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Modification and Validation of a Maturity Assessment Tool for Public Health Information System Implementations in Sri Lanka

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Abstract

Introduction: Maturity models assess the snapshot view of an organization and simultaneously guides the organization to advance on a road map towards ultimate levels of maturity. The health industry has recently embraced maturity models as a tool to improve the management of health information systems. Most electronic health information systems in Sri Lanka need assessment and monitoring and can benefit vastly by adopting maturity models. This study was conducted to modify and adopt a maturity model for public health institutions in Sri Lanka.

Methods: A review of the literature was done to identify a suitable model to measure the maturity of the public health information system implementations. A Modified Delphi study was then carried out with six experts to adapt the selected maturity tool, Public Health Information Technology (PHIT) maturity index, to the Sri Lankan context. Necessary modifications to the PHIT tool were done according to the comments gathered in the Modified Delphi rounds, and the validity of the tool was established. Finally, Key Informant Interviews were carried out with nine interviewees to qualitatively validate the instrument.

Results: The Public Health Information Technology maturity index developed by the University of Maryland, USA, was modified to suit the Sri Lankan context. Comments from the experts were accommodated during the initial rounds of the Modified Delphi study. It further derived the following values, indicating excellent content validity: I-CVI > 0.8 for 57 total items, S-CVI/Avg = 0.988, S-CVI/UA = 0.929 and Free-marginal kappa = 0.95.

Discussion and Conclusions: Modified and validated PHIT tool can be used to measure the maturity of public health institutions in similar contexts.

Keywords:

Maturity Models, Public health information systems, Public health information system management

Introduction

Significant investments are made to develop and implement many electronic information systems in the world[8]. This has led to the arbitrary emergence of numerous types of information systems in every industry. In the recent past, there have been efforts to revisit and reform the implementation strategies in order to standardise these random manifestations[17]. On the other hand, the necessity to evaluate and improve the functions and performances of the systems has been increased due to the rapid growth of demands within institutions[17]. Recently, consultants and researchers have developed a wide range of maturity models for the purpose of measuring and recommending certain facets of the "maturity" of information systems. Maturity models have the potential to assist the managers of healthcare organisations in accomplishing their goals[12]. These models are built on the understanding that information systems grow with time, from one level to another[1].

Maturity can be described as a particular method to explicitly define, manage, measure and regulate an evolutionary path of an entity or an organisation[12]. The term can be generalised as "a measure to evaluate the capabilities of an organisation with regards to a certain discipline"[21]. From the perspective of the information systems, it can be described as a way to define to manage and to measure the evolution of specific processes of an information system[16,18]. The definition of "maturity models" is a frequent term being used in the vicinity of information systems (IS) both as a proactive approach to continuous improvement and as a means of self-assessment. There have been numerous types and versions of maturity models since their introduction to the field of information systems. In particular, the popularity of maturity models increased in the late 1980s with the introduction of the Capability Maturity Model (CMM) and its successor Capability Maturity Model Integration (CMMI) [11].

Maturity models are defined as a series of sequential stages from the initial stage to the optimal final stage of maturity. The levels can be qualitatively or quantitatively defined in a stepwise manner to achieve full capability[24]. Maturity models are valuable tools that can be used for auditing and benchmarking information systems. It serves as a measuring instrument for assessing progress against targets. Using maturity models, managers can easily understand the strengths, weaknesses, opportunities, and threats of an information system. It also supports decision-makers in project management and in the development of organizational policy[19] as these models can guide the information system managers to concentrate on the less mature aspects of the system. Hence, improvements can be more focused and aggressive[16].

Maturity models are needed for healthcare to improve the processes of the care pathway, resources and infrastructure. Patient safety, data interoperability, data privacy and security are of the highest importance to the success of the health information systems. There are numerous maturity models used in a hospital setup [3]. The public health component is almost unattended in the above models. However, if it is run optimally, public health information systems have the potential to improve the efficient and effective use of information when achieving public health objectives. In other industries, models of information technology maturity have been widely used to guide the assessment and for planning activities of system implementations. Information technology maturity model tailored for public health information systems has been unfortunately unavailable since re-

cently[4]. To fill this gap, Public Health Information Technology Maturity Index was created by a team of researchers from the University of Maryland, USA in 2015. This Maturity Index includes four primary measurement categories and 14 subdimensions associated with 57 questions and a scoring rubric. The index refined an expanded view of the capabilities required of diverse public health institutions, the challenges they face, and the strategic, political, and tactical operating environments public health institutions must manage, all of which may influence information technology strategy[4]. Except for this research, maturity model development for public health systems are scarce globally.

In Sri Lanka, application of such models has not been made for the curative or public health sector according to the available published literature. Curative health sector medical record implementations in Sri Lanka are still in the inception stage, and only portions of the medical records are being computerized[7]. In contrast to this, public health information systems are established island-wide and might benefit from a maturity assessment due to their operational capacity and coverage. Therefore, it is quintessential to search for the ability to adopt a suitable maturity model for the utilization of public health institutions in Sri Lanka. Hence, the research question was "How to measure and compare the maturity of Public Health Information Systems in Sri Lankan context?". This research focuses on adopting maturity models for public health institutions in Sri Lanka.

