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A DELPHI STUDY OF THE IMPORTANT FACTORS FOR BI SYSTEM IMPLEMENTATION IN THE PUBLIC SECTOR ORGANIZATIONS

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Graphical abstract

CSFs	Consensus%
Continuous management	100
Scalable and flexible system	100
BI team skill	100
Resource allocation	90
Coordination between IT and	90
Organization culture	90
BI strategy	80
External consultant	80
User involvement	80
Iterative and incremental	80
Well established business case	70
Clear vision	70
Business champion	70
Integration with other system	70
Data quality and integration	70
User skill	70

Abstract

This paper depicts the effect of Critical Success Factors (CSFs) on business intelligence (BI) system implementations in Malaysian context by applying a Delphi study. The results of this study provides insight to the most important CSFS which assist the Malaysian public sector organizations to organize their resources through understanding those CSFs that are most likely to have an impact upon the implementation of the BI system. The modified Delphi study was selected to conduct this study. Result of first round of Delphi study revealed that the user access is insignificant factor for the success of BI system implementation. Moreover, overall finding of Delphi study highlighted the continuous management support, scalable and flexible system, BI team skill, resource allocation, organization culture, and coordination between IT and business units as most important CSFs for implementation of BI system.

Keywords: Critical success factors, Business intelligence system, Public sector, Delphi study

1.0 INTRODUCTION

Nowadays there is much activity in the usage of information and communication technologies (ICT) to improve public service delivery [1, 2]. Moreover, due to the wide range of activities, they produce huge volume of data. Thus a skilful analysis is vital for them to take full advantage of the value of this asset [3]. According to Hartley and Seymour [4] BI is one of the IS product which has an important contributory role in addressing the needs of service delivery in public sector. Despite the criticalness of BI system in public sector previous research on BI have mostly focused on private organizations, reflecting their situations, requirements and BI success factors. Only a few researches have carried out in the area of CSFs for BI in public sector. Therefore one of the potential contexts to conduct research on CSFs for BI implementation is public sector [3].

Binti Mohamad and Bin Mohamed [5] highlighted the rate of BI system adoption in the Malaysian public sectors is increasing. She emphasized that implementing BI system in public sectors is an important project which needs further investigation to insure of its success. Furthermore, Mohamadina *et al*. [6] underlined, Malaysian public sector is an appropriate context to conduct a research on CSFs for BI implementation since Malaysia is witnessing a major change in MIS and traditional methods used for decision making. This evidence disclosed, Malaysian public sectors need to follow up factors, which lead to the success of BI system implementation project. Therefore, the increasing rate of BI systems adoption in Malaysian public sector, the complexity of BI system implementation and the shortage of academic research regarding CSFs justify a more concentrated study on CSFs for BI implementation.

2.0 CRITICAL SUCCESS FACTORS FOR BI SYSTEMS IMPLEMENTATION

The concept of CSFs for the first time was introduced by Bullen [7] in 1979. Critical success factors considered as situated essences that assist extend the limitations of process improvement, and those impact is much richer if observed within the specific context of their significance in each phase of the implementation process. As Moss and Atre [8] stated determining CSFs is crucial for the success of BI implementation. They believed identifying CSFS is one of the important stages in BI implementation lifecycle. Factors affecting the success of BI system implementation are complex and many authors have identified a diversity of factors that deemed to be critical to the success of BI system implementation. Through an extensive literature review in journals and conferences 16 studies that discussed CSFs for BI systems implementation were found. However, the highest referred papers were selected for this study summarized in Table 1.

Table 1 CSFs for BI systems implementation by various authors l a

	Author	CSFs	Context
1	Wixom and Watson [9]	Management Support, Resources, Champion, User Participation, Source Systems, Development Technology, team skill	Manufacturing, Healthcare, Retail Wholesale, Telecommunications Financial, Services/ Banking Insurance, Government, Utilities Education, Publishing Petrochemical
2	William Yeoh [10]	Committed management support and sponsorship, Clear vision and well-established business case Business-centric, championship and balanced team composition, Business-driven and iterative development approach, User-oriented change management Sustainable data quality and integrity, Infrastructure related factors,	Electricity, Gas, Water utilities. Telecommunications, Rail infrastructure and Fleets, Municipal utilities. Public transportation Authority, Energy utilities, logistic transportation company
3	Adamala et.al [11]	management support and sponsorship, adequate resources, management decision quality, user education and training, user satisfaction, user support, strategic BI vision, team skills, source systems, technical framework, development of technology and tools, system functionality, tools, BI cost, BI system usability, data quality and reliable resources, modelling of dimensional data and meta-data, information area readiness, user participation, user commitment, user support, well-established business case,	Poland, private sector

