A Multi-facet Approach using Conceptualization, Application, and Usability Measurement to Developing Financial Learning System for Hospital

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Abstract— **This paper proposes a multi-facet approach based on business concept, needs of application, and usability measure to develop a hospital financial learning system. Hospital financial requirements are gathered from management and staffs as the conceptual basis to model the proposed application. Users' data are then used to develop a software prototype. Factors affecting behavioral intention to adopt the software are analyzed for further usability assessment. The principal criteria are perceived usefulness, perceived ease of use, and attitude toward using. Acceptance test is conducted based on Technology Acceptance Model. The results show that the management and staffs are welcomed to have the software, subject to faster time to learn (p-value 0.000), and easy financial management content to grasp (p-value 0.015), having the coefficient of determination 87.3% at 0.05 level of significance. Thus, software developed by the proposed approach will help hospital executives and personnel to raise omniscience in financial management that maintains the hospital sustainability.**

Keywords—Financial learning system; hospital financial management; business game; usability measurement

I. INTRODUCTION

Software is a critical instrument in the daily lives of this digital age. In recent years, the proliferation of software applications have spanned in many industries, ranging from business, academic, entertainment, and even health care. The results of application improve the production process and gain competitive advantage which contribute to more innovation. In health care, software has been extensively applied in management and traceability for shorter and efficient radiopharmaceutical process [1]. Studies in designing user interface for medical OPD replacing paper-based patients' data, their diagnosis, and prescription [2]. A more advanced software research and development concerns telemedicine for rural patients to receive medical treatment comprehensively and equally [3].

Nowadays, many hospitals are under pressure to provide premium health care service at nominal price. The predicament of reducing operating costs, yet maintaining quality service forces the administration to resort to efficient organization-wide management, in particular, the financial management system. Almost all hospitals adopted some financial software packages to handle wide range of financial operations such as cash flow, medical supplies and inventory, purchasing, payroll, income. One of the most important difficulty is the lack of financial management knowledge. Many staffs are not professionally educated or experienced in financial relevant areas to be capable of undertaking in-depth analysis, planning, assessment, and implementation. A practical solution taken by hospital management is establishing a financial learning system.

The learning process can be divided into two steps, namely, acquire knowledge and create knowledge [6]. The first step can be conducted in many different formats, for example, lecture, reading assignment, or training video. However, the acquired knowledge does not last long and must be supplemented by knowledge creation. This step can be built from several practices, for example, self-learning, group discussion, or knowledge transfer by mentor. The latter step is more difficult to achieve than the former step, but the acquired knowledge persists.

One of the biggest drawbacks of learning system is lack of motivation. The digital age makes traditional learning approach uninteresting to participate. An innovative approach to the learning system is through business game simulation. Business game simulation (BGS) is one of the most popular learning methods that simulates the business environment and allows learners (or challengers) to input their business decision. BGS can be used to train executives and employees to plan and manage in many disciplines, e.g. financial management, organizational behavior, resource management [4]. This research exploits BGS as the strategic plan of learning given limited resources available to gain as much benefit as possible [5]. Details will be further elaborated in the sections that follow.

This paper is organized as follows. Section II describes detail of the proposed method in three major steps, requirements gathering, system architecture, and software design. Section III describes the experiment to validate the proposed approach. The results of study are discussed in Section IV. Some final thoughts and future work are concluded in Section V.

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II. Proposed Method

This study introduces a business conceptual model of application to develop a software prototype for hospital financial learning system. The scenario utilizes a case study and financial statement of XYZ hospital which is one of the most efficient hospitals in financial management. The process starts from conventional requirement gathering from hospital stakeholders such as administrators, doctors, and staffs. All relevant factors are compiled and analyzed for use in the design of the following software development models: (1) scenario-based model, (2) class model, (3) flow model, and (4) behavioral model. A prototype is created along the process to measure its usability for acceptance test by means of Technology Acceptance Model (TAM) [7]. There are four criteria to be deployed in TAM, namely, perceived ease of use, perceived usefulness, attitude toward using, and actual system use. An overview of the proposed method is shown in Fig 1.

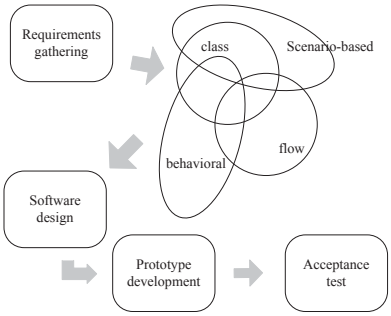

Fig. 1. Conceptual business models of hospital financial learning system.

A. Requirements Gathering

In this step, XYZ hospital management, doctors, and supporting staffs were interviewed for financial requirements. The hospital financial management starts from all departmental reports compiled for new period planning. Accounting records of the operating costs by department are analyzed in terms of cash flow, income, and financial position. The data are processed to arrive at the Financial Ratio, encompassing the Quick Ratio and Profit-Asset Ratio. Other results are also prepared accordingly. This process is depicted in Fig 2.

