

A Review of Health Information Technology Implementation Success Factors: Importance of Regulation and Finance

Thi Thanh Hai Nguyen, Kaija Saranto, Tommi Tapanainen, Diana Ishmatova

Abstract

Finding the factors contributing to the successful implementation of Health Information Technology (HIT) can help relieve the stress on healthcare systems worldwide caused by e.g. aging populations. This research reviewed the existing literature and identified 16 success factors for HIT implementation, of which one, the influence of external environment, was not found by prior reviews. This factor is crucial in HIT implementation because healthcare organizations in many countries are highly regulated by government policy and dependent on subsidies. The existing research showed a clear tendency for qualitative empirical work in HIT implementation, and in particular, on individual case studies, creating the need for future quantitative research on HIT implementation success factors. The review also suggested a pyramidal research approach and a taxonomy which shows the interactions of different stakeholders with implementers. These can serve as a reference for scholars and implementers of HIT in studying HIT implementation success factors.

1. Introduction

Many healthcare organizations are now utilizing HIT (an “umbrella” concept which is explained in part 2) to improve their operation [1]. Successful implementation of HIT that results in benefits for the organization is often, however, challenging. There is a need to closely link these technologies to organizational processes and routines. Moreover, healthcare environments are characterized by high safety requirements for the systems and data processing, restrictive government standards and legislation, and traditional division of work, constituting challenges that further complicate HIT implementation. This research was to undertake a review of the literature to add to our knowledge regarding what is currently known about the state of HIT implementation as a whole. The outcomes of this review provide taxonomy of success factors that can help different stakeholders in future implementations. Eventually, it can also contribute to a knowledge base of strategies and methods to facilitate implementations and to the subsequent achievement of organizational objectives. Research questions are “How has the topic of HIT implementation been studied” and “what have

been identified as success factors in HIT implementation”.

It is difficult to define “success” or “failure” in general terms because this can depend on the criteria used and the point of view of the interest group in question, i.e. one person’s failure may be another’s success [2]. For example, [3] concluded that success and failure in HIT is composed of six different aspects (i.e. the willingness of the users, fulfilling the role and tasks, supporting good medical practice, benefiting the healthcare organizations, and easily be upgraded). In practice, however, success defined with any one of these aspects may be disputed depending on the interests of the evaluating party. One minimum standard for project success may be that the project was not prematurely stopped [4]. In this paper, we accept the definitions of success used in the articles we reviewed, which were rarely stated explicitly. Therefore, these success definitions are likely to subsume the interests of various parties involved in the HIT projects, rather than just one party.

2. Research Methodology

This literature review to examine HIT implementation was divided into four phases: planning, selection, extraction, and execution [5]. The following keywords were employed: “implementation”, “health information technology” or “health information system”, or “electronic health” or e-Health, or “medical informatics” and “success”. Professional databases (i.e. PubMed, Medline, CINAHL, and Web of Science) were used. The search was not limited to any publishing date.

The first search was performed at the end of February 2012 and repeated four months later. Two new key words, namely “health information system” and “medical informatics”, were added in the second search. The third search with the same search terms as the second search was conducted in February 2013.

The screening phase examined the studies more closely to assess their relevance. Data extraction was undertaken using Excel sheets to summarize the papers and classify the implementation factors of HIT.

In the last phase, the reviewers aggregated, discussed, organized, and compared the findings and actually wrote the review. The publications were analyzed and presented according to the reviewing

framework determined in the extraction phase above. The major factors and trends in the HIT implementation in the papers reviewed were identified and grouped. The findings are presented in the tables and described in the narrative text below.

3. Study Selection

In total 487 papers indexed on search terms were identified and reviewed to include only articles that met the selection criteria: (1) focus on HIT implementation, (2) data content of HIT implementation analyzed, (3) success factors or recommendations presented, (4) addressing organizational factors, (5) paper written in English and peer reviewed, (6) non-academic papers such as technical reports, description of systems with no analysis and news articles were excluded, and (7) articles electronically retrievable as full texts or available locally. As a result, 271 papers were excluded and 170 papers were retained for more detailed evaluation. However, of this number, 92 papers were duplicated and 30 papers were not available electronically or could not be obtained locally. After screening the full papers, 58 papers were excluded because their scope was on national analysis rather than the organizational level (9 articles), their focus was not on HIT implementation (43 articles), or they lacked keywords or other standard indicators of scientific papers (6 articles). Finally, 36 papers were included in the review (Figure 1).

