A Role of Training in The Successful Implementation of Hospital Information Systems

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Abstract—The adoption of HIS has many benefits including reduced waiting time, errors, less paperwork and errors, and easy data retrieval and reporting. The research aims to define whether the training provided by the IT department has an effect on the successful implementation of HIS at the hospital. System and information qualities were significantly associated with the benefit of HIS. Data taken from 296 hospital employees of Mongolian Japan Hospital is used to assess the effect of the implementation of HIS on employee satisfaction and individual benefit. Training had a mediating role in enhancing the effects of system and information quality effects on net benefits perceived by employees. Assessing individual training results may lead to the effective administration of training at the hospitals.

Keywords—training, HIS, information quality, system quality, individual benefit.

I. INTRODUCTION

With the evolution of information technology Hospitals have been adopting hospital information systems (HIS). A variety of categories of HIS are utilized, for instance, Clinical decision support systems (DSSs) to enhance the quality of decisions by managers and physicians; Electronic Data Interchange to fasten admission/discharge/transfer of patients; Knowledge Management Systems (KMS) to support financial and marketing activities; and Picture Archiving and Communication System to archive and transfer images.

This study aims to evaluate the performance of IS in public hospitals based on the Delone and McLean IS success Model and the Technology Acceptance Model. The DeLone and McLean IS Success Model [1] recommends six distinct factors, predicting the success of IS, System Quality, Information Quality, Service Quality, Intention to Use, User Satisfaction, and Net Benefits [2, 3]. TAM model advocates promote Ease of Use and the Usefulness of the system as determinants of effective use of the system. Several previous studies have utilized both models in the evaluation of HIS and the results were different. For instance, Van Der Meijden et al. [4] and Park et al. [5] examined a variety of HISs of different medical organizations and found that both System Quality and Information Quality significantly influenced User Satisfaction. Pai and Huang [6] examined the influence of three quality determinants of HIS, system, information, and service, on user satisfaction through the mediating factors (perceived ease of use and perceived usefulness) by utilizing path analysis for the structured equation model (SEM). Intention to Use is an important success factor, focusing on Net Benefits as an outcome factor [7].

Delone & McLean (2003) measured success in two levels, as the net benefit of a system for individual work practices and organizational impact [8]. These success factors were found to be also applicable to evaluating health information systems [9]. Moreover, successful implementation is strongly related to end-user perceptions and involvement. As defined in previous studies, key attributes include the support of management, training or education, organizational aspects such as culture and rewards, design of the system, and project management (e.g. IT support) [9, 10]. Hence, these factors may define the success of the implementation of IS.

As Baus (2004) defined usability is one of the critical factors in the successful implementation of the HIS. Time, training, and/or monetary investments are critical factors to provide adequate training to learn how to use the new system. The implementation of IS at hospitals can be successful with
dedicated healthcare professionals who have had the opportunity to receive the education and training necessary to use the HIS and more easily integrate it into their unique setting. Follow-up training and on-site support are good methods to make content with the IS applications and ensure successful usage by users with different levels of computer skills [11].

Satisfaction is an intellectual and emotional response or feelings or attitudes toward an experience with IS [12]. Al-Maskari and Sanderson (2004) assessed “user satisfaction” as the main evaluation concept of information system success [13]. System usage and user satisfaction are surrogate measures of IS and are widely accepted and used as success indicators [14].

Furthermore, the usefulness of a system is often measured by examining user satisfaction. User satisfaction has systemic-dependent aspects, such as content satisfaction, interface satisfaction, and organization satisfaction, but also systemic-independent personal aspects such as individual dislike for computers [15]. Wong and Arjpru [16] identified awareness of IS as the critical factor that influences user satisfaction. Furthermore, they stated that IS management needs to have effective IS strategies to maximize user satisfaction to increase the use of an Information System over time. This can be implemented by continually providing regular training on the updates of the system’s abilities, supporting employees in learning new knowledge, and extending their skills.

Based on the above rationale, we propose that training plays a mediating role in the success of HIS and the main predicting factors of IS, system, information, and quality. To increase the use of an Information System over time, user satisfaction should be focused on and enhanced by continually providing regular training on the updates and supporting employees in learning new knowledge and skills.

