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ITJ

ISSN 1812-5638

INFORMATION TECHNOLOGY JOURNAL

ANSInet
Asian Network for Scientific Information
308 Lasani Town, Sargodha Road, Faisalabad - Pakistan

Information Technology Journal 12 (5): 894-906, 2013
ISSN 1812-5638 / DOI: 10.3923/itj.2013.894.906

Evaluating E-Government System Effectiveness Using an Integrated Socio-Technical and Fit Approach

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Abstract: Most information systems fail to achieve their objectives for a variety of reasons including over budget, out of scope and inability to fulfill the stakeholders' and users' expectations. Researchers have different perspectives and use multiple definitions and measurement methods to evaluate the effectiveness and the success of information systems due to their complexity and subjectivity. This study used HOT-fit (Human, Organization, Technology and fit) Evaluation Framework to evaluate the effectiveness or the success of a Malaysian Electronic Government application, namely Project Monitoring System (PMS) as the case study. The data collection methods used in this qualitative research include in-depth interview, observation and document analysis. This study shows that PMS has not achieved the expected effectiveness level and there were misfits among human, organization and technology factors. To fully achieve the goal as a complete system, SPP II has to undergo further enhancement and solve all the related problems and issues. A number of factors influencing system effectiveness and lessons learned were identified and could guide future IS development. The factors include: system quality, information quality, service quality, system development, system use, user satisfaction, organization structure and organization environment. The findings of this study also show that the HOT-fit Evaluation Framework can be used flexibly in evaluating Electronic Government project.

Key words: Evaluation, information systems, e-government, system effectiveness, framework, fit

INTRODUCTION

Information Systems (IS) effectiveness is a complex issue (Thong and Yap, 1996) and researchers continue to have problems identifying appropriate measures to measure system effectiveness (Pather *et al*., 2004). This problem is also attributed to the multi-dimensional nature of Information Systems (IS), containing both qualitative and quantitative aspects as well as the various and contradictory views of its evaluators (Hamilton and Chervany, 1981). It seems impossible to obtain an accurate measure for IS effectiveness in addition to its subjective view within organizations. The challenge in evaluating IS success or effectiveness including e-government application remains a prevalent discourse in the literature (Kaisara and Pather, 2011; Srivastava, 2011).

In this study, we define system effectiveness as the ability of an IS to continuously accomplish goals using optimum resources within a specified time. We attempt to evaluate e-government effectiveness in Malaysia to identify whether it has achieved its expected outcome, particularly to support agency efficiency and effectiveness in providing services and subsequently improve the government service delivery system. In order to investigate this problem, we chose an e-government application known as Project Monitoring System (PMS) as a case study.

PMS is one of the pioneer applications in the Malaysian e-government implementation. It is the first monitoring system that linked all 25 Federal Government ministries, department and 700 agencies online. PMS provided a new mechanism for project implementation monitoring that encompasses three aspects, namely application, data and communication to enhance project management efficiency and effectiveness. It also provides an information repository facility to support report generation and decision making.

PMS evaluation was conducted based on an evaluation framework introduced by Yusof *et al*. (2008b) and Yusof (2011). The framework, known as HOT-fit (Human, Organizational and Technology-fit), was originally developed for Health Information Systems (HIS)

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but is also applicable to general IS as it is based on previous IS models and literature. HOT-fit uses the IS Success Model to categorize its evaluation factors, dimensions and measures (DeLone and McLean, 2004) and adopted the fit concept from the IT Organization-Fit Model (Scott-Morton, 1991). Human and organizational factors played an important role in IS development and implementation (Yusof *et al*., 2008a). These factors and the fit or alignment among them can be addressed to carry out a comprehensive IS evaluation. We evaluated all three factors using selected measures relevant to the study context. This study aims to discuss the evaluation findings of e-Government effectiveness in improving delivery system of the government service using the HOT-fit framework as a tool for evaluating system effectiveness.

THEORETICAL FRAMEWORK

Information systems evaluation (ISE) and ISE models: Various researches have been done to evaluate IS effectiveness and success. Most of researchers viewed IS effectiveness and success from different perspectives and used a variety of definitions and measurement methods. We reviewed a number of evaluation models relevant to IS effectiveness and success in this section (Table 1). Based on all four models, in general, it can be seen that the IS Success Model (DeLone and McLean 1992), has been used as a basis to develop and enhance system success model in different context by combining it with previous experience, research and model.

Telemedicine System Success emphasized on system impact relevant to individual and service on system use and user satisfaction that subsequently affect organizational effectiveness (Hu, 2003). IS Acceptance (ISA) Model introduced by Seen *et al*. (2007) highlighted on system net benefits that influence user satisfaction and use (critical mass) as well as desire to use.