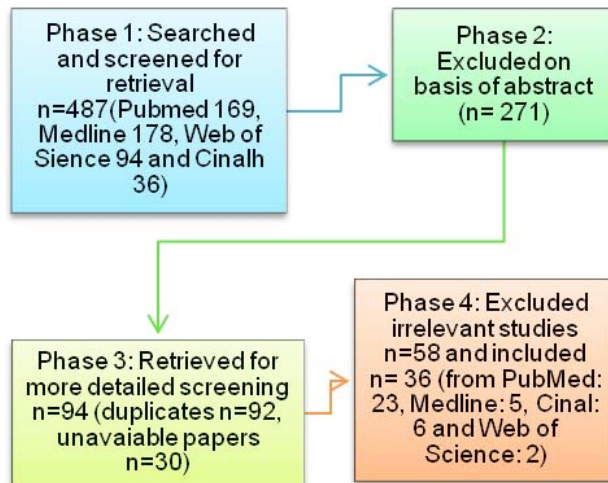


Figure 1: Flow diagram of the review

The papers included in the present review were published between 2001 and 2013. More than 86% of the studies had been published after 2006. Publishers included diverse fields in around 20 different journals

and conferences, including health care management, medical informatics and medicine. The majority of the studies were conducted in North America (69.45%), of those 61.11% and 8.34% were from the United States and Canada respectively. 19.45% of papers were from European countries (the Netherlands: 2, the United Kingdom: 2, Italy: 1, Sweden: 1, and Spain: 1). The remainder were from Australia (1), Israel (1), and Mexico (1).

Of the 36 articles reviewed, electronic health records (EHR) (n = 11 studies) was the type of technology covered most frequently, followed by computerized physician order entry (CPOE) systems (n = 5); and 4 pertained to electronic medical records (EMR). Other forms of technology were e.g. clinical decision support systems (CDSS), Tele-homecare (Intelligent Distance Patient Monitoring), Microsoft Access (used in Diabetes Self-Management Programs) digital imaging system (PACS), interactive health communication system (IHCS) and Health Information Technology (HIT)/Health Information System (HIS) as a general term.

4. Research trends

The studies could be divided into four types: empirical studies, model-building studies, conceptual papers, and literature review studies (Appendix 1). The empirical studies (27 papers from [6] to [32]) were all case studies and action research-type studies using qualitative research methodologies (e.g. interviews, observation and documentation analysis). In the case studies, the researchers were outsiders in the HIT implementation projects, and in the action research-type studies, the researchers were concurrently members of the HIT implementation projects, describing their own experience and knowledge gained after the project had been completed.

The model-building articles (5 papers from [33] to [37]) concentrate on building holistic theoretical frameworks such as implementation success models using the literature. They are similar to conceptual papers (i.e. [38], [39]) in using the prior literature to make theoretical conclusions but differ from conceptual papers in that the conclusions in the latter are more limited in nature. Literature reviews (i.e. [40], [41]) deal with a specific topic or analyze existing data to arrive to a new understanding of a topic. In short, the analysis of earlier studies suggests the research in HIT implementation has tended to fall into one of two groups: one with case-study method provides lessons learned or recommendations grounded on data collected or/and experience gained from individual case studies, and the other attempts to create generic models.

