

Incorporating Business Intelligence Module in a Mobile-Based Service Management and Online Reservation Portal

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Abstract: This paper sought to identify the current manual reservation and cost forecasting processes of a food and beverage (FnB) service provider in terms of its implementation of an mobile-based service management and reservation portal, develop a reservation and cost forecasting sub-modules as part of a set business intelligence (BI) module that can be incorporated to the said mobile-based system, and investigate the results of the business intelligence module using functional, integration and acceptability tests. The study utilized the descriptive and developmental methods of research along with ASSD (Agile-Scrum Software Development) as SDLC (System Development Life Cycle) method and the IPO (Input-Process-Output) software development framework. These methods and frameworks were used to describe the existing manual forecasting processes of the subject FnB service provider, define the features, functional and non-functional requirements of the system, and develop the system, respectively. Findings showed that a lot of problems are encountered by the employees of the subject company in computing reservation and cost forecast and that the developed business intelligence modules, once integrated and implemented with their existing mobile-based system, can help mitigate the issue. Findings also revealed that the results of the functional and integration tests have complied with the functional requirements of the system and that the BI module has also passed the acceptability test as evaluated by the stakeholders.

Keywords: business intelligence, reservation and cost forecasting, mobile-based service management and online reservation portal

1. Introduction

The utilization of a computerized system to achieve better performance and quality is a business model brought about by modernization and improvement in the information technology as computerized systems basically aim to deduce repetitive manual tasks, access essential business information anytime and anywhere, and reduce human resource while at the same retaining a high level of efficiency. The saved resources – energy, time, money, supplies, etc. can then be used to focus on product or service quality improvement.^[1]

Among the industries that implement computerized systems and information technology is the hospitality industry in which the tourism industry is a field thereof. Under the tourism industry is the travel industry which has three categories: direct providers, support services, and developmental organizations. The restaurant business and catering services belong to the direct providers category. Here in the Philippines, most restaurants do not only offer *ala carte* dining for walk-in diners but also catering services to maximize restaurant assets and resources.^[2]

The Hospitality Magazine of Australia reported in 2015 the seven technologies that are bringing positive changes in the hospitality industry. These are customer relationship management, electronic point of sale, marketing automation, online booking systems, smart appliances and smart phones, and the social media.^[3] The report emphasized that businesses using these technologies have increased significantly along with the substantial popularity of the business establishment using it and that a well-designed, mobile friendly website with an online booking service and with a simple interface is essential. It has also highlighted that an important decision for many hotels and restaurants is whether to use a third-party online booking service, or to develop their own customized online booking system with business intelligence capabilities.

In a 2012 case study made by Ezora, a world-class provider of web-based analytics, business intelligence and reporting solutions based in the Dublin, over its client 23.5 Degrees, the first worldwide franchisee of Starbucks corporation, it highlighted that in order for business enterprises under the Food and

Beverage industry to realize their growth and potential, the need for a business management platform with business intelligence and analytics capabilities is of high concern.^[4]

Business intelligence (BI) are software features that process existing business historical data saved and accessible in a database, convert them into advanced analytics and forecasting information that can be used to provide substantial data relations, patterns and correlations among relevant data and guide stakeholders during decision making.^[5]

A mobile-based service management online reservation portal is an online system that is accessible via computers and mobile devices and is a dedicated to aid the sales and marketing departments of an FnB service provider by positioning itself as the central communication portal between the clients and the business. It aims to deliver accurate, timely and essential information about target or upcoming service commitments, menu, promotions, events,

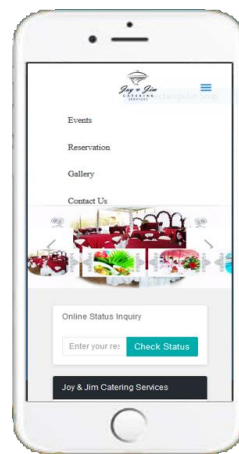


Figure 1. The mobile-based service management online reservation portal.

and customer feedbacks. Through it, important information will be received by each department in real-time and the time saved can be devoted to focus on integral functions and enhance the delivery of quality services.