Knowledge Management Success Model (Jennex and Olfman, 2006) also emphasized on system net benefits on system use and user satisfaction as well as intent to use and perceived benefit. In addition, focused is also given to overall benefits that influence knowledge process or strategy. HOT-fit evaluation framework (Yusof *et al*., 2008a) also highlighted similar importance on the overall benefits on system use and user satisfaction in addition to system development and organizational structure and environment.

All models include different factors, dimensions and measures according to the respective evaluated area. However, it can be seen that the HOT-fit evaluation framework (Yusof *et al*., 2008a) featured additional characteristics such as two dimensional between dimensions and fit between technology, human and organizational factors. Moreover, the framework also consists of organizational factors that encompasses structure and environment dimension as well as additional human dimension, namely system development. These additional features enables a more comprehensive and holistic approach to evaluation.

IS effectiveness or success is a multi dimensional concept that can be evaluated at multiple level. Therefore, there are many ways that can be taken to measure a specific IS using previous evaluation models. This study applied the HOT-fit evaluation framework (Yusof *et al*., 2008b) based on its suitability to evaluate the PMS case study.

HOT-fit evaluation framework: The HOT-fit evaluation framework (Yusof *et al*., 2008b), as depicted in Fig. 1, was developed based on previous studies which includes two models namely the IS Success Model by DeLone and McLean (1992, 2004) and IT-Organization Fit Model by Scott-Morton (1991) to evaluate Health Information System (HIS). The IS Success Model was used to identify evaluation categories such as factor, dimension and measure. The IT-Organization Fit Model identifies appropriate concepts and relationships among evaluation factors namely human, organization and technology. These three factors are essential components in IS and the system impact are evaluated through the overall net benefits.

Figure 1 shows the fit between all three aforementioned factors that can be measured and analysed using nine dimensions: System Quality, Information Quality, Service Quality, System Development, System Use, User Satisfaction, Organizational Structure, Organizational Environment and Net Benefits. System Development was identified during the analysis of the systematic review (Yusof, 2011). Two dimensional relationships were identified between these dimensions: Information Quality and System Use, System Quality and System Development, User Satisfaction and System Use, System Use and System Development, Organizational Structure and Organizational Environment, and Net Benefits with the dimensions of Human and Organization.

The framework can evaluate the performance, effectiveness and impact of IS or IT in a rigorous, systematic and continuous manner. It has been validated using a number of case studies and a systematic review (Yusof *et al*., 2008b; Yusof, 2011). The framework can be used to understand issues, relationships and alignment

Table 1: Comparison of information systems evaluation (ISE) models

ISE model	Measured aspects: Input data quality	System quality	Information quality	Service quality	Technology features	Management action	System use	Intention to use	Perceived benefits	Additional features
Telemedicine Success Model (Hu, 2003)	✓	✓	✓				✓		✓	Emphasis on system impact
Knowledge Management Success Model (Jennex and Olfman, 2006)		✓	✓	✓				✓	✓	Influence of net benefits on knowledge process or strategy
IS Acceptance (ISA) Model (Seen *et al*., 2007)				✓	✓	✓	✓	✓		Able to predict system acceptance
HOT-fit Evaluation Framework (Yusof *et al*., 2008b)	✓	✓	✓	✓	✓	✓	✓	✓	✓	Two dimensional relationshops between dimensions and fit between factors

ISE model	Measured aspects: User satisfaction	Use satisfaction	System development	Organisational structure	Org. environment	Service impact	Impact individual	Org. impact	Net benefits	Additional features
Telemedicine Success Model (Hu, 2003)	✓				✓	✓	✓	✓		Emphasis on system impact
Knowledge Management Success Model (Jennex and Olfman, 2006)	✓	✓							✓	Influence of net benefits on knowledge process or strategy
IS Acceptance (ISA) Model (Seen *et al*., 2007)	✓								✓	Able to predict systemacceptance
HOT-fit Evaluation Framework (Yusof *et al*., 2008b)	✓	✓	✓	✓	✓	✓	✓	✓	✓	Two dimensional relationshops between dimensions and fit between factors