		clearly defined business need, measurable business benefits, business-driven BI initiatives, planning and scope definition, adoption of incremental delivery approach, project schedule, external consultants, business domain committed expertise	
4	Öykü Işık [12]	Data quality, integration with other system user access, Flexibility of system,	Organizations randomly selected in United States
5	Sebastian Olbrich and et.al [13]	corporate strategy, distribution channels, financial, top management support, market dynamics, BI strategy, data source, IT budget sophistication of IT infrastructure, degree of user involvement in IT projects	diverse industries
6	Babazadeh and Ihad [14]	Top management support, Clear goals and objectives , Effective project management, culture of the organization, User education and training, stakeholders active involvement, Data and information accuracy and integrity , Enterprise IT infrastructure and legacy system ,Suitability of hardware and software, System reliability and flexibility, IT skills in an organization , System perceived usefulness and learnability, change management, committed management support and sponsorship, perceived contribution made by the BIS to organizational performance	Literature review
7	Olszak and Ziemba [15]	adequate budget, competent BI project manager (leadership), and skilled (qualified) sufficient staff/team/managers, past experience and cooperation with a BI supplier, well defined users' expectations (information requirements) and adjusting the BI solution to users' business expectations (requirements) integration between BI system and other systems, appropriate technology and tools ,user friendly BI system	SME in Poland
8	Anjariny *et al*. [16]	management support and sponsorship, adequate resources, presence of champion, management, decision quality, user participation/involvement, user education and training user commitment, user satisfaction, user support, strategic BI vision, well-established business case, clearly defined business need, measurable business benefits, business-driven BI initiatives, planning and scope definition, adoption of incremental delivery approach, project schedule, team skills, external consultants, business domain committed expertise, source systems, technical framework, development of technology and tools, system functionality, BI tools, BI cost, BI system usability, data quality and reliable resources, modelling of dimensional data and meta-data, information area readiness	Malaysian organization

In this review wherever necessary, a common name has been provided for the same concept which named differently by the various authors. In general, 17 CSFs were extracted from previous studies, which are listed and explained as follows:

1) Continuous management support
2) Resource allocation
3) well established business case
4) BI strategy
5) Clear vision
6) Coordination between IT and business units
7) Business Champion
8) External consultant
9) Iterative and incremental approach
10) User involvement
11) scalable and flexible system
12) User access
13) Integration with other system
14) Data quality and integration
15) User skill
16) BI team skill
17) Organization culture

Continuous Management Support

Management support and sponsorship has been widely acknowledged as the most important factor for BI system implementation. A successful BI application can expose internal problems it can be spoiled by internal politics and resistance. A strong team of management support is required to guarantee the success of BI in organizations. Gaining consensus support from management can help establish legitimacy for the project.

Resource Allocation

Financial, human and other resources has been found to be a problem in reengineering implementations. Dedicated resources are critical to realize the benefits associated with a BI package. Resource requirements need to be determined early in the project and often exceed initial estimates and the inability to secure resource commitments up front may doom project efforts.

Well Established Business Case

Substantial business case identifies the proposed strategic benefits, resources, costs, and timeline). A well-crafted business case investigates all feasible approaches to a given problem and enables managers to select the options that suit the organization.

BI Strategy

Business Intelligence strategy enables organizations to measure their performance and look for competitive advantages, accurately land listen to their stakeholders.

Clear Vision

In a BI implementation project, formulate the vision is one of the most important factors. Successful approach exists in an organization with a clear strategic vision to guide the BI implementation as compared to non-successful ones. As a BI initiative is driven by business, thus a strategic business vision is needed to direct the implementation.

Coordination between IT and Business Units

Since the business unit assumes ownership for purchasing, managing, and developing system for its use and IT units is responsible for the quality of implementation, the BI system implementation required involvement of both business unit and IT unit in order to achieve success.

Business Champion

Having a project champion is the main aspect of BI implementation. In fact, a BI initiative often spans multiple functional units and demands extensive data and resources from these business units. In this respect, the champion is critical to ensure the careful management of the organizational challenges that arise during the course of the project.

External Consultant

External consultant will assist business champion and implementation team within complicated tasks therefore it considered critical for the success of BI system implementation.

Iterative and Incremental Approach

Each methodology of information system designing and implementing should be characterized by certain standards. BI systems should be rapidly implemented, which is quite difficult because such systems are specific for each enterprise. Although based on standard components shortens time required to build BI, each implementation necessitates adjusting of a particular system to specific requirements of an enterprise. The iterative and incremental development method assists BI team to accelerate project.

User Involvement

User's participation during software development attempt is one of the factors, which affect on successful BI implementation. The changes of the business processes should be handled and constantly user participation in the process of system development is necessary. Indeed the involvement of different levels of users is very important to define the scope and develop the functional BI solution[17][17]. Contribution of BI users in certain phases of implementation is vital for the success of BI.

The user participation is a fundamental part of effort from the early stage of implementation. If the business users shape the solution, the business requirements will be meet successfully. This results in higher rate of system usage and more success for BI system.

Scalable and Flexible System

The business intelligence system should address scalability and flexibility requirements to meet dynamic business requirements. The flexible and scalable infrastructure design leads to develop a BI system align with growing information/data needs.

User Access

The BI platform should enable users to access required information immediately. Besides, the level of access to information for different level of managements should be determined.