Integrating a BI module to an existing mobile-based FnB reservation management system would provide reservation and cost forecasting features that can be used by business owners in their decision-making business functions.

2. Objective of the Study

The core objective of the study is to design and develop a business intelligence module that would perform reservation and cost forecasting for an existing mobile-based service management and online reservation system.

Specifically, it sought to:

a. Identify the current profile and manual forecasting procedures that a local FBS provider is implementing in computing its reservation and cost

forecast as it implements a mobile-based service management and online reservation portal;

b. Enumerate the functional and non-functional system requirements, processes, and features of the reservation and cost forecasting modules that will be integrated to the existing mobile-based service management and online reservation system; and

c. Evaluate the results of the business intelligence module using functional, integration and acceptability tests.

3. Conceptual Framework

The context of the proposed business intelligence module to be integrated with a mobile-based service management and online reservation portal was identified and organized using the Input-Process-Output (IPO) Model. In this model, input corresponds to the existing manual business forecasting processes for reservation and cost, the functional and nonfunctional requirements of the system, and the integral features and components of the system.

In this undertaking, the researchers utilized one of SDLC's (System Development Life Cycle) methodologies, Scrum, a form of Agile Software Development, which includes product backlog, sprint planning, sprint backlog, iterative-incremental development and delivery or the actual sprint, sprint review, and sprint retrospective as shown in Figure 1. The details on how the researchers applied Scrum in developing the proposed BI module is discussed in the Methodology section of this paper.

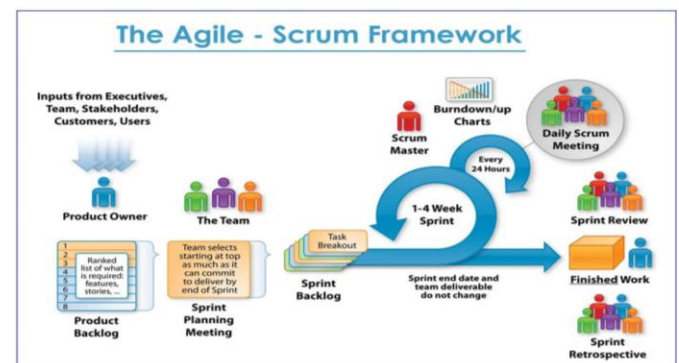


Figure 2. The Agile-Scrum Framework used by researchers as System Development Life Cycle method. (Image courtesy of c-sharpcorner.com)

After substituting all the requirements of the study and undergoing the software development

methodology, the expected result of the project is the set of business intelligence modules to be integrated with the existing mobile-based service management and online reservation portal.

4. Review of Literature

a. Existing Process of F&B Service Management. Every organization's departments, regardless how gargantuan or complex, aim to perform towards its unifying mission and vision. It is accomplished by creating and enhancing timely strategies, strict implementation and monitoring^[6]. As to FBS businesses, processes are standardized.

The following are the key and orderly processes in the F&B service reservation^[7]: inquiry, reservation, initial or full payment, and approval. These front-of-the-house processes are standardized, observed and implemented mostly by all food and beverage services providers worldwide.

Meanwhile, among the standardized back-of-the-house processes in an FBS enterprise are accounting, financial, human resource and administrative processes where accounting-related forecasts are involved.^[8]

Because the FBS processes are standardized and conducted in an orderly manner, the application of business intelligence to forecast reservation demands and forecast future costs of reservation requisites can be merged at any point in between the above-mentioned back-of-the-house processes without affecting sales and service revenues but rather create an opportunity to maximize income if forecast is carefully planned and conducted.^[9]

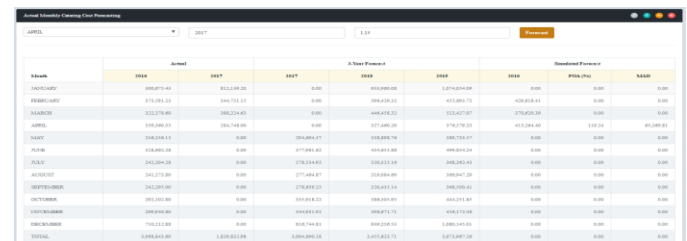
Since the subject business has already an existing mobile-based service management and online reservation system, the existing data and database structured can be used in developing the BI module for the reservation and cost forecasting.