5. Success factors based on empirical studies

Table 1: Success factors from empirical studies

Success Factors	Explanation	References	Number of studies	Percent of studies
End-users				
Information, training & technical support	Such as past experience in technology, change and innovation, innovating mindfully, staff educators, models of shared local training and support, stressing the benefits, and providing evidences	[6], [7], [8], [9], [10], [11], [12], [13], [14], [15], [16], [17], [18], [19], [20]	15	41.67%
End-user participation	End-user participation and involvement in the development of the system can assist to meet the need of end-users & organization	[6], [8], [15], [16], [18], [20], [21], [22], [23]	9	25.00%
Champion	Assigning a physician, who is enthusiastic about the system itself, to champion a project led to success. He/she is also called a change advocate, change agent, or idea champion.	[6], [11], [15], [16], [20], [24], [25], [26], [27], [28]	10	27.78%
Incentives, regulations and/or other policies	Financial support/awards for active promotion of the system use or regulations which motivate/compel system use	[24]	1	2.78%
Quality of system, information and service	Such as usability, reliability, timeliness and accuracy	[23], [27]	2	5.56%
Infrastructure Quality	Such as connectivity, interoperability, standardization, integration, privacy and security	[7], [9], [14], [16], [28]	5	13.89%
Leaders				
Sufficient Resources	Such as finances and staff	[7], [14], [25], [30]	4	11.11%
Commitment and support from executives leaders		[8], [11], [25], [29]	4	11.11%
Implementers				
Project management and planning	Such as scope, schedule, budget of project, change management and implementation plan /strategy	[7], [8], [9], [12], [16], [22], [27], [29], [17]	9	25.00%
Performance of the project team	The ability of multi-disciplinary teamwork to complete the task	[9], [12], [8], [20], [23]	5	13.89%
Organization				
Cooperation and collaboration among administration, IT, and clinical functions		[17], [21], [25], [30], [31], [32]	6	16.67%
Co-development of system and workflow	Redesigning workflow when modeling systems including re-engineering process, understanding the organizational context, understanding the extent to which the new IT-system affects the organization, its structure and/or work procedures	[7], [8], [15], [21], [23], [28]	6	16.67%
Openness of the organization to change and innovation		[11], [14], [15], [19]	4	11.11%
Vendors				
Collaboration with the vendors		[22], [29]	2	5.56%
Other stakeholders				

Influence of external environment	Such as economics, healthcare reform, competition and government policies	[27], [30]	2	5.56%
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5.1. Provision of information, training and technical support

Studies (e.g. [8], [9], [11], [12], [13], [18] [20]) reported that adequate staff training was crucial to successful implementation. Particularly, small practices need much more training and support from vendors than do large groups since they do not have enough dedicated information technology staff and an administrative layer that could plan work flow and train staff [7].

Knowledge translation and innovating mindfully were also found to play an important part in the success of the project [10], [19]. Mindful innovation favors innovation acceptance and positive outcomes. Conversely, innovating mindlessly indicates following fads, fashion, or best practices without paying attention to the specifics of the project context. This increases the risk of human resistance and limited added value [19].

5.2. End-user participation

Studies (e.g. [6], [8], [16], [20], [21]) reported that end-user participation in the system development and implementation was fundamental to the success since it led to good user acceptance and signs of positive impacts on work practices. When the end users were actively involved in the design and implementation process they could report their information needs or concerns directly to the implementers which can increase the contribution to clinical practice [21].

5.3. Champion

Several studies (e.g. [11], [15], [16], [20], [24], [25], [26], [27], [28]) found that a physician as a champion for the implementation project could improve its chances of success. At sites where a clinical champion was identified, implementation was generally much faster [24]. Furthermore, the clinical champion helped identify a technical champion to coordinate installation and encouraged overall acceptance of the new clinical application [20].

5.4. Incentives and regulation

Incentives, whatever their form, are necessary to encourage adoption and lay the concrete foundation for implementation [24]. Financial incentives such as cost

sharing or financial sponsorship from organizations are required to drive implementation decisions. However, incentives, even financial incentives, are occasionally insufficient. Then, strong administrative guidance may be necessary to direct HIT implementation [24].

5.5. System, service and information quality

DeLone et al. found that if the quality criteria of system, information and service are good then the system will be used and the user satisfaction improves, and these have positive impacts on both the individual and organizational levels [42]. In other words, to maximize the chances of success, the system characteristics must be paid attention to. Improving system design can serve to mitigate the general doubts about the rationale for systems [23], [27].

5.6. Infrastructure quality

Telecommunications capability, rigorous security, interoperability, standardization, and connectivity of clinical information systems are important for quick adoption and to make the system useful for the participants by allowing them to access and input events [9], [14], [16]. National standards on the interoperability of medical data systems would be a big step forward for small practices [7].