Methods

Public Health Information Technology (PHIT) maturity index [4] was selected from the literature review to be modified to suit the context. It is evident that tools should be modified and validated when used in different contexts[20]. The modified Delphi method[5] was used to culturally adopt the maturity assessment tool. Modified Delphi is procedurally similar to its predecessor (Delphi method), the only difference being starting with carefully selected questions or a tool[5]. This method is considered to be advantageous in terms of response rate and credibility as it helps to establish the reliability of the initial work on literature or previously developed tools. The Delphi method helped them to validate and improve the tool. The selection and the composition of the expert panel were based on the Van de Wetering and Batenburg PACS maturity assessment tool modification using six experts (three radiologists, neurologist, medical informatics research scientist, technology expert)[27]. There are many studies[9] done based on the modified Delphi method. However, the method here is mostly instigated by Kumar & Mahal's modified Delphi technique described in their research of tool development for the risk assessment of prediction of pressure ulcer[9].

The research was carried out in selected five public health institutions. Three health informaticians who are pioneers in driving most of the public health information system implementations in Sri Lanka and three other experts (Community Care Physicians) in public health contributed to the modified Delphi rounds (As an additional method to increase the credibility of the face validation, seven registrars and three senior registrars of health informatics MD, one ICT officer and one data entry operator who are not working in the selected five public health institutions were also selected.). The participants were initially approached by e-mail and telephone and the principal researcher met all the experts in person to explain the tool and to get consent.

The Modified Delphi review was conducted using e-mail and with the help of the online forms where participants were initially encouraged to express free opinion and a new version was circulated in the next round accommodating the comments. In the second round, a rating sheet was used to obtain ratings for each question of the tool.

The tool was assessed for;

- Relevance in assessing the maturity level of the system
- Appropriateness of wording
- Cultural Acceptability in the local context

After the second round, a conclusive third round was held where all experts agreed on consensus. Key-informant interviews were later taken into consideration for further modification of the tool.

The following facets of validity were assessed.

- Face validity (Qualitatively)
- Content validity (Quantitatively using I-CVI, S-CVI, Kappa statistic[22] and Qualitatively)
- Construct Validity (cannot be quantitively calculated as the sample size is very small)
- It is evident that the validation of a quantitative tool can be achieved by qualitative methods according to Hyrkäs et al.,[6], and Mullens and Kasprzyk[14] hence underpinned by a qualitative assessment using the key informant interviews apart from the modified Delphi study.
- Internal consistency (Cronbach's Alpha value calculated)

Content validity was assessed using CVI values and Kappa value. Content Validity Index is used extensively for quantitative assessment of content validity. To retain more credibility, a mixed-method approach was occupied to both qualitatively and quantitatively assess the content validity.

Results

Face validity of the tool

Face-validity applies to subjective evaluations of the appearance and significance of the measuring instruments by researchers to inspect whether the objects in the instrument look appropriate, fair, unambiguous and transparent[15]. Face validity was qualitatively analysed by consulting six experts in the field, three health informaticians who are pioneers in driving most of the public health information system implementations in Sri Lanka. Also, the other three experts (Community Care Physicians) in public health contributed to assess face validity. All agreed that relevancy, ambiguity, fairness and clarity are retained.

As there was debate over whether the people outside of the said domain should be incorporated to conclude the face validity, seven registrars and three senior registrars of health informatics MD, one ICT officer and one data entry operator who are not working in the selected five public health institutions were invited to assess the face validity. This was conducted to ascertain the credibility of the validation methodology. All agreed that the tool was clear and relevant.

Content validity

Calculated values for CVI (I-CVI and S-CVI/ S-CVI/UA) are as below.

- I-CVI > 0.8 for 57 total items
- S-CVI/Avg = 0.988
- S-CVI/UA = 0.929

Rating scores were dichotomised to 'relevant' and 'non-relevant'. The Likert scale values were 1-4. Values of 3 and 4 were considered relevant, and values of 1 and 2 were considered not relevant.

Kappa value is calculated (0.95). Free marginal Kappa is considered best for multi-rater Kappa statistics. The famous multi-rater kappa of Fleiss is considered to be affected by prevalence and bias, which can contribute to the phenomenon of durable, yet a minimal kappa value[22,26,29].

- Percent overall agreement = 97.66%
- Free-marginal kappa = 0.95
- (95% CI for free-marginal kappa [0.91, 1.00])

Internal Consistency

Cronbach's Alpha value for the tool was calculated and yielded a value of 0.93, indicating an excellent internal consistency.

Inputs from Key Informant Interviews

As the first part, the quotations were analysed to find further suggestions to modify the tool. The following figure is a summary of the quotations that were combined in the code ‘domains to be added’. The items suggested were process management, standard operating procedures, accessibility under standards, interoperability and change management.