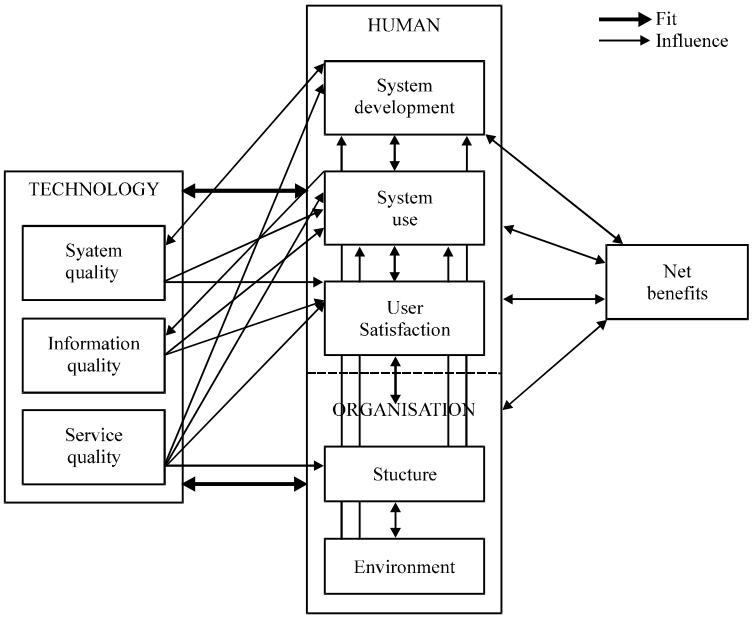

Fig. 1: Human-organization-technology fit (HOT-fit) evaluation framework (Yusof, 2011)

between human, organization and technology as well problems and system performance. It can also be used to identify process information requirement in complex applications. The framework can be used to conduct a systematic and rigorous evaluation in any system development life cycle.

METHODOLOGY

Research design: We employed qualitative methods in the case study strategy to gain detail insight of the system effectiveness.

Data collection: We collected the data through interviews, observation and document analysis methods. The HOT-fit evaluation framework and case study protocol guided the data collection process. Interviews were conducted in two phases over a four months period. Based on the former phase findings, questions were refined for the latter phase to obtain better quality data. The interview duration is between sixty to ninety minutes, depending on the level of the user. The interview questions were formulated based on: (1) the HOT-fit framework, in particular, relevant effectiveness measures, (2) enquiries made to the officers who involved with the PMS development and (3) interview questions reported in the literature.

Study location: The case study was conducted in Implementation Control Unit at the Prime Minister Department of Malaysia.

Study subject and respondent: PMS was selected as the case study based on its importance in the nation development project. PMS, launched in 2001, is one of the first E-Government projects meant to strengthen the monitoring of the National development project implementation. The system supports the government in strategic planning and decision making through a number of functions, namely project implementation analysis, projection and forecasting, and report generation. The system could also analyse project implementation status and its possible problems at the early stage and correction action could be taken speedily. PMS obtained the Asia Pacific MSC in Information Technology and Telecommunication Award (APMITTA) in 2001 for the Best Electronic Government Applications category.

We used a purposeful sampling method to select 20 informants from multiple user levels, based on their skills and experience pertinent to the PMS (Table 2). We collected data using a number of methods, including in-depth interview, observation and document analysis, allowing triangulation to increase study reliability (Yin, 2003). Field notes and informant checking were also performed to increase study credibility.

Data analysis: We analysed the data using five main steps proposed by Rithcie and Spencer (1994) familiarisation, identifying a thematic framework, indexing, charting, mapping and interpretation. We used thematic analysis and compared transcripts and memos based on our study database.

Table 2: List of Informants

Informant position	Initial	User Category	N	Years of system involvement
Officer	ABC	Monitor (monitor project implementation)	1	10
Grade 54	DEF	Monitor/User	2	10
Grade 52	GHI	Monitor/User	1	3
Grade 48	JKL	Monitor/User/ Facilitator (responsible for PMS and facilitate user)	5	3 to 5 and 10
Grade 41	MNO	Monitor/User	4	2 to 3
Grade 38	PQL	Facilitator	1	11
Grade 32	RST	Facilitator	1	10
Grade 29	UVW	Facilitator/User	1	4
Grade 17	XYZ	User	3	1 to 3
Total			20	

RESULTS

As mentioned above, the study seeks to evaluate system success or effectiveness. To answer the question, we choose a Malaysian E-government application, namely the Project Monitoring System (PMS) as the case study. We evaluated the system in terms of producing the expected results such as supporting the agency in providing services and subsequently enhance the government service delivery system.

Project monitoring systems (PMS): PMS is a centralised, modular, web-based integrated system that contains three functions: Operational, Management and Knowledge Base. The Operational Function eases the monitoring of daily projects. The Management Function has two modules, Executive Monitoring and Outcome Evaluation, which support top management in decision making through analysis, forecasting and evaluation. The Knowledge Base Function contains three modules: Problem and Solution, e-Library and Practice Guide, which allow quick access to knowledge and information sharing.

