7	8
14	2009	7	8
15	2010	12	13
16	2011	13	14
17	2012	7	8
18	2013	7	8
19	2014	3	3
20	2015	8	9
Total		92	100

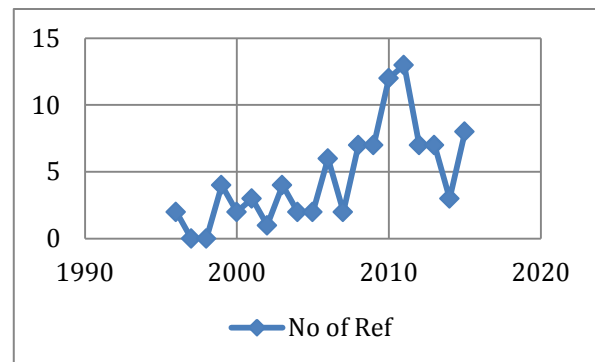


Figure 1: Number of publications per year from 1996 -2015

Total refining numbers of HISSFs derived from related literature are (80) SFs, (see appendix (A)). Number of studies discussed the HISCFSs were (80) papers out of (92) papers, which represent 87 %. Rest of studies were (12) out of (92), which represent 13 % covered some related concepts and deffinitins in our study.

5.3 How Can We Categorize The Investigated HISCFSs?

There are a lot of classifications of CSFs derived from related literature; we can summarize these classifications in table2.

Table 2: CSFs Context and Classifications

Discussion Context	CSFs Classification	Authors
Problems and challenges of E.health in Developing Countries	(1)Technical and operational, (2)Social and Cultural, (3)Native Environment, (4)Legal, (5)Policy Making, (6) Financial	(Khalifehs oltani and Gerami, 2010).
Bridging the gap between actuality and design	(1)Information, (2)Technology, (3)Process, (4) Objectives and Values, (5)Staffing and Skills, (6) Management System and Structure and (7) Other Resources	(Heeks, 2002).
Adoption of an ERP	(1)Cultural issues , (2)Functionality requirements , (3)Expertise and people and (4)ERP practices	(Ngai et al., 2008).
Factors affecting the adoption of a new IT	(1) Environment, (2)organization , (3)Technology	(Hsiao et al., 2009).

Future of e-Health and Telemedicine depends on	(1)Human factors,(2) economics and (3) technology	(Vitacca et al., 2009).
New frameworks for the success factors	Project, Project manager and the team members, Organization, and External environment.	(Belassi and Tukul, 1996)
IS Success Model	Information Quality, System quality, Service quality, intension to use, User satisfaction and Net benefits.	(Delone, 2003)
health information system Design – Reality – Gap Model	Information, Technology, Processes, Objectives and Values, Staffing and Skills, Management Systems and Structures; and Other resources	(Heeks, 2006, Heeks, 2003, Heeks et al., 1999)
Proposed a new conceptual framework of three Theories	Human, Technology, Organization, and Environment	(Ahmadi et al., 2015)
Seven categories for success factors of health IT implementation	Ethical, Financial, Functionality, Organizational, Political, Technical and Training	(Fritz et al., 2015)
A Hierarchical Model of Health Service Quality	Interpersonal, technical, administrative and environment.	(Dagger et al., 2007)

The results of the HICSFs categories analysis indicated that HIS planners and executives must take into account the following influential categories: Human, technical, management/operational, social and legal factors, even though it is understood that the all CSFs identified are important for HIS to succeed. We tried to assign main dimensions for the HISCFSs (multidimensional view or a set of factors, single dimension, multidimensional view but specific area of practice and others), and sub dimensions (human, technical, managerial or organizational, social and legal), also we tried to identify frequenceis of HISCFSs main and sub dimensions among related studies as shown in table 2.

5.3.1 Analysis of HISCFSs Existing Classifications

The study tried to group the derived HISCFSs in to five dimensions including (human, technical, managerial / organizational, social and legal), based on the nature of each factor with its cited context additional to the author’s experiences in healthcare domain, then we linked and assigned them to each of our main and sub categories. As a basic framework for classifying the success criteria, we chose Brender et al’s large Delphi study(Gruber et al., 2009), because it summarized the

experiences of many HIS experts, but instead of six we use five main factors due to our literature findings.