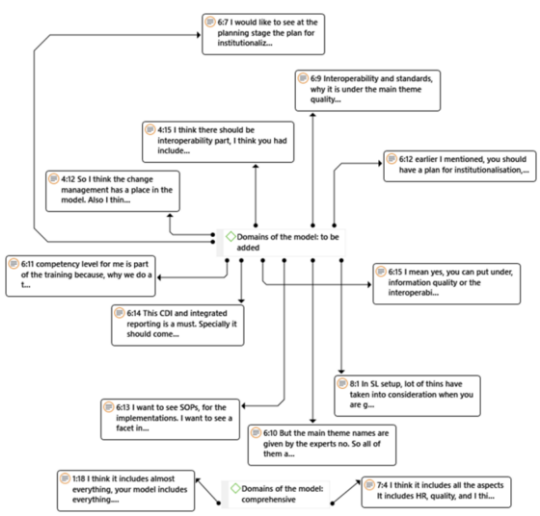

Figure 1: Summary of Quotations Analysed

Discussion

The PHIT maturity index was a good choice as per the many key process areas that it carried. It was an added advantage that it was from the health domain. It is a hybrid type maturity model where you have both level placement and road-mapping to indicate how to achieve higher maturity levels. Considering the above, it was deemed ideal for the Sri Lankan public health setup. The model comprises of four key process areas and 14 subdivisions of the key process areas. The main four includes Scope, Quality, Human resource, policy and infrastructure and community digital infrastructure.

Discussing the modification of the tool, the main focus area is a modified Delphi study, where the experts expressed their opinion on the relevance of the questions in assessing the maturity of the system, appropriateness of the wording of the questionnaire and the cultural relevance of particular questions. Experts were representing the community health as well as the health informatics domains. Free comments were allowed in the initial round. Several suggestions were gathered and analysed via e-mail.

The words in the original tool, “somatic, behavioural and social service sites” were modified. As Sri Lanka does not have such kind of demarcation between the public health institutions and the services are delivered by mostly the same staff using the same resources, it was decided that the most logical demarcation can be considered as the MOH (Medical Officer of Health area), District and National levels. It was incorporated in the questionnaire by consensus to retain the pattern of the answers.

Questions 13-17 were there considering the public health organisation as a holistic unit, delivering its services to address the entire set of health needs of the client(patient). Most of the experts agreed that it is not true for the Sri Lankan setup. Therefore, for easy completion, researchers created some scenarios depending on the question scope.

For clarity, some terms were explained at the beginning of the tool. (e.g. service site, service area, institution, systems). Changing question number 56 – immunisation register into school health related question retaining the answer pattern was done. Naming convention, question number 52 – ‘Outpatient clinic’ was re-named to ‘GP Clinic’. In question number 23, the percentages were adjusted to 90% instead of 75% as all the systems are implemented Island wide.

The above-mentioned changes were done after the first round, and the questionnaire was circulated for a rating on a Likert scale of 1-9. An online form sent in mail was used to collect the rating scores as well as any other comments. The comments were nil, except one which read: “I think better if explain industry-wide standards a bit”. According to the comment, a table explaining the industry-approved standards was added at the end of the tool.

According to the ratings for relevance, the questions 3, 13, 14 and 15 got low scores. These questions were regarding the Electronic Health Record (EHR). The concept of EHR still being new to the public health scenario in Sri Lanka, there have been many pieces of research done inside and outside of the country on the adoption of EHR in the public health setting. The principal researcher in a previous study has piloted an electronic child health record to be continued as an EHR at the MOH level[13]. Even though it is new to the system, there is no debate that it should be there.

According to many studies, tools that are used for research can be qualitatively validated. However, this tool was validated in a mixed approach, as the sample size is only 5 and factor analysis to determine the construct validity is not reliable when the sample size is too small. However, as the original tool was validated in a public health setting and construct validity was established, by proxy it can be justified that the population was similar, and the validation proves to be true for our context too.

On the other hand, that argument can be hindered, by the fact that the service delivery structure of public health institutions of the USA and Sri Lanka are dissimilar. To overcome this, the validity of the questionnaire was supported qualitatively, using KIIs. During the KIIs, some deficiencies were identified according to few experts. They suggested that the questions regarding Standard Operating Procedures (SOPs), accessibility and change management should be included. The suggestion of changing the names of the key process areas was to be critically analysed with the help of more experts and should be addressed in a newer version.

The other concerns of the experts were about proper documentation of the expectations of the ultimate level of maturity and the methodology (frequency, responsibility, the mode to administer) to follow when conducting a maturity assessment.

Conclusions

This study aimed to modify and validate a maturity model to measure the maturity of public health information systems in Sri Lanka. Public Health Information Technology (PHIT) tool is selected as the tool to measure maturity as it included most of the key process areas used in health-related maturity models.

The PHIT tool was then modified to apply to the local context. Modifications mostly focussed on the cultural adaptation of terminology. The modified tool was validated quantitatively and qualitatively. The PHIT tool is, therefore, suitable to use in public health maturity assessments in Sri Lanka.

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