The evaluation findings in this section are organized into factors, dimensions and measures (denoted in italics) based on the HOT-fit evaluation framework, starting from Technology, followed by Human, Organization and Net Benefit.

Technology

System quality: Data accuracy in the PMS was only between 80 to 85%. There is no problem with general project information, but inconsistencies always occurred in project finance and development. Various efforts have been made to ensure data accuracy, including establishing special task force, data cleaning and bilateral meetings at multiple levels. Data accuracy can be questioned, as users did not enter data at the required time and used different project scope criteria.

More than half of the users agreed that PMS is easy to use and user friendly. Mixed reactions and opinions were given by the informants about the PMS ease of use. Positive remarks include "it is easy to use if a user has advanced skill"; "data are more accessible through screen links" and "one-stop, easy and quick information access". Negative comments include "not user friendly", cumbersome and complex and frequent occurrences of the following technical problems:

- Too many terms that must be understood
- Unable to export important fields
- Unable to display certain information
- Only one screen can be opened at a time
- No drop down list

From the ease of learning perspective, a facilitator must guide PMS use, as it is complex and contains too much information as well as unnecessary features and functions. On-going training is also needed for system familiarity. PMS is easy to understand, as it uses the native Malay language and has simple functions, including easy screen movement, as in e-mail. System Monitor JKL stated that PMS can be easily self-learned through the user manual, as it resembles web page navigation. However, learning the system is difficult for other users, particularly the IT illiterate and phobic. The detailed user manual was unhelpful and confusing for certain users.

PMS could be easily accessed through three networks and all informants viewed PMS as reliable in obtaining required information. PMS downtime is low and all informants were satisfied with the PMS response time, which was between four and six seconds. The PMS user's work environment was equipped with the latest tools and hardware as well as internet (IT Infrastructure).

Flexibility refers to the ability of a system to be integrated with other systems. To enhance the monitoring system in Malaysia, PMS must be integrated with two

main systems related to project development: finance and physical progress. Integration was difficult due to the involvement of many parties and non-uniform standard features within the three systems. In addition, the original system developer contract expired and the project was assigned to another contractor.

Information quality: PMS data were sufficient and highly needed (relevant) for meeting presentation, reporting and information validation for external system, such as finance. However, users still complained about difficulties in generating reports, as 43 standard reports in PMS did not fulfil the required report criteria. Users had to double their work, as top management did not use the default reports. According to 15 of 20 informants, the system reports were very important and useful. Although there were issues in data accuracy, basic information could be obtained for monitoring and served as the basis for a project site visit.

Almost all informants agreed on the clarity of data and reports. According to Monitor JKL, users often entered ambiguous information, particularly in the activity field. Reports contained information that was sorted by category and title. In general, all informants were satisfied with three report formats: pdf, html and Excel. Users preferred Excel, as it is more flexible; however, large amounts of information took too much turn-around time.

Additionally, 14 of 20 informants saw that PMS contained too much information (conciseness) that could cause difficulties for users and required long periods of data maintenance. However, user DEF thought that the system data were insufficient and must be improved by adding information on project problems and solutions for project overrun.

Data were less reliable, as some users did not enter accurate data, including hiding certain project information and dates. Users were satisfied, as information can be obtained directly and quickly due to the system's real-time nature (timeliness). However, informants were not satisfied with report generation processed in batches after midnight to avoid interruptions, such as data entry during the day.

Service quality: Problems pertinent to PMS can be reported and logged in through the help desk. Problems are first solved through phone calls followed by a physical visit, if necessary. Users are then informed that the problem was solved and that he/she had been logged out. The implementer agency also established an Agency System Workforce Action Team (SwaT) that monitors system infrastructure and problems.

To this end, 17 of 20 informants agreed that most system reports received quick responses due to the availability of technical staff assigned specifically to PMS (responsiveness). According to the customer charter, the help desk solved simple problems in one day and complex problems took up to five days. This is usually achievable for problems that do not involve PMS maintenance.

All informants agreed that both technical and non-technical staff assigned to PMS were competent (assurance). The highly efficient service made users feel comfortable to directly report problems. The follow-up service depended on the type of problem reported. Normally, PMS technical staff follow-up on users who reported directly to them instead of the help desk service. The implementer agency also initiated a service called 'Knock-Knock PMS', where technical staff generated PMS reports to identify less-maintained fields and users with inactive ID to be contacted for assistance.