II. RESEARCH METHODOLOGY

To accurately evaluate the efficiency of such systems, scholars propose different methods. In recent years, the use and satisfaction of HIS have mainly been evaluated in the forms of questionnaire surveys, in-depth interviews, individual case studies, and material collections. For instance, Lising and Kennedy [17] applied a qualitative study by conducting a behavioral observation to know the time allocation during the healthcare process. Lee et al. [18] used a one-to-one or one-to-many quality interviews to analyze the users’ opinions on a system. Meanwhile, the questionnaire survey method is the most widely used, aiming at user satisfaction and attitude toward the system. Hortman and Thompson [19] carried out open Q&A in both questionnaires and forms to identify users’ satisfaction and opinion, determining that nurses feel positive about the system by reducing paperwork, providing healthcare instruction, and being equipped with learning functions. Chae et al. (2011) utilized a survey of 44 tertiary hospitals and revealed that management support, standardization, and training had a significant effect on HIS adoption by employees [20].

III. RESEARCH INSTRUMENT AND SAMPLING

A questionnaire with 57 items in 7 groups was developed to collect data from 296 hospital workers including doctors, nurses, and administrative and technical officers of the Mongolia Japan Hospital through forms.google.com. The sample size was calculated as follows:

\[ n = \frac{m^2 \times (1 - P)}{\varepsilon^2} \times (1 - Z^2) = \frac{m}{1 + \frac{m - 1}{N}} \]  

Where: \( m \) is the sample size when the number of populations is unknown; \( n \) is the sample size; \( Z \) - 95% probability level Z value (1.96); \( P \) - probability level (0.5); \( \varepsilon \) - sampling error (0.05); \( N \) - Population

\[ n = \frac{m^2 \times (1 - P)}{\varepsilon^2} \times (1 - Z^2) = \frac{m}{1 + \frac{m - 1}{N}} \]

\[ n = \frac{1.96^2 \times 0.5 \times (1 - 0.5)}{0.05^2} = \frac{384.1 \times 0.05}{384} = \frac{203}{430} \]

The survey covered 296 workers of Mongolia Japan Hospital, which is higher than the estimated sample size (203), increasing the reliability of the sample. MS Excel and IBM SPSS Statistics25 were used to process the survey results.

IV. RESEARCH RESULTS

The survey covered 296 respondents which are 87.8% are female, 71.6% are 29-34 aged and 43.2% are doctors. Most of the participants (45.9%) are educated in bachelor's degrees and 50% are worked for more than 3 years (Fig 1). About using and working on hospital information systems 77% work on this system for up to 8 hours, and 45.9% answered that they need some help to work.

![Fig 1. General information about the survey participants](image-url)

The KMO (Kaiser-Meyer-Olkin) index of sampling adequacy is 0.867, which is above required minimum level, indicates that the sample size is satisfactory.

A principal component analysis resulted in 4 components with 30 items, including training, system and information qualities, and net benefit perceived by the employee (Table I). We used Cronbach’s alpha coefficient to test the reliability of the survey questionnaire. Reliability refers to the assessment of the degree of compatibility between the measurement variables of many subsections or the internal stability of measurement. Internal compatibility is acceptable if Cronbach’s alpha value is greater than 0.7. In our study, Cronbach’s alpha is at an appropriate level, which is between 0.915 and 0.977.
Hierarchical regression analyses have been performed to assess the effect of information quality, system quality, and training on the benefit of hospital information system adoption.