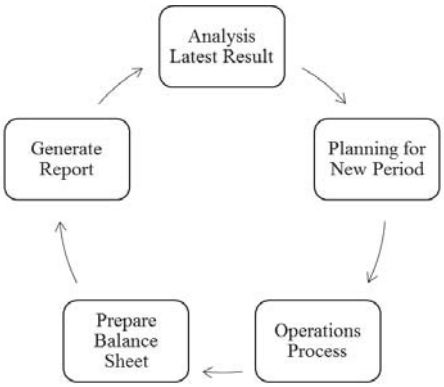

Fig. 2. Hospital financial planning process.

The fact that the majority of members of the administration are doctors makes it difficult to understand such a complex financial process. Conventional training is uninterested, time-consuming, and more importantly, uninformative. Thus, presenting financial lessons in the form of business game interests the hospital executives.

The data collected by in-depth interviews showed that the predominant requirement was the process of creating a comprehensive report that could reflect more precise outcome of relevant account information than existing separate reports. In addition, data analysis for strategic planning should be incorporated for subsequent design and implementation of the financial operating system.

B. System Architecture

Analysis of XYZ hospital management requirements reveals the flow of data usage in predicting the financial future of the hospital. A number of scenario-based models of the learning software are created to gauge how they will support the above requirements. The models must provide mechanisms to support management strategy on Medical Service, which is a plan for providing in-patient and out-patient expenditure, investment prospect of medical supplies, equipment, and facilities. This in turn should be integrated with additional capabilities such as marketing management, inventory control. Examples of such capability boost and efficiency are marketing 7P (price, place, product, promotion, people, process and physical evidence), economy of inventory to maintain optimal and fresh medical supplies. Fig 3 shows a mock up dashboard of user interactive learning summary. Case in point, the economic environment is a major factor that will affect operational management of the hospital. If economic conditions are good, it is high time for the administration to execute proper strategy to boost service and profitability. On the contrary, if the economic conditions are in a big slump, administration will need to execute some contingency plans accordingly to keep the hospital operate without losses. Thus, analysis of the economic outlook, for instance, can provide appropriate decision making and course of action for efficient and effective hospital management.

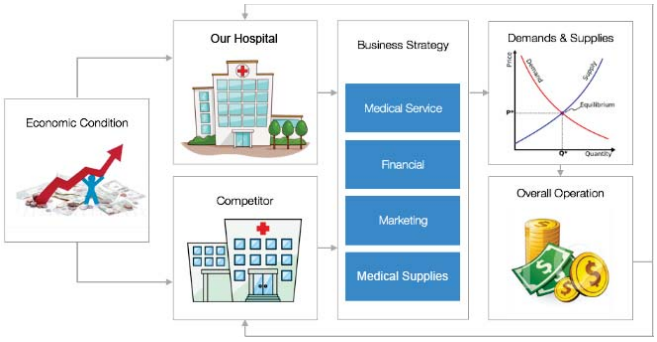

Fig. 3. Dashboard of the proposed system architecture.

C. Software Design

This study establishes four types of learning skills, namely, technical skill, conceptual skill, social skill, and human skill. The focus will be on human skill. All other skills will

somehow be embedded in the design without explicit reference of emphasis.

The main functional elements of the software is based on what the analysis process contains. The simulation stratgy is the following: (1) set up a working environment and business function that simulate a financial management learning scenario; (2) create a trigger-event function that sends an event out to the user making decision on the financial scenario; (3) create a receive function that accepts the decision from the user; (4) create the calculation function that determines the result of the decision from (3); and (5) create a display function that shows the financial statement and corresponding analysis, and performance evaluation by the user. Fig 4 shows a use case diagram of the proposed model. The game can be divided into two parts, namely, user and instructor. The user plays the game against BGS AI which serves as a rival user. The instructor defines game parameters, while the BGS Ruler creates a simulated environment and events to feed both user and BGS AI. The remaining system functions such as decision cost strategy to determine the cost of financial outcome, while calculate result computes the final results based on inputs, parameters, and user's decision.

The next step is to create a flow model that illustrates the flow of data items in the system. Due to space limitation, the collaboration diagram that illustrates the operational sequence of all associated objects and the working process are not shown here. In a nutshell, the working process starts from the instructor setting parameters and sending them to BGS Ruler to simulate business conditions and environment. The BGS Ruler then sends trigger event to the User and BGS AI. Both users reply with their decision to BGS Ruler for calculating market share, financial statement, and financial analysis. The resulting financial report is sent back to the user, BGS AI, and the instructor.