b. Functional and Non-Functional Requirements. A requirement is consisted of two kinds, functional and non-functional. Functional requirements control how the system is projected to work and what types of results it will yield in the domain of application. It refers to the need that a system must include.^[10]

The capability to correctly forecast is the most important functional requirement of any business intelligence module that will perform for reservation cost forecasting.^[11]

Forecasting, also called demand forecasting, is a method of systematically projecting historical business transactions such as purchases, revenues, expenses, inventory, etc. into future demands that will serve as basis for decision making.^[12]

The researchers used one of the quantitative detail forecasting methods - the Specified Percent Over Last Year (SPOLY). The SPOLY forecasting method utilizes a user-specified forecast factor as percentage of increase or decrease to be multiplied from previous historical transaction amount relative to the forecast range of time. This methodology usually requires 3 months of the most recent actual transaction amount known as the hold out period, plus a complete year of historical transaction amounts known as history amounts. This method is usually used if factor such as seasonality is to be considered or given weight.^[13]



Month	Actual	3-Year Forecast	Standard Forecast
JANUARY	100,000.00	100,000.00	100,000.00
FEBRUARY	120,000.00	120,000.00	120,000.00
MARCH	150,000.00	150,000.00	150,000.00
APRIL	180,000.00	180,000.00	180,000.00
MAY	200,000.00	200,000.00	200,000.00
JUNE	220,000.00	220,000.00	220,000.00
JULY	250,000.00	250,000.00	250,000.00
AUGUST	280,000.00	280,000.00	280,000.00
SEPTEMBER	300,000.00	300,000.00	300,000.00
OCTOBER	320,000.00	320,000.00	320,000.00
NOVEMBER	350,000.00	350,000.00	350,000.00
DECEMBER	380,000.00	380,000.00	380,000.00
TOTAL	2,400,000.00	2,400,000.00	2,400,000.00

Figure 3. Table of the Actual Cost Forecasting computes a 3-year forecast for the actual monthly catering cost spent for every reservations finished.

The formula for the specified percent over last year forecasting is as follows:

$$\text{forecast} = A_h \times f_{us}$$

where:

forecast = forecast amount
 A_h = historical Amount
 f_{us} = user-specified forecast factor

To assess the performance of SPOLY, a 3-month simulated forecast was computed where the Percent of Accuracy (POA) and Mean Absolute Deviation (MAD) methods were used. POA and MAD are forecasting performance evaluation methods that are used to evaluate the accuracy of the forecast factor that the user has specified. POA indicates whether the forecast factor is above or below the 100% accuracy rate while MAD tells whether how high or low the deviation amount is. In order to gain the most accurate forecast factor, the POA should be close to 100%. On the other hand, attaining a near-zero value for MAD is desired to have an accurate forecast.^[14]

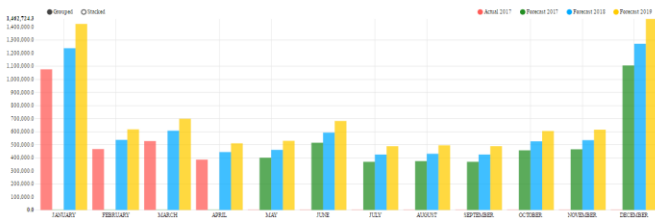


Figure 4. The forecast graph of the Actual Cost Forecasting for a 3-year forecast from figure 2 (Table).