### TABLE I. FACTOR ANALYSIS RESULT

<table>
<thead>
<tr>
<th>Factors</th>
<th>Causes</th>
<th>Component 1</th>
<th>Component 2</th>
<th>Component 3</th>
<th>Component 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. HIS determines the final outcomes (change records)</td>
<td>0.879</td>
<td>0.877</td>
<td>0.872</td>
<td>0.875</td>
<td></td>
</tr>
<tr>
<td>2. The integration of HIS has an advantage to employees</td>
<td>0.873</td>
<td>0.872</td>
<td>0.871</td>
<td>0.875</td>
<td></td>
</tr>
<tr>
<td>3. The integration of HIS is beneficial for the hospital</td>
<td>0.864</td>
<td>0.873</td>
<td>0.872</td>
<td>0.875</td>
<td></td>
</tr>
<tr>
<td>4. HIS can make medical care better</td>
<td>0.859</td>
<td>0.873</td>
<td>0.872</td>
<td>0.875</td>
<td></td>
</tr>
<tr>
<td>5. The use of HIS can improve decision-making skills</td>
<td>0.852</td>
<td>0.873</td>
<td>0.872</td>
<td>0.875</td>
<td></td>
</tr>
<tr>
<td>Using HIS will equal save money</td>
<td>0.838</td>
<td>0.873</td>
<td>0.872</td>
<td>0.875</td>
<td></td>
</tr>
<tr>
<td>7. HIS can improve communication among staff</td>
<td>0.826</td>
<td>0.873</td>
<td>0.872</td>
<td>0.875</td>
<td></td>
</tr>
<tr>
<td>8. HIS is often used as work</td>
<td>0.777</td>
<td>0.873</td>
<td>0.872</td>
<td>0.875</td>
<td></td>
</tr>
<tr>
<td>9. The level of HIS for any work</td>
<td>0.880</td>
<td>0.873</td>
<td>0.872</td>
<td>0.875</td>
<td></td>
</tr>
<tr>
<td>10. HIS can make the process accurate</td>
<td>0.818</td>
<td>0.873</td>
<td>0.872</td>
<td>0.875</td>
<td></td>
</tr>
<tr>
<td>11. HIS has a positive effect on the quality of any work</td>
<td>0.782</td>
<td>0.873</td>
<td>0.872</td>
<td>0.875</td>
<td></td>
</tr>
<tr>
<td>Using HIS in daily work improves productivity</td>
<td>0.800</td>
<td>0.873</td>
<td>0.872</td>
<td>0.875</td>
<td></td>
</tr>
<tr>
<td>12. HIS information is accurate and updated</td>
<td>0.594</td>
<td>0.873</td>
<td>0.872</td>
<td>0.875</td>
<td></td>
</tr>
<tr>
<td>13. HIS produces a full report</td>
<td>0.813</td>
<td>0.873</td>
<td>0.872</td>
<td>0.875</td>
<td></td>
</tr>
<tr>
<td>Results from data analysis are reliable</td>
<td>0.821</td>
<td>0.873</td>
<td>0.872</td>
<td>0.875</td>
<td></td>
</tr>
<tr>
<td>System information is organized and need to read</td>
<td>0.779</td>
<td>0.873</td>
<td>0.872</td>
<td>0.875</td>
<td></td>
</tr>
<tr>
<td>System information is easy to understand</td>
<td>0.827</td>
<td>0.873</td>
<td>0.872</td>
<td>0.875</td>
<td></td>
</tr>
<tr>
<td>The information presented in the HIS is accurate</td>
<td>0.792</td>
<td>0.873</td>
<td>0.872</td>
<td>0.875</td>
<td></td>
</tr>
<tr>
<td>HIS provides the information I need for my work</td>
<td>0.792</td>
<td>0.873</td>
<td>0.872</td>
<td>0.875</td>
<td></td>
</tr>
<tr>
<td>System training is provided in a short period of time</td>
<td>0.844</td>
<td>0.873</td>
<td>0.872</td>
<td>0.875</td>
<td></td>
</tr>
<tr>
<td>HIS is easy to integrate with other systems</td>
<td>0.792</td>
<td>0.873</td>
<td>0.872</td>
<td>0.875</td>
<td></td>
</tr>
<tr>
<td>HIS is user friendly (visible, accessible, ...)</td>
<td>0.792</td>
<td>0.873</td>
<td>0.872</td>
<td>0.875</td>
<td></td>
</tr>
<tr>
<td>The HIS user interface is well organized</td>
<td>0.792</td>
<td>0.873</td>
<td>0.872</td>
<td>0.875</td>
<td></td>
</tr>
<tr>
<td>HIS is flexible</td>
<td>0.792</td>
<td>0.873</td>
<td>0.872</td>
<td>0.875</td>
<td></td>
</tr>
</tbody>
</table>

Results demonstrate that information quality and system quality have a significant positive effect on benefits perceived by employees (Model 1, Table II). According to Model 2 and Model 3, training has a mediating role between information quality and benefits, as well as, between system quality and benefits. \( R^2 \) of Model 2, which includes the interaction of system quality and training, had significant change predicting approximately 62.5% of the variance in the perceived benefit. In Model 3 we removed the interaction of system quality and training and added information quality and training interaction. Results demonstrate an \( R^2 \) has a significant change in the value of 0.650.