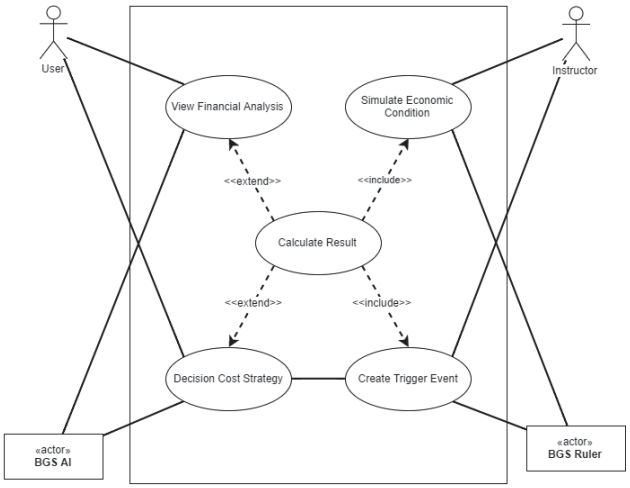

Fig. 4. Use case of the system design.

The last component of the design is the behavioral model which explains the mechanism of the software process. Fig 5 shows the activity diagram of the model. There are 4 lanes, namely, User, User Interface, BGS Ruler, and Instructor, each of which representing the software subsystems. The activity starts from user login with user id and password. If it is a valid user, the BGS Ruler generates an economic environment and conditions from the parameters set up by the instructor. Moreover, BGS Ruler creates a trigger event to be sent to both users, where the decisions are to BGS Ruler. All activities are displayed on the GUI subsystem.

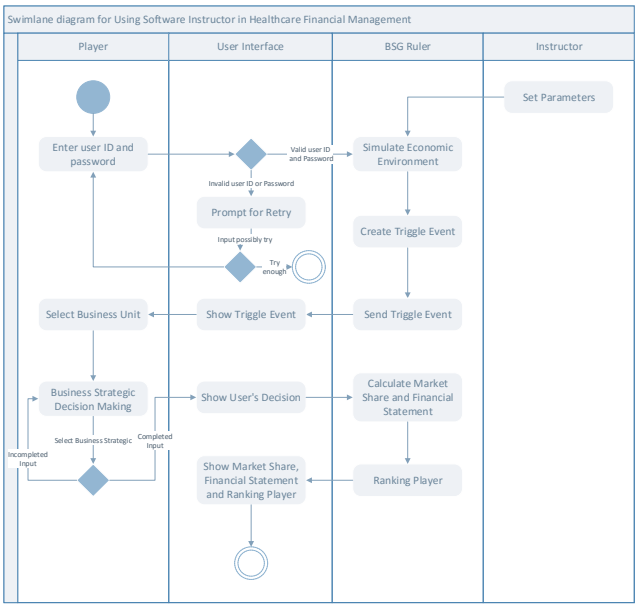

Fig. 5. Principal activities and corresponding subsystems.

III. Experiment

The software prototype was implemented according to the above four models. The main features of this prototype are classification of types of business, input decisions, and resulting charts and tables report. The software front-end GUI was developed by AngularJS Framework, while back-end processing employed PHP and MySQL. WebSocket protocol was deployed as the real-time data communication means. Fig 6 depicts an example report of the software prototype.

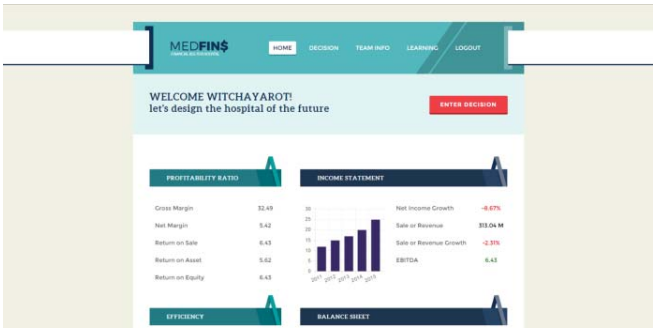

Fig. 6. Example report

A. Acceptance Test

A survey was conducted to collect participating users' data. A set of questionnaire were distributed to select twenty staffs by purposive sampling. All of them were regular computer

users. Data being collected from the questionnaire consisted of demographic data, perceived ease of use, perceived usefulness, attitude toward using, and behavioral intention.

The actual acceptance test employed Technology Acceptance Model (TAM) to measure the prototype usability. This means that user acceptance indicated their willingness to use the software as a financial management learning tool. Table 1 shows the acceptance test criteria of TAM, the variables, and their description.