The formulae for percent of accuracy and mean absolute deviation are as follows:

$$POA = \frac{\sum SF}{\sum HOP} \times 100\%$$

where:

POA = Percent of Accuracy
SF = Sum of simulated forecasts
HOP = Sum of hold-out period amounts

$$MAD = \frac{\sum_{i=1}^n (SF_i - HOP_i)}{n}$$

where:

MAD = mean absolute deviation
SF = simulated forecast
HOP = hold-out period amount
n = number of historical months
i = period

Meanwhile, non-functional requirement is associated to progressing system characteristics such as actions to crucial system properties and reliability. ^[15]

Secure access to historical data saved in the systems database should be a core non-functional requirement of a business intelligence module considering that forecasting reports are usually used by higher ranking employees. The forecasting modules must also provide support to mobile devices operating systems and most commonly utilized web browsers. ^[16]

c. Features of the System. IEEE (Institute of Electrical and Electronics Engineers) Standard Number 829 gives a clear definition of a feature which is a unique property of a part or the whole software. A computer system can be tagged as “feature-rich” and “business-intelligent” when it has an array of business forecasting and analytics features, options and capabilities available to the software’s end user. ^[17]

Core features of BI modules for a mobile-based service management and online reservation portal must include reservations forecasting, reservation cost forecasting, and forecasting visualizations such as tables, graphs and charts. ^[18]

d. Software Testing. Software testing, also called systems testing, is a quality assurance process which refers to the systematic execution of a computer program to look for bugs or errors. ^[19] In this research, the researchers implemented the functional, integration and UAT or user acceptance test.

Functional test is quality assurance procedure of evaluating the functions of the system being developed based on specifications and requirements by entering data and investigating the returned results if it complies with the said requirements and specifications. ^[20] On the other hand, integration test refers to the process of searching for faults to software modules created as they are merged or incorporated with initial software modules and ensure that if in case a module will fail due to exception errors, it will not crash the whole system but only affect those features and functionalities under it. ^[21]

Meanwhile, UAT or user acceptance test is the the final test process conducted before final software deployment and live run. It is performed by pilot system end users to find out if the computer system developed is ready to be used and can execute the set of functionalities and features it is intended and expected to do. The three methodologies that can be chosen as UAT are the formal acceptance testing, informal acceptance or alpha testing, and the beta testing. ^[22]

The researchers utilized the past reservation and cost records stored in the existing database of the mobile-based service management and online reservation system of the subject business as test data and ensure that none of these records will be updated. After which, the researchers conducted the functional test by entering forecast date and user-specified forecast factor as input parameters to the reservation and cost forecasting modules. The researchers evaluated the outputs and performed manual computations to double-check the results and if it complies with the expected output of the forecasting method implemented. After all the modules are developed and thoroughly tested, a copy of the existing mobile-based service management and online reservation system together with the tested forecasting modules were installed in a virtual server machine to initiate the integration test. During the integration test, laptops, mobile phones and tablets were used to connect to the

virtual server and operate the functionalities of the BI modules developed.

After the successful integration test, the User Acceptance Test was conducted. The researchers prepared a UAT questionnaire, oriented the end-users of the functionalities and features of BI modules created, and briefed them about the purpose of the UAT. The end-users tested the system by accessing the test server using laptops, tablets and mobile phones and filled-up the UAT questionnaire simultaneously. The results of the UAT were tabulated and suggestions were noted.

5. Methodology

a. Research Design. The researchers employed the descriptive method of research in order to identify the current manual reservation and cost forecasting processes of the subject F&B service provider in terms of their implementation of the mobile-based service management and online reservation portal.

Descriptive research is an attempt to determine, describe or identify factual information on certain instances through a process of data collection or survey instruments such as questionnaire, interview, and face to face observation.^[23] The researchers employed descriptive research by using survey questionnaires, interview and observation which are detailed in the succeeding sub-sections.

In contrast to descriptive method of research, the developmental method of research is defined as the organized study of planning, crafting, developing, and assessing instructional processes, programs, and products that should comply with the criteria of internal effectiveness and constancy. Its purpose is to assess changes over an extended period of time.^[24]

The researchers utilized the developmental method of research by creating and developing the actual business intelligence modules for the mobile-based service management and online reservation portal using the Scrum model as an SDLC methodology as follows: the researchers conducted survey, observation and interview to gather the inputs, suggestions and recommendations of stakeholders and identify the reservation and cost forecasting features expected, specifications and requirements on how it will be integrated with the existing mobile-based system. A detailed software development plan was created and presented to the business owner for approval. Upon approval, the development team was organized and

briefed about the tasks involved (or the product backlog) in the software development plan. The development team planned how to undertake and finish each task according to schedule. The sprint was performed thru a series of task delegation, meeting, and updating until all product backlogs or tasks are finished. After which, the finished product has been reviewed in the form of integration test and UAT.

b. Research Population and Sample

The research is conducted in a local FBS provider implementing a mobile-based service management and online reservation system. The research population of the study included the business owner/manager, the company's FBS, accounting, and IT heads.