5.7. Sufficient Resources

Sufficient resources (e.g. finance and staff) are important to ensure sustainability of HIT projects [14], [25], [30]. The source of such finances is often from the healthcare organization and/or the government, but researchers point out that alternative sources of finances – such as insurance companies and the patients themselves – for HIT need to be considered as well [7].

5.8. Commitment and support from leaders

There are many difficulties and challenges in the process of HIT implementation [43]. However, with the commitment and support of the top management team, the project team could overcome the obstacles to implement the systems successfully [8], [11], [29]. For example, the Vice President and the Chief Nursing Officer provided financial and organizational support to the taskforce which contributed to the project success [25].

5.9. Project management and planning

The implementation plan should define the scope of the project and include methods to align the goals of the organization and to identify, evaluate and overcome unanticipated challenges [9], [12], [27], [29]. The implementation plan should also include change management for the work processes. As about 80% of project resources are allocated to process change management including e.g. training hospital staff and integrating new e-Health procedures into clinical practice [16], a detailed change management plan is required to ensure that these resource-intensive tasks are understood at the outset.

5.10. Performance of the project team

The implementation of any system has to be managed by a project-group, which should have representatives from the IT, administration and clinical department which are the future users [9], [12], [20]. Inclusion of the clinical personnel in the project group helps in building a system that fulfills the need of the future users and also encourages the eventual adoption of the system [8].

5.11. Collaboration among administration, IT, and clinical functions

Interdepartmental collaboration or collaborative relationship between physicians, hospital administrators, IT specialists, and other stakeholders (e.g. state officials) is necessary [17], [25], [30], [32]. For example, [18] stated that IT staff should collaborate with nurse and physician leaders in planning process redesign. In a hospital setting, closing the gap among the medical informatics minority, the health professionals and the hospital management, through their collaborative responsibilities and participation in the decision-making process can make the difference between the success and the failure of a good computer-based solution [31].

5.12. Co-development of system and workflow

As already pointed out by [44] in his classic article, work redesign can have considerable merit in IT implementation. This is true also in HIT projects. An understanding of the work processes and information flows of the current process configuration is necessary to design new, more efficient processes with the possibilities afforded by the capabilities of the new system. While the characteristics of the new system

should be planned to match the new envisaged process scheme, the efficiencies provided by this redesign can also help to gain user acceptance of the new system [7], [8], [23], [28].

5.13. Openness of the organization to change and innovation

As shown by [45], some individuals are more prone to adopt new technology than others. The presence of these early adopters and opinion leaders who can draw their peers into adopting the new HIT can facilitate the adoption process of the implemented system. These people should be included in the development team and be targeted first in the adoption trials [11], [14], [15].

5.14. Collaboration with the vendors

One important factor in HIT implementation is developing relationships among the healthcare organization and the vendors. Such cooperation can help in bringing together the latest IT expertise and practical clinical expertise in the organization, which is crucial in solving problems that arise during the implementation [29]. This relationship-building can also help in understanding the long-term potential of the technology and therefore give knowledge of new IT that can further contribute to the IT strategy of the healthcare organization [22].

5.15. Influence of external environment

The external environment can affect HIT implementation through the regulatory and legislative system as well as financial conditions related to the general economic environment and government subsidies [27]. The actions of the national and local government thus have direct bearing on the success of individual HIT implementations in healthcare organizations through these instruments [30].

6. Contribution

Two prior literature reviews were found on the topic, one of them focusing on the whole of HIT [40] as this review, and the other concentrating on a limited subfield of HIT [41]. This review, however, found a success factor, "*influence of external environment*", that is not included in the set of findings of prior reviews.

In terms of practical implications for this finding, the external environment (e.g. regulatory and financial framework) is particularly important in healthcare

because healthcare in general and HIT in particular is often heavily regulated and financed by the government. The sustainability of many HIT projects is threatened when grants or financial support from the government are suspended [30], [46]. Other aspects of external environment such as standardized data contents or legal requirements which govern healthcare services as well as HIT applications can also have influences on the outcome of HIT implementation [47]. Therefore, e-Health implementation programs should be aligned with healthcare policies to ensure that HIT adoption is sustainable and to create the long term conditions for the success of HIT implementation [48].