Table 3 summarised the findings from the System, Information and Service Qualities under the Technology factor.

Table 3: Summary of technology factors of the PMS efficiency evaluation

Dimension	Findings
System quality	Questionable data accuracy
	Less user friendly
	PMS was quite difficult to be learned
	Network problems affect PMS accessibility
	Low downtime
	Average response time is 4-6 second
	Integration problems with other main systems
	Complete and up to date IT infrastructure
Information quality	Irrelevant reports
	Important and very useful information
	Organized reporting format
	Accurate report information
	Information overload
	Doubtful information reliability
	Reporting is not real time
Service quality	Good technical support
	Quick response time towards user report
	Competent and skillful staff
	Follow-up service

Human

System development: The PMS objectives were still not completely attained after nine years of use (system purpose), including its integration with other important systems. However, its objective to establish a highly collaborative system environment to maximize the efficiency and accuracy of project monitoring was quite successful. Another objective, to provide project monitoring using less paper, remains in progress, as users still store development records manually and use paper reports during meetings.

PMS contract and finance planning and management were performed in a detailed and organized manner by the implementer agency to ensure that it was more economical, efficient and effective than the existing system. PMS was developed by a consortium of four

contractors. System design and strategy were implemented by one appointed contractor. Users were involved in the system design through User Requirement Specifications (URS).

PMS Project Management followed the best practices, as its Steering Committee (SCPMS) was established at the inception to ensure smooth and organized development and implementation. The SCPMS members consist of the associated federal agency and consortium. Although, members changed constantly due to transfer and promotion, the SCPMS worked hard to implement the PMS. In the project scheduling aspect, PMS development involved three phases: Phase 1-Operation, Phase 2-Management and Phase 3-Knowledge Base. The PMS was scheduled from November 1998 until June 2001. However, it was completed in March 2002. The PMS migration process to a web-based environment was performed in two phases based on function and module. Phase 1-Operational Function was scheduled to start in July 2006 and end in July 2007 but the process was completed in October 2007. Phase 2 implementation was completed in stages. Two modules began being used in 2009, with another module in 2010. All informants agreed that the relationship with IT staff was good at the implementer agency, ministry and user levels.

System use

Nature of use: Here, 16 of 20 informants admitted using PMS according to their expectation (use for intended purpose). PMS was always used to generate reports, check updates and update information. However, 10 other informants said that the system was only used when needed. The type of frequently used information included general information, finance, project activity and progress, and percentage of system use. Other information was used infrequently or not at all, as users did not understand their meaning.

For project development, 70.7% of users used the system to monitor and generate reports (purpose of use). Other information used included the following:

- Identify completed projects to evaluate project outcome
- Remind users about required updates and their system use status
- Prepare for project site visit
- Prepare answers for Parliament question
- Prepare paperwork presented in meetings
- Prepare a small diary, containing detailed, updated project information for the leader

The average amount of system use was approximately 50 to 100%, depending on the user level. For facilitators and users who entered data, the system use increased from 75 to 100%, whereas monitors used the system approximately 50% of the time. The Prime Minister mandated using PMS for all development projects in the nation. Additionally, 10 of 20 informants stated that they used PMS because they were required to and needed it to carry out their task (voluntariness of use).

Informants had different views about their motivation to use PMS, including:

- To complete tasks easily
- To add new knowledge
- As annual key performance indicator (KPI) for Ministry Executive
- To increase unit reputation through weekly and monthly competition in PMS usage
- They must use it, and no motivation is involved
- Director's order

All informants indicated that user attitude plays an important role in system implementation. Informants had positive attitudes towards PMS, though they raised concerns about the system and data accuracy. Some users were interested in learning and using PMS: for example, they took their own initiative to upgrade their office networks. There are also users who were not fully committed and did not attend training. They sent representatives instead, which resulted in difficulties in using the system.

On average, informant skill was between 50 to 100 %. Most users were not specifically assigned to handle PMS and had other responsibilities. As PMS became an extra workload, they could not focus on it completely. Conversely, the information update level for users who were specifically assigned for PMS was 100%, with trusted information accuracy.

User are informed and provided training when there are changes in PMS, such as adding a new module. Training requests remained high, due to high user turnover. Training for Trainers was conducted in February 2009. To increase system use and acceptance, training was conducted every Thursday, which was also declared as PMS Day. Only 60.2% of users said that the given training was sufficient and effective in helping them use PMS.