The respondents aide as the focal persons who have given invaluable direct information on the actual daily processes of an FBS business establishment in terms of forecasting for reservations and cost. The respondents joined the final User Acceptance Test (UAT) to evaluate the entirety of the business intelligence modules and its integration with the mobile-based FBS system.

c. Instrumentation and Data Collection

The researchers used instruments and techniques to achieve the stated objectives by employing questionnaires, personal interviews, observation, and analysis of business forms/documents to develop the BI modules and finish the study.

c.1. Observation. The researchers used the observation method in obtaining data relevant to the study. Observation is the process of enabling researchers to learn about the business forecasting and analytical activities of people under study in their natural setting through observation and participation in the said activities.^[25]

In this method, the researchers joined the respondents as they use the mobile-based service management and online reservation portal and keenly observed the current profile of the system and the manual forecasting processes of reservation and costs. The observation was matched with face to face interview. The flow of data and information involved in performing the manual processes were fully analyzed and noted accordingly.

The researchers were able to identify the strategies, problems, constraints, risks and possible conflicts involved in performing the manual forecasting processes of the subject businesses.

c.2. Interview. Another method employed by the researchers in collecting data is the interview method. An interview method is a prepared set of relevant questions asked to the stakeholders which provides in depth explanation.^[26]

In this method, the researchers prepared interview script which were personally asked to the respondents in order to identify the functional and non-functional requirements that the BI modules to be integrated with a mobile-based service management and online reservation portal will embody. Relevant answers were jotted down while unclear answers were fully clarified and discussed with the respondents.

The researchers also prepared sets of survey questionnaires which were used and floated as follows:

- **During the Planning Phase** – the respondents were provided individual questionnaires to answer questions relative to their current manual forecasting processes.

- **During the Final User Acceptance Test** – the respondents were provided questionnaires to assess the developed BI forecasting modules. They were tasked to fully evaluate the integration of the BI modules with their existing mobile-based system, assess it to its fullness and in terms of the following aspects: performance, information, economic, control and security, efficiency, and service.

The researchers utilized the relative frequency to produce a frequency distribution table of the survey results of the respondents. The formula of the relative frequency is:

$$F_R = \frac{f}{\sum F} \times 100\%$$

where:

F_R = Relative Frequency rate in %

f = Frequency result

$\sum F$ = Sum of frequencies

The respondents were briefed first to the purpose of the survey and were assured that their answers will be held and kept confidential by the researchers. Questions raised by respondents while answering the survey questionnaires were immediately entertained and made sure that vague matters were clarified prior to answering.

The answers of the respondents were tabulated and the results were incorporated in the design and development of the Business Intelligence Modules for a

Mobile-Based Service Management and Online Reservation Portal.

c.3. Analysis of Documents. The researchers also employed document analysis as a tool for data collection. Document analysis is the process of gathering and collating documents and other forms associated to the functions of the business, after which, the collated documents are studied to identify the subjects and flow of the actual business operations. Documents include written plans and programs.^[27]

The researchers collected and analyzed business forms and reports relevant to the computation of reservation cost forecasts which includes reservation forms, menu order form, service request form, menu cost form, and menu packages. Reports gathered from the existing mobile-based service management and online reservation portal were reservation reports and package reports. These served as guidelines for the developers in identifying the data that will be part of the forecasts.

6. Findings

After the interview, survey and observation with the respondents, the current manual reservation and cost forecasting processes of the subject F&B service provider were identified.

Table 1 presents the degree of problems encountered by the respondents in the manual forecasting of reservations.