To make a comprehensive conclusion we made a detailed analysis of all items. A frequency analysis was used to define the contribution of each item.

### TABLE II. REGRESSION OF HIERARCHICAL LINEAR MODELING ANALYSIS

<table>
<thead>
<tr>
<th>Variables</th>
<th>Dependent variable: Hospital Information System Benefit</th>
<th>Model 1</th>
<th>Model 2</th>
<th>Model 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intercept</td>
<td>0.817 (0.000) ***</td>
<td>1.034 (0.000) ***</td>
<td>1.491 (0.000) ***</td>
<td></td>
</tr>
<tr>
<td>Information quality</td>
<td>0.393 (0.000) ***</td>
<td>0.220 (0.000) ***</td>
<td>0.099 (0.548)</td>
<td></td>
</tr>
<tr>
<td>System quality</td>
<td>0.460 (0.000) ***</td>
<td>0.131 (0.094)</td>
<td>0.458 (0.004)</td>
<td></td>
</tr>
<tr>
<td>Information quality ( \times ) Training</td>
<td>0.078 (0.000) ***</td>
<td>0.064 (0.049)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>( R^2 )</td>
<td>0.817</td>
<td>0.825</td>
<td>0.804</td>
<td></td>
</tr>
<tr>
<td>F</td>
<td>200.720</td>
<td>102.130</td>
<td>123.352</td>
<td></td>
</tr>
</tbody>
</table>

\*\*\*{p<0.001, \*{p<0.01, \*{p<0.05, \*{N=296}

With the implementation of HIS, information has been well organized, providing easy access to required data, correctness of the data is facilitated by promptly fixing errors. Unfortunately, issues with reports’ incompleteness and incompleteness to job requirements are observed (Fig 3).

To make a comprehensive conclusion we made a detailed analysis of all items. A frequency analysis was used to define the contribution of each item.

According to the results, implemented HIS’s system quality is user-friendly, suited to work style, and has a well-organized interface. However, complications with integrating with other systems, and inflexibility are observed (Fig 4).
Training provided by Mongolia Japan Hospital’s Information Technology unit such as guidance, manuals, and HIS menu instructions is insufficient from the users’ perspective (Fig 5).

Overall, more than half of the respondents expressed a positive attitude toward the implementation of the hospital information system. They defined the benefits of HIS as good support in their work by lessening paperwork and fastening everyday operations. However, the use of hospital information systems presents some difficulties. For instance, 85.1% believed that even though the hospital information system digitized the records, it created the need to process new documents. Moreover, 83.7% think that new tasks have been added by using the hospital information system.

V. CONCLUSION AND RECOMMENDATIONS
The objective of this study was to determine factors influencing the success of the system from the user’s perspective. The conceptual model and hypotheses were defined based on IS Success Model and the Technology acceptance model. The model was validated by Reliability analysis and the Principal Component analysis. Multiple regression analysis was adopted to test hypotheses.

From the results, we may conclude that system and information quality have a major effect on the acceptance of information systems and Training enhances the effects of predicting factors. From this, we can elaborate that training on every step of implementation will ease and fasten the process of acceptance of the system.

A detailed review of construct items revealed that not only technical support but also user-centric management, including training, involvement of employees at every stage of implementation, and development of a user-friendly interface may enhance the successful adoption of HIS. Moreover, the limitations described by respondents may help managers and decision-makers do more rational decisions.

Overall, despite the strengths such as decreased number of work and fastened workflow, the quality issues of the system are under consideration. Further development of HIS at Mongolia Japan Hospital has to consider users’ opinions to define which items should be improved. As can be seen from the respondents’ opinion user menu, guidance is required for quality work. In this instance, the Information Technology unit may have to develop a thorough operational plan, focusing on the main problem area. Moreover, training and running specialized courses for the staff, especially for new employees may encourage them to perform tasks better and take the initiative in solving everyday problems with the system.

REFERENCES
[10]. Gagnon et al., 2012; Häyriinen & Saranto, 2004;