Table 3: Frequency of HISCFSs Dimensions listed in literature

Context of CSFs	Sub_Dime nstions	Success Factors Studies	Total Accurre nces
Multidime nsional view or a set of SFs	Set	(Poon and Wagner, 2001, Gortzis, 2011, Ram et al., 2013a, Alvarez, 2011, Sultan et al., 2014, Heeks et al., 1999, Axelsson et al., 2011, Heeks, 2006, Chawla et al., 2010, Ram et al., 2013b, Bowns et al., 1999, GROUP, 2000, Wood-Harper et al., 2004, Khalifehsoltani and Gerami, 2010, Heeks, 2002, Ngai et al., 2008, Belassi and Tukul, 1996, Delone, 2003, Bivolaru et al., 2009, Ahmadi et al., 2015, Dagger et al., 2007, Gruber et al., 2009)	22
Single dimension views of SFs	Human	(Suhonen and Paasivaara, 2011, Esmacilzadeh et al., 2015, Villalba-Mora et al., 2015, Martikainen et al., 2014, Liu and Cheng, 2015, Chakraborty and Majumdar, 2011, Otani et al., 2010, Kupfer and Bond, 2012, Ali et al., 2013, Pappu and Quester, 2006, Gill and White, 2009, Caballero and Hullin, 2009, Wade et al., 2014, Drews, 2013, Hardiker and Grant, 2011)	15
	Technical	(Lenz and Kuhn, 2001, Ringim et al., 2012, Reichert, 2011, Adesola et al., 2015, Netjes et al., 2010, Reijers, 2005, Vanwersch et al., 2011, Rebuge and Ferreira, 2012, Limapornvanich et al., 2010, Wilson et al., 2010, Kundu et	14

		al., 2012, Bakhtiyari Shahri et al., 2012, Paré et al., 2008, Chow and Cao, 2008)	
	Mgt/Org	(Bradley, 2008, Hanlie Smuts, 2010, Rodgers, 2011, McAlearney et al., 2013, Jennett et al., 2003, Jaana et al., 2011)	6
	Social/Culture	(Jos Aarts, 2010, Berg, 1999, Stock et al., 2007, Vitacca et al., 2009)	4
	Legal	(Hodge Jr et al., 1999)	1
Single Dim. Total			40
Multidimensional view of SFs but specific area of practice	Set	(Spetz et al., 2012, Altuwajiri et al., 2011, Cucciniello et al., 2015, Panda and Sahu, 2012, Miller et al., 2008, Eskandari et al., 2011, Spedding, 2008, Shei-Ling Ku, 2006, Gupta and Denton, 2008, George et al., 2013, Hsiao et al., 2009, Levis et al., 2006, Patel et al., 2013, Schrauf, 2011, Heeks, 2003, Safdari et al., 2015, Fritz et al., 2015)	18
Others	Related Concepts	(Chan et al., 2010, Carrin et al., 2010, Haux, 2006, Porta, 2004, Tierney and McDonald, 1996, Hübner-Bloder and Ammenwerth, 2009, Haya R.Robin, 2001, Sanmartin et al., 2003, Grober and Bohnen, 2005, de Kok, 2010, WHO, 2006, Greenhalgh and Russell, 2010)	12
Total			92

We used frequency-based selection technique (de Kok, 2010) to identify HISCSFs frequencies and categories from exiting LR. We identified HISCSFs repeatedly suggested in the literature as important determinants of HIS success, we can summarize below points as discussion and analysis.

- Few studies addressed HISCSFs as multidimensional view or a set of factors were only (22) out of (80), which represented 27.5 %
- Most of studies addressed HISCSFs as single dimension e.g. (organizational, social, human,

and management factorsEtc) were (40) out of (80), which represented 50%, this point can detailed as below:

- Human factors (15) out of (40), which representd 37.5%
- Technical factors (14) out of (40), which representd 35%
- Management/ Organizational Factors (6) out of (40), which representd 15%.
- Social factors (4) out of (40), which representd 10%
- Legal factors (1) out of (40), which representd 2.5%
- Few studies addressed HISCSFs in specific area of practice e.g. (chronic disease, IS as general, specific clinical department....etc) were (18) out of (80), which represented 22.5%,

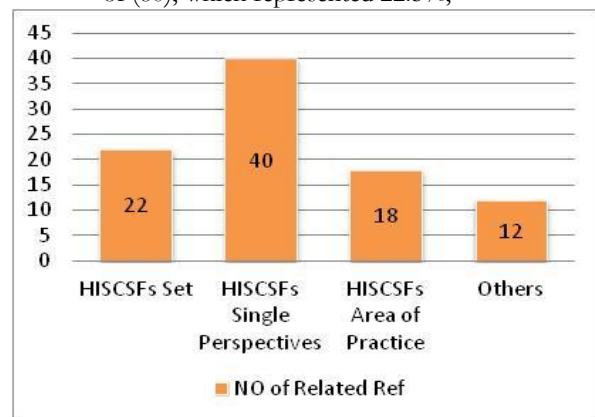


Figure 2: HISCSFs Main Dimensions and Number of Studies

Analysis of HISCSFs sub dimensions indicated the important role of specific dimension than others and represents its worthwhile weight. Figure 3 illustrates these sub dimensions.