Table 1
Degree of Problems Encountered by Respondents
During Manual Reservation Forecasting

Problems	Extremely High		High		Moderate		Low		Extremely Low		TOTAL		RANK
	f	%	f	%	f	%	f	%	f	%	f	%	
Slow computation of monthly reservation	2	50%	1	25%	1	25%	0	0%	0	0%	4	100%	3
Difficulty in computing monthly reservation	4	100%	0	0%	0	0%	0	0%	0	0%	4	100%	1
Difficulty in evaluating forecast accuracy	3	75%	0	0%	1	25%	0	0%	0	0%	4	100%	2
Difficulty in identifying factor rate	1	25%	1	25%	1	25%	0	0%	1	25%	4	100%	4

Among the problems they encountered in manually computing the reservation forecast, difficulty in computing the monthly reservation ranked first with 100% of the respondents unanimously reported it to be extremely high degree, followed by difficulty in evaluating forecast accuracy with 75%, slow computation

of monthly reservation with 50% and difficulty in identifying factor rate with 25% ranked last.

Table 2 presents the degree of problems encountered by the respondents during the manual computation of reservation cost forecasts.

Table 2

Degree of Problems Encountered by Respondents During Manual Computation of Reservation Cost Forecasts

Problems	Extremely High		High		Moderate		Low		Extremely Low		TOTAL		RANK
	f	%	f	%	f	%	f	%	f	%	f	%	
Slow computation of monthly costs	2	50%	1	25%	1	25%	0	0%	0	0%	4	100%	2
Difficulty in computing monthly costs	1	25%	1	25%	1	25%	1	25%	0	0%	4	100%	3
Difficulty in evaluating forecast accuracy	3	75%	0	0%	1	25%	0	0%	0	0%	4	100%	1
Difficulty in identifying factor rate	1	25%	1	25%	1	25%	0	0%	1	25%	4	100%	3

The respondents ranked the difficulty in evaluating forecast accuracy as the number 1 problem being encountered in manually computing reservation cost forecasts with 75% frequency rate, followed by slow computation of monthly costs with 50% frequency rate, and difficulty in computing monthly costs tied with difficulty in identifying factor rate both with 25% frequency rate.

The results of the survey were considered and jotted down by the researchers and mitigating measures to counteract the problems were incorporated in the planning and designing phase of the BI modules.

Aside from determining the current manual forecasting processes of the subject FBS provider, after discussing the information gathered during the observation and interview, the functional and non-functional requirements were identified by the researchers.

The major functional requirements of the business intelligence modules are as follows:

- The system must be capable to have a correct reservation and reservation cost forecasts based on the inputted user-specified factor rate and forecast period.
- The system must compute for the correct evaluation of forecast using percentage of accuracy and mean absolute deviation methods.
- The system should ensure that data results are correct and complies with widely-accepted forecasting methodologies.

- The system should organize and display the results of the forecast as well as its corresponding accuracy evaluation using tables, graphs and charts.

On the other hand, the following are the non-functional requirements of the business intelligence modules:

- The system must support concurrent throughput transactions.
- It should provide 24/7 updated information to users.
- It should rely on available past records of reservations and costing stored in the systems database.

The above functional and non-functional requirements were incorporated in the development of the business intelligence modules to be integrated with the mobile-based Service Management and Online Reservation Portal.

With careful planning, designing, coding and testing, and after taking into considerations the strategies and measures to counter the prevalent problems encountered in the manual forecasting processes of the FBS provider in terms of reservation and reservation cost, the Business Intelligence Modules were developed composed of Reservation Forecasting and Reservation Cost Forecasting. It was integrated with the Mobile-based Service Management and Online Reservation Portal. Figure 2 exhibits the framework of the mobile-based system with the BI modules developed.