Implementation programs should also carefully consider scenarios in which government aid is reduced and standards are introduced, etc. to account for the effect of external factors to program objectives.

Furthermore, this review significantly expanded on several crucial success factors of the prior review, as detailed on Table 2. In particular, our review expands [41] on “implementation process”, “management support”, “motivation and rationales”, and “trust”. The expanded success factor list that is the finding of this review can help scholars and practitioners to more accurately understand these success factors and define metrics for their measurement in organizations.

Table 2: Comparison of success factors between [40] and this review

[40]	This review
Education and training support	Information, training & technical support
Information need assessment	End-user participation
Implementation process	(1) Project management and planning (2) Performance of the project team
Management support	(1) Commitment and support from executive leaders (2) Champion (3) Resources
Work routines and workflow integration	Co-development of system and workflow
Motivation and rationales	(1) Incentives, regulations and/or other policies (2) Openness of the organization to change and innovation
Integration of the system	Quality of system, information and service
Trust	(1) Cooperation and collaboration among administration, IT, and clinical functions (2) Collaboration with the vendors
Technical system performance	Infrastructure Quality
Participation and user involvement	End-user participation
System effectiveness	Quality of system, information and service
No corresponding success factor	Influence of external environment

7. Discussion

Success factors or critical success factors are the key elements which have significant influence in achieving the intended goals of organizations. According to [49], critical success factors are "areas of activity that should receive constant and careful attention from management." The list of success factors found by this review assists the organizations concentrate on the right priorities since they are factors that have been found to be important repeatedly in different studies, confirming their central role in HIT implementation.

As a whole, the success factors that were found in this review cover many of the aspects of HIT implementation. However, what is truly important for a

given project can differ depending on the context, and therefore scholars and practitioners should enlist the success factors for their needs using the list given in this paper as a guideline. The relative reporting frequencies of various success factors also differs in the literature, and attention should be given to the fact that such reporting frequencies do not necessarily indicate the importance of a given factor in a certain project instance.

7.1. Taxonomy of success factors

The existing literature reviews on HIT-related subjects have addressed the implementation of individual applications such as Electronic Health

Record (EHR) in physical therapy setting [41] or Health Information Technology (HIT) in primary care or hospital [40]. These reviews applied different strategies, for example the keywords of [41] did not include “success” and “implementation” whereas keywords of [40] include implementation but not “success” and are limited to “qualitative methods”. While [40] used meta-analytic methods to extract data, [41] stated that formal meta-analytic methods were precluded from their review because of the heterogeneity in study design, setting, system characteristics, outcomes measured, and results reported.

Despite these differences/varieties, these papers shared similar “success factors”. For example, many earlier studies considered assigning a physician champion to the implementation project and provision of information, training and support to be crucial factors for successful implementation. While these success factors are supported e.g. [33], [34], [35], [40], [41] in the case of CPOE, EHR and HIS respectively, we found that these two success factors are most frequently referred to in HIT implementation research in general. While important lessons have been learned from these individual approaches, it is possible that some findings in these reviews can be widely applicable to HIT in general.

In addition, even though there are many differences in HIT implementation (such as different technologies and healthcare settings), there are six groups participating in the implementation: implementers, end-users, organization, leaders, vendors and external stakeholders such as state officers. We assign the success factors to the interest groups which they are most closely related to (see Appendix 2 and Table 1). The implementers (system designers, Chief Information Officers (CIOs)/IT managers, or project managers) are in the center, emphasizing that their responsibility is to understand the needs of each interest group – and the implicated success factors – in the implementation. For example, the implementers should manage their relationship with end-users since successful implementations generally require satisfied users. Thus, understanding factors that affect the technology adoption of end-users can improve chances of a system’s success [50], [51].