The level of user satisfaction among the informant was between 60 and 80%. Overall, 67.7% of users stated that they were satisfied with PMS, as it assisted them in project monitoring. For specific system function satisfaction, users were satisfied with modifiable report formats that greatly helped them prepare reports for top

management. The Change Notification Module was greatly appreciated, as processes could be completed quickly- only in three days- and process delay could be identified. Basic project information was helpful and easily obtained. Additionally, 65.5% of users were satisfied with PMS functions and facilities, as they are complete and sufficient for monitoring project implementation. However, not all PMS functions, facilities and information were fully utilised (55%) due to a lack of awareness of PMS's actual capabilities.

Although, they faced problems with PMS information accuracy, 18 of 20 informants admitted that PMS was useful and important in supporting project monitoring and enabling users to share expertise, problems, solutions, and best practices (perceived usefulness). PMS is a complete system, from project planning to evaluation. Some users saw PMS as troublesome, felt that information was difficult to obtain and "it was just a regular database because manual validation still need to be performed to ensure data accuracy" (Facilitator UVW). For satisfaction in decision making, users were satisfied with system input pertinent to project development and monitoring update status. However, information accuracy could affect satisfaction in decision making.

Table 4 summarises the findings of System Development, System Use and User Satisfaction under the Human factor.

Organization

Structure: To fully encourage PMS use, various strategies were taken by the implementer agency, including the following:

- Reward ministry that achieves highest system use, best update performance and best ten users
- On-going PMS Data Cleaning sessions and training, including Training for Trainers
- Weekly quiz to encourage user appreciation of PMS
- Establish (System Workforce Action Team) (SwaT) and Knock-knock PMS
- Produce 40 series of Project Implementation Performance Bulletins that contain PMS update report (since 2006)
- Email PMS update levels to top management on a weekly basis. The initiative successfully increased the update of general information, physical progress and finance to almost 100%

The initiatives taken at the ministry level included the following:

- Establish a task force to update PMS information. The team contains 20 members and operates concurrently in a specific room
- Five strategic approaches to evaluate implementation problem, problem solving action, collaboration network, empowerment and acknowledgment
- Organise a hands-on project management course

High turnover of PMS users at the ministry level due to transfers and promotions required training new users. New users normally take time to learn and familiarise themselves with PMS, causing ineffective system use. Disrupted update processes also affect overall project monitoring.

Strong top management support for PMS, particularly at the federal level, encouraged its use. Top managers also fully used PMS. According to user XYZ, "[Our] Boss is great, he provided

Table 4: Summary of Evaluation of Human factor in PMS

Dimension	Findings
System development	PMS objectives were not fully accomplished
	Detailed planning for system development
	User views were included in system design
	Project management was based on best practice
	System were implemented in phases
	System were installed using centralised strategy
	Good relationship and collaboration between users and IT staff
System use	PMS was used as intended
	Information were used for various purposes
	Amount of system use is between 50 to 100%
	User need to use PMS in their task
	There were many motivation to use PMS
	User attitude played an important role in system implementation
	User skill was between 50 to 100%
	On-going training
User satisfaction	User were satisfied with specific functions
	User satisfaction level was between 60 to 80%
	PMS was very useful and important in supporting monitoring of project development
	Data inaccuracy affected decision making satisfaction

Table 5: Summary of PMS Organizational factor

Dimension	Findings
Structure	Numerous strategies were taken to encourage system use
	High turnover among PMS user
	Top management was positive and provide full support for PMS
	Teamwork is crucial to ensure effective and optimal function of PMS
Environment	Age factor also affected PMS use
	Government policy and administration change affected PMS indirectly
	Good and encouraging effort and collaboration between stakeholders

support, knows what is going on, [and] he used the system more than I do". However, there were still some top managers who gave negative responses that affected system use and updates, as low-level users took PMS lightly. User involvement is also important, in addition to continuous support from the implementer agency and strong collaboration from all stakeholders to ensure smooth system use (teamwork).

Environment: From the demographic aspect, age factor also affected PMS. The senior users usually took longer time to learn PMS, had difficulty to understand system information and required repeated system explanations. Some senior users brought younger users to support them during project application.

Decision making or orders from federal levels and administration also indirectly affected PMS usage (Government/Politics). Ministry reshuffling caused various system updates that affected system use and manual reporting. Good efforts and close collaboration by stakeholders (Inter Organizational System) eased the monitoring of update processes at the agency level. However, internal conflict at the ministry and agency levels affected information updates and subsequent data accuracy.

Table 5 summarises the findings of the Structure and Environment dimensions under the Organizational factor.