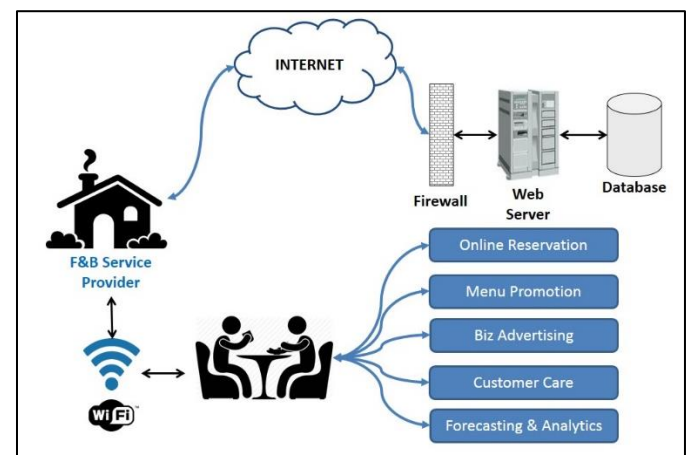


Figure 5. Framework of the Mobile-based Service Management and Online Reservation Portal with the integrated Business Intelligence (BI) Modules.

A User Acceptance Test (UAT) was conducted and questionnaires were floated to the respondents to assess the BI modules and its integration with the existing modules of the mobile-based system. The results of the UAT were tabulated and showed that no B.I. module has been found faulty or require user interface changes. The integration of the BI modules with the existing mobile-based system has been seamless also and raised no error. This means that the BI modules developed have passed the functional and integration tests.

Table 3 exhibits the result of the final user acceptance test (UAT).

Table 3

Overall Rating of the BI Modules Developed as Rated by Respondents the During Final UAT

ASPECTS	RESPONDENTS' RATING					For Implementation
	1	2	3	4	AVE	
Performance	91	93	93	94	92.75	YES
Information	95	88	90	92	91.25	YES
Efficiency	93	88	93	94	92.00	YES
Control & Security	94	87	94	93	92.00	YES
Economic	87	96	97	94	93.50	YES
Service	89	95	95	93	93.00	YES
Average	91.50%	91.17%	93.67%	93.33%	92.42	YES
Overall Average	92.42%					YES

In terms of overall performance aspect of the BI modules developed, the respondents rated it with 92.75%, 91.25% in terms of information aspect, 92% in terms of efficiency and control & security aspects, 93.50% in terms of economic aspect and 93% in term of service aspect. The BI modules got an average overall rating of 92.42% and the respondents unanimously recommended its implementation.

7. Conclusion

Based on the findings presented regarding the manual reservation and cost forecasting processes of the subject food and beverage service provider, the following conclusions are drawn from this study:

- The current manual reservation and cost forecasting processes of the FBS provider were identified which include difficulty in computing monthly

reservation and difficulty in evaluating forecasting accuracy as top ranking problems;

- With the existing manual forecasting processes identified, the functional and non-functional requirements of the business intelligence modules to be integrated with the existing mobile-based service management and online reservation portal were determined and were incorporated in the development of the reservation and reservation cost forecasting modules;

- The reservation and reservation cost modules passed the functional and integration tests having no fault found during the aforementioned tests and during the final user acceptance test.

- The integration and implementation of the business intelligence modules developed were recommended during the Final User Acceptance Test (UAT) by the test participants who gave the BI module an outstanding 92.42% as overall average rating in terms of its performance, information, efficiency, control and security, economic and service aspects.

8. Recommendations:

The Application of business intelligence (BI) especially in an online reservation system has to be managed by the business owner itself being the person with direct control over decision making as to when to increase or decrease its stocks and man power. It is also recommended that using BI in a computerized systems should be done and managed with as much discipline as any other information technology (IT) project in order to effectively achieve its success. It should also be considered that nature of BI solutions rely on the specific methodology being applied on every specific systems developed.

Development of BI requires knowledge on data and demands tight collaboration between the business owner and technologists. It is recommended that both must be educated about the complex technology of data mining and what is possible with their data. Interdependence is a must, because without input from the business users the project will have limited value, better information and communication could help a lot with their work to be positive.

It is also recommended that organizations should embrace the potentials of using Business intelligence and Forecasting in undertaking and operationalizing a business intelligence solution as part of an increasing demands of business intelligence data anytime, anywhere and a broader “management system” initiative.

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