TABLE I. TAM CRITERIA

Criteria	Variable	Description
Perceived ease of use	PEOU1	The software has clear goals and measurable.
	PEOU2	The software can understand in a short time.
	PEOU3	The display can be easily understood.
	PEOU4	An overview of the software is easy to comprehend.
Perceived usefulness	PU1	The software enhances the knowledge of hospital financial management.
	PU2	The software reduces the time to learn financial management.
	PU3	The software enhances skills in strategic planning, short-term.
	PU4	The software enhances skills in strategic planning, long-term.
	PU5	An overview of the software with the benefits of its use.
Attitude toward using	ATT1	The software helps learn finance easier.
	ATT2	The software helps students understand the overall of hospital financial management.
	ATT3	The software contributes to increasing confidence in decision-making in financial management.
	ATT4	The software helps hospitals get more efficient in financial management.
Behavioral Intention	BI1	Users want to use if get a license for free software.
	BI2	Users want to use if buy a software license.
	BI3	Users want to use if company purchase a software license and give free access.

IV. DISCUSSION

The demographic data explain background of the participants and the proportion of their viewpoints. Approximately 30 percent of participants are male and 70 percent are female. Ninety percent aged between 20-30, while the remaining 10 percent fall between 31-40. Over 85 percent of respondents are single and 15 percent are married. Moreover, the base salary of 70 percent of respondents are in the range of less than $1,000, while the remaining 30 percent range between $1,000 to $1,500.

The technology acceptance criteria used a five-point scale ranging from 1 (Strongly disagree) to 5 (Strongly agree) to assess their opinion. Table 2 shows the majority of respondents yielding relative high average on all acceptance criteria except buying a software license (BI2). The respondents are reluctant to buy their own copy of the software since the hospital has already furnished a free software license (BI1) or purchase by the hospital for them to use (BI3). Analyzing the relationship among all criteria to BI category, particularly BI3, reveal that affecting factors are perceived usefulness (PU), perceived ease of use (PEOU), and attitude toward using (ATT).

TABLE II. MEAN AND S.D. OF TAM CRITERIA

Criteria	Variable	Mean	S.D.
Perceived ease of use	PEOU1	4.50	0.51
	PEOU2	4.50	0.51
	PEOU3	4.50	0.51
	PEOU4	4.50	0.51
Perceived usefulness	PU1	4.70	0.47
	PU2	4.50	0.51
	PU3	4.35	0.49
	PU4	4.30	0.47
	PU5	4.60	0.50
Attitude toward using	ATT1	4.40	0.50
	ATT2	4.40	0.50
	ATT3	4.30	0.47
	ATT4	4.40	0.50
Behavioral Intention	BI1	4.55	0.51
	BI2	3.65	0.74
	BI3	4.55	0.51

Table 3 shows that the above relationship indeed exists at 0.05 level of significance among the behavior intention to use the software that purchased by the organizations or companies and give permission to use (BI3), the software reduces the time to learn financial management (PU2), and the software helps them learn financial management easier (ATT1). Following Table 3, the coefficient of determination is 87.3% indicating that the variation dependent factor (BI3) depends on most of the independent variables (PU2, ATT1).

TABLE III. MODEL SUMMARY

R	R Square	Adjusted R Square	Std. Error of the Estimate
0.934	0.873	0.858	0.1925

Table 4 shows the relationship with behavior intention to use with purchased by the organizations or companies (BI3) and reducing time to learn financial management (PU2) have the relationship with a p-value = 0.000, whose relationships level equals to 0.720 (B = 0.720). Moreover, the relationship with behavior intention to use with purchased by the

organizations or companies (BI3) and helpful to learn financial management easier (ATT1) have the relationship with a p-value = 0.015, whose relationship level equals to 0.300 (B = 0.300).

TABLE IV. RESULT OF MULTIPLE REGRESSION

Model	Unstandardized Coefficients		t	p-value	VIF
	B	Std. Error			
(Constant)	-0.010	0.433	-0.023	0.982	
PU2	0.720	0.109	6.612	0.000	1.600
ATT1	0.300	0.111	2.699	0.015	1.600
ANOVA: F = 58.286, p-value = 0.000					

Both independent factors show a positive relationship with behavioral intention, particularly if the software makes it easy to learn financial management. The intention will be in favor of accepting the software.

V. CONCLUSION

This study proposes an intriguing approach by starting from conceptualized business scenarios, gathering application requirements, and measure the prototype software usability to developing software for learning financial management in health care. This in turn provides an alternative guideline for developing learning tools or relevant software in hospital financial management. Assessment on behavioral intention to use the software prototype for learning financial management in health care is performed with hospital executives and personnel. The result shows that hospital executives and staffs are satisfied to use the software subject to shorter time to learn and easier to grasp the contents.

Thus, learning by software developed via this process will help hospital executives and personnel achieve a successful knowledge in the designated area. To further omniscience in organizational development and effective operational efficiency will lead to long-term sustainable hospital. Future research may focus on more factors, in-depth interview, and different size and nature of hospital such as community hospital, private hospital.

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