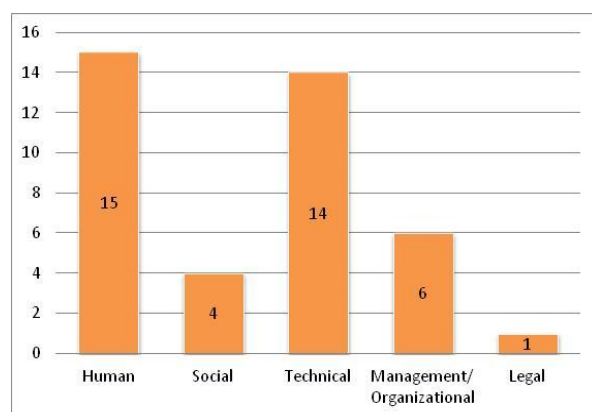


Figure 3: HISCSFs sub dimension and Number of Studies

6. SUMMARY

This study reviews the existing HISCSFs proposed by various authors in the related literature. By combining and analyzing these factors, a set of HISCSFs are

identified, refined and grouped. The results of the HISCSFs analysis indicate that HIS planners, developers and implementers must take into account specific categories as most significant to achieve HIS successfulness. Even though it is understood that the all CSFs identified are important for HIS to succeed. Accordingly, efforts should be oriented to answer the question how to manage and maintain these HISCSFs to contribute for healthcare real problems and support the improvement processes.

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Appendix A

Health Information System Critical Success Factors (HISCSFs) Derived From LR

SN	HISCSFs
1.	long-term government commitment
2.	Involvement of health authorities at national, provincial and district levels
3.	Vision, strategy and national plans for health informatics projects
4.	Well Defined Objectives , Scope and Procedures for a Health Informatics Project s
5.	Allocation of adequate resources for information and telecommunications infrastructures
6.	linking the system to business objectives
7.	Development of a gradual and flexible implementation approach with Smaller Project Milestones
8.	Establish key performance indicators system
9.	Proper needs assessment
10.	legislative, ethical and constitutional frameworks
11.	Establishing a national data protection authority
12.	Incorporating industry-wide security protections
13.	Providing privacy safeguards based on fair information practices
14.	Identify and Providing an up-to-date category of threats to healthcare assets.
15.	Enforcing security policies through appropriate security measures
16.	Support for pilot schemes as soon as they prove successful
17.	Business Competition
18.	Top Management Support
19.	Good contract management
20.	Establishing capabilities for process redesign
21.	Risk Management

22.	Staff management
23.	Cost management
24.	Sustainable finance
25.	Corporate Strategy Relationship
26.	Measurement vs. Management
27.	Organizational Learning
28.	Data Quality
29.	Establish priorities
30.	Ownership of project
31.	Establish continuous improvement processes method
32.	Clarify the role of health professionals
33.	Integration: Workflow, healthcare processes
34.	Information Flow Channels
35.	Empowering patients with information of their rights and responsibilities
36.	Patient satisfaction
37.	Minimizing waiting time(WT)
38.	Minimizing cost
39.	Minimizing medical errors(ME)
40.	Minimizing length of stay (LOS)
41.	Reward systems are required to motivate employees' morale respectively
42.	Staff loyalty and support
43.	Medical staff satisfaction
44.	Healthcare Community Cultural Acceptance
45.	Education or training of physicians, managers and nurses
46.	Project Team's Capability
47.	Reward systems are required to motivate employees' morale respectively
48.	Support for change from both leaders and staff (Business process improvement concepts)
49.	Employee satisfaction
50.	Reward systems are required to motivate employees' morale respectively
51.	Staff loyalty and support
52.	Recruiting and developing IT staff with the appropriate skill set (i.e. PM, HL7)
53.	Top management satisfaction
54.	Sustainable supply and authenticated vendors
55.	Vendors and suppliers fare competition
56.	Vendors and suppliers satisfaction
57.	External Supplier's Support
58.	Understand users, tasks, and the environment;
59.	Collection of appropriate information by front-line staff
60.	Integration of technical services and solutions
61.	Cost benefit analysis for health informatics projects
62.	Staying current with the rapid changes in technology
63.	Policy of access, communication and participation
64.	Enable users of e-Health services to reap the benefits of online communities
65.	Immature software industry
66.	User Involvement and Cooperation
67.	Information and awareness about e-Health applications
68.	User-Friendly System
69.	Appropriate design and content of e-Health services
70.	Flexibility
71.	Mobile Communication Suitability

72.	Follow up with users;
73.	Access of timely information by front-line staff
74.	Dependence on online systems in the absence of redundant solutions
75.	Trusted, Transparent, Bureaucracy, Higher, Feedback and Up-to-date processes
76.	Adequate and reliable networking between health care providers
77.	Delivery performance
78.	maintaining control
79.	Hands-on support
80.	Communication