Net benefit

Job effect: Over 80% of users said that PMS could help them perform their jobs in project monitoring in a smooth and easy manner (job benefit). Reports and information could be provided and accessed easily and quickly from various ministries. PMS was helpful in project site visits, as project information was readily accessible for reporting purposes. Staff productivity increased as jobs became faster and more efficient. However, some users did not feel any difference in their job performance after using PMS.

Users had different views on job workload while using PMS. Some users said that their workload increased because of the following reasons:

- Data must be entered into the system manually
- Ministry's top management did not use the system data
- Manual reverification of data accuracy was needed due to dubious data

Job workload did not increase for some users whose main duty was PMS. Other users said that their workloads were reduced, as general project information, including graphical reports, could be accessed directly from PMS. An increased workload was also seen as a one-off process during new data entry. Some users said that, though their workload increased with PMS, their work problems were reduced.

Although, they had difficulties using PMS, 15 of 20 informants said that their efficiency and effectiveness increased when doing their jobs. PMS greatly improved decision making pertinent to project implementation. Decision making quality also increased with fast information access, reporting and multiple analyses. However, doubtful data accuracy (approximately 85% accuracy) affected analysis accuracy and subsequent decision making. Many reporting errors could be minimised using the export and drop-down list functions.

The overall development cost for PMS so far is approximately Ringgit Malaysia (RM) 70 millions. The original development cost was RM 50 millions and it occasionally increases due to system improvement, change, migration to a web-based environment and integration. Table 6 illustrates the findings summary for the net benefits dimension.

Fit among Humans, organizations and technology: Fit and misfit among humans, organizations and technology were identified in the PMS case study and categorised as follows (Table 7).

Human, organization and technology

Fit: Excellent Service Quality, good collaboration and relationships among all stakeholders and top management leadership and support contributed to smooth PMS use. In summary, the specific factors are Technology: Service Quality (technical support, quick response time and

Table 6: Summary of PMS net benefits

Measures	Findings
Job Effect	Support project monitoring task
Productivity	Increased user productivity
Work load	Various user reaction: same and increased (but helped in reducing problems and increased efficiency)
Effectiveness	Increased
Decision making	Greatly support project implementation
Error	Reduced reporting errors
Cost	Increased on occasion

Table 7: Fit and misfit among the Human, Organization and Technology factors

Factor	Fit	Impact	Misfit	Impact
Human, organization and technology	Excellent Service Quality	Smooth system use	Lack of specific staff for PMS	Low training attendance
	High collaboration and close relationship between stakeholders		High turnover between PMS user	Disrupted update process
	Leadership and top management support			Reduced information accuracy
Human and technology	Migration from Lotus Notes to web based environment	Increased system use	Doubtful data accuracy	Decreased system use, user satisfaction and decision making
	Excellent service quality	Increased user satisfaction	Network access problem	
			PMS was not user friendly and difficult to learn	
			Dishonest user	Unclear information and questionable data reliability
			Reporting was not generated in real time	Unable to attain all system objectives
				Decreased system quality
Human and Organization	Close relationship between stakeholders	Good collaboration and teamwork to make system work	Uncommited user	Decreased system and information quality
	Order and support from top management	Encourage low level user to use the system	Continuous system change	Decreased system use
Organization and Technology	Strategy to provide best service	High adoption rate	Poor top management commitment	Irrelevant Reporting
				Increased workload among low level staff

assurance); Human: System Development (relationship with IT staff) and Organizational: Structure (leadership, top management support, teamwork).

Misfit: Misfit among humans, organizations and technology can be seen from the unavailability of specific staff members for PMS and high user turnover which affected training attendance, information updates and subsequent data accuracy. The specific factors are Organization: Structure (staff turnover), Human: System Use (training) and Technology: System Quality (data accuracy).

DISCUSSION

PMS was still unable to achieve its maximum effectiveness and fit among human, organization and technology factors that affected overall PMS adoption. This conclusion is also made based on the problems that still occurred after nine years of system use, namely networking access, integration, human resource and user skill. Yusof *et al*. (2008a) also stated that the fit among these three factors are important in realising IS. The revalidation of PMS information could be avoided if users at all level updated information and fully used the system.

PMS should be a complete system, covering all phases from project planning to evaluation. However, it was still not achievable, as PMS was implemented in stages and updates systems according to changes in government policy and politics.

Some users, particularly seniors, viewed PMS as unfriendly. There was too much information to be entered, and obtaining this information was difficult. Some functions were seldom used because users did not understand them and there was no need to use them. DeLone and McLean (1992) and Seddon (1997) stated that IS and its information must be reliable, readily accessible and easy to use. Many PMS reports were used less due to differences in top management requirements of system reporting templates. According to Or and Karsh (2009), to increase fit between technology and users, it is important to understand and consider user options, requirements, and skill at the design level.