7.2. The pyramidal research approach

Future research can conduct surveys in healthcare organizations targeted to each interest group in order to understand the relative importance of these success factors. Further studies to understand each individual factor are also necessary and useful. For example, [52] studied the role of cognitive and learning theories in

providing effective training programs for a successful HIT implementation while [53] studied on methods to facilitate and improve real end-user participation. Regarding implementation strategy [54], [55] suggested different strategies in HIT implementation (e.g. Single-Vendor, Best of Breed Strategy and Best of Suite). We hope this pyramidal study approach (Figure 2) to contribute to create a solid foundation for the HIT implementation science.

While a certain number of factors such as the HIT adoption of end-users (e.g. [43], [47], [51], [56], [57], [58], [59]) have a wealth of earlier research, some factors have received a little attention from both research and practice community. For example, despite the importance of the “external” factor as discussed above, this review found that research on this factor is still limited. Thus, further studies on how government finance mechanism is supporting the successful HIT implementations, how IT strategies and healthcare reform are aligned, or what kind of long-term development healthcare organizations experience in response to technological changes should be conducted. In addition, very few papers have conducted further studies about implementers who are usually CIOs/IT managers of the organization. The role of IT managers is crucial since they are often the change advocates of IT-related endeavors [60], [61]. An effort is needed to make clear the added value that a health informatics group can achieve and what kinds of skill or ability they need to contribute to the success of HIT implementation. This could be an important avenue for future research.

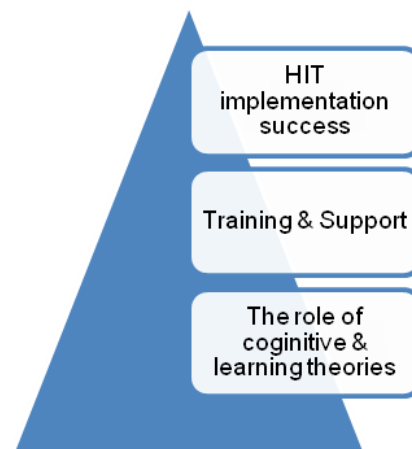


Figure 2: An example of a pyramidal research approach

8. Conclusion

This paper aims to identify the current state of knowledge about successful HIT implementation. It found that besides the attempt to systemize the factors, many studies reported the experiences of scholars involved in individual cases of implementation. The review also found the “influence of external environment” success factor and discussed two approaches which can be applied to identify the research issues in HIT implementation science. For example, among others, the research on “the influence of external environment” and “implementers” was still limited despite their importance roles. This review set out to organize the knowledge gained in previous studies. Thus, further studies on these themes are recommended.

A limitation of this study is that the literature search was restricted to databases in the healthcare field. Databases in other scientific fields, such as information systems management, were not used. The reason for this was that prior literature reviews had also concentrated on these healthcare field databases. It could therefore be expected that most relevant literature would be found in these professional databases as opposed to databases in other fields not related to healthcare.

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Appendix 1: Comparison of different types of research in HIT implementation

Type	Number of articles	Technology	Setting	Country	Research Methodology
Empirical	27	Various HIT such as Clinical Decision Support Systems (CDSS), Computerized Provider Order Entry (CPOE), EHR, EMR, Telehomecare and Microsoft Access (used in Diabetes Self-Management Programs)	Various settings such as healthcare centers, family practice, hospitals, and nursing home large or small, in the city or rural areas	Australia, Canada, Italy, Israel, Mexico, Spain, UK, USA, The Netherlands,	Qualitative method: Case studies (e.g. interviews, observation and documentation analysis and case description). Two types of researchers: 1. Outside of the HIT implementation projects or 2. Members of the HIT implementation projects
Field guides/ Principles/ Model	5	EHR, CPOE and Interactive health communication system (IHCS)		USA	Three different methods 1. Based on the practical experience to provide the “field guides” 2. Used a grounded theory to analyze the collected data from the panel expert to create a consensus set of recommendations for CPOE implementation and then reconciled with the data from case-studies to create the list of principles 3. The model was conceptualized (by an advisor-panel), developed (interviewing key informants), and validated (survey and statistics)
Literature Review	2	EHR and HIS	Physical Therapy Hospitals, primary care	USA and Sweden	
Conceptual	2	Patient care information system (PCIS) and Health Information Technology (HIT)	Healthcare organizations	USA and The Netherlands	

Appendix 2: Different perspectives in implementation