As an e-Government project, PMS planning, management and development were performed carefully, orderly and according to the best practices. Earlier studies proved that the quality of system planning, including project scheduling, communication and information management, contributed to system success (Byrd *et al*., 2006).

The level of user satisfaction towards PMS was only approximately 60 to 80%. However, users acknowledged that PMS provided overall benefits, including positive work accomplishments, increased productivity and supported decision making. Hsu *et al*. (2009) also identified a significant relationship between user satisfaction and achievement that leads to improved decision making and efficiency.

The study also applied the same approach as Jennex (2008), where the basis for system success or efficiency was measured from system use. Before the first quarter of 2009, the system use was less than 50%, which can be associated with the user satisfaction percentage, which was between 60 and 80%. The findings are supported by those of Hsu *et al*. (2009), where there is a positive relationship between user satisfaction and system use. However, increased PMS use can be seen in early 2010 as a result of top management's order to assign PMS use as a Ministry KPI.

According to Gelderman (1998), voluntary or enforced system use can also influence overall system use. Ozkan *et al*. (2008) had the same view and stated that in public sector, system use is not suitable for measuring system effectiveness, due to the bureaucratic situation of the sector. However, we measured PMS effectiveness with system use, as adoption of the system remained low despite its enforcement.

Various efforts were made to ensure optimum PMS use, including continuous training, data cleaning, recognition, and technical support. However, user attitude and skill largely affected PMS both positively and negatively. High user acceptance can encourage system use and support project monitoring as well as provide other benefits to the overall job, including improved process and increased productivity and vice versa. Yusof *et al*. (2008a) also discovered that user skill and attitude play important roles in effective and efficient system function. The provided training should also be more than just "technology know-how" (Blake *et al*., 2010; Meneklis and Douligeris, 2010). Users must be aware of the system's effect on work processes; clear system understanding can create a sense of ownership of the system and its belongings among users, who can see the effects of using PMS.

Top management roles and commitment also play important role in ensuring PMS effectiveness. PMS use by top management indirectly encouraged PMS use among low-level users. The findings resembled previous work, where continuous support from management (Yu *et al*., 2010) and active stakeholder involvement (Meneklis and Douligeris, 2010) were critical in encouraging long-term system effects. A system that is not fully utilised cannot function effectively and efficiently (Young and Jordan, 2008).

Furthermore, we found that the HOT-fit evaluation framework is applicable to evaluating e-Government projects. However, a number of adaptations were made during framework application by grouping different measures in the same cluster and refining sub measures. The HOT-fit framework can be used flexibly to evaluate a system according to the evaluation purpose, method and suitability of measures.

A number of factors influencing effectiveness have been identified, including the following:

- **System quality:** Data accuracy, user-friendly, ease of learning, accessibility, integration and response time
- **Information quality:** Relevancy, usefulness, data conciseness, data reliability and timeliness
- **Service quality:** Technical support, responsiveness, and assurance
- **System development:** Planning, project management, project scheduling, and relationship with IT staff
- **System use:** Attitude, training, skill, amount of use, motivation to use and system acceptance
- **User satisfaction:** Overall satisfaction, perceived usefulness and satisfaction with software
- **Organizational structure:** Top management support, leadership, teamwork, strategy, staffing and staff turnover

- **Organizational environment:** Government, politics, and inter-organizational system

Our findings are in line with those of Floropoulos *et al.* (2010) that demonstrate the existence of strong relationships among System Quality, Information Quality, Service Quality, perceived usefulness and user satisfaction when examining the success and effectiveness of an e-government project in Greece. Gorla and Lin (2010) discovered that organizational factors have a more significant effect on system effectiveness than the technical factors.

CONCLUSIONS

The contributions of this exploratory study can be seen from two aspects: factors influencing system effectiveness and validation of the HOT-fit framework. The identified factors can guide IS development, particularly e-government application as well as planning and policy making for the nation's public service. The study showed that the HOT-fit framework can be applied to evaluate e-government projects and a general IS in a rigorous, systematic and structured manner. Flexible application of the framework could provide a comprehensive overview of the human, organization and technology factors as well as the fit among them. Apart from the impact, the benefits and advantages of an IS can also be evaluated based on the comprehensive outcome measures and dimensions.

The study has a number of inevitable limitations. First, we are not able to interview informants outside our geographical location as the process would be time consuming. Therefore, the selected informants are limited to the users at the federal level only. Second, we only evaluated limited number of measures featured in the HOT-fit framework due to the study time constraint.

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