Integration with Other System

The BI system architecture should be flexible to integrate with existing business application and technologies. System integration in BI system refers to two things: the ability to extent the BI software with new capabilities and modules and the system's ability to coexist with other enterprise solutions.

Data Quality and Integration

Sustainable data quality and integrity is crucial for successful BI implementation. The degree of data accuracy has a great impact on information system implementation. Many data related issues inside the systems are not revealed until that data are settled and queried within the BI systems. Therefore, data quality affects the quality of management system reports, which in sequence it influences the decision outcomes. In other word, poor data quality can hinder business decisions at all levels of the organization. The main concerns for data quality are the source system and BI process within integrating data from different sources. Data quality issue often arises when data do not support business requirements. However, data should not only support by original source system it also should match with the integrated system requirement. Based on aforementioned reason Data quality plays key role in the success of BI implementation.

User Skill

A highly skilled workforce is also important for successful BI implementation. Poor skills and experience employees cannot get any benefit of the new implemented BI system, although an expert team develops the system and meet all their requirements.

BI Team Skill

The project team is responsible for implementing the system. If the BI team has not sufficient skill and knowledge, the project will fail. In fact, for the project implementation personnel of the team, should possess the essential technical skills and have the suitable technology to achieve their responsibilities[18][18]. Then high level of team skills leads to project implementation success.

Organization Culture

All organizations have culture, the sets of norms and values, which collectively guide the behavior of their employee. The coordination between the organizational culture and information system deems critical for organizations to gain the potential benefits from the system.

3.0 METHOD AND SAMPLING FRAME

A two rounds modified Delphi study which began with a predetermined list [19] to rate the CSFs was selected to conduct this study. As Thompson [20] noted the use of a modified Delphi is a proper option if information concerning the study area is available. The purposive sampling was applied to select the panelists. They were drawn through LinkedIn according following criteria: having long-term experience in BI system implementation, being part of BI team in public organization or being part of BI project from vendor while they understand and know the atmosphere and requirements of public organization. Numbers of participants in Delphi study vary according to the scope of the problem and resources available [21, 22]. In this study, nineteen panelists invited which thirteen of them accepted to join the study and finally only eleven attended in first round and ten of them remained in second round.

According to Skulmoski [19] where the panel is homogeneous, same as this study, then a smaller sample of ten to fifteen people yield sufficient results. Moreover, there are previous quantitative Delphi studies which used less than 15 panelists such as Holey *et al*. [23] with 12 participants. Therefore, the number of ten participants deemed properly enough and adequate for shaping a significant result. In each round, questionnaire were sent to the experts through electronic mail and they were asked to rate the degree of importance of each CSFs in BI system implementation based on a 5- point scale, ranging from low to critical (including NA=not applicable). Following Green [24] level of consensus for the first round was measured by reaching 70 percent agreements. For the second round level of consensus set to 90 percent as suggested by Holloway [25].

4.0 RESULTS

The first round as suggested by Hsu and Sandford [26] started with a close-ended questionnaire. The first Delphi round questionnaire, included three parts first part encompasses brief introduction in determined CSFs. Second part encompassed series of questions in respect with demographic information and confirmation of expert availability to attend in the Delphi study. In the third part, the participants rated the CSFS that were identified in BI literature. The outcome of first round assisted researcher to obtain general view of experts about CSFs. In addition, it helped to identify the readiness of experts to participate in this study. All results are exposed in tables, which present the percentage of agreement for each CSFs (calculated by SPSS software). For the rating questions the criticality for each factor for the success of BI implementation was acquired through the level of agreement for inclusion into the Round two, the consensus was set at 70 percent. Therefore, only those factors that achieved the verge of 70 percent of responses in agree or strongly agree, were considered consensus elements. Analysis of the preliminary consensus statements for each question of first and second round is shown in following (Table 2).

Table 2 Level of consensus in round one and two

CSFs	Round one Consensus%	Round two Consensus%
Continuous	100	100
Resource allocation	90.91	90
Well established business	72.72	70
BI strategy	72.72	80
Clear vision	72.72	70
Coordination between IT	90.9	90
Business champion	72.72	70
External consultant	72.72	80
Iterative and incremental	72.72	80
User involvement	81.82	80
Scalable and flexible	90.91	100
User access	54.6	-
Integration with other	72.72	70
Data quality and	72.72	70
User skill	72.73	70
BI team skill	100	100
Organization culture	90.90	90

According to result of the first round of the Delphi study, 16 factors are critical for the success of BI system implementation in Malaysian public sector. The only factor, which did not reach the level of consensus, is user access with the 54.6 percent agreement among experts. Three of participants viewed the user access as a feature of BI system not a factor, which affects the implementation success. Another participant commented the user access always is notice by BI vendors as security issues, thus they create authorization object to cope with it. According to participant comments user access deemed to be a feature, which is considered by BI vendor, not a CSF.

Moreover, the result of the second round revealed the continuous management support, scalable and flexible system and BI team skill are the most important CSFs with 100 percent agreement. Resource allocation, organization culture, and coordination between IT and business units were considered in the group of important CSFs.

5.0 DISCUSSION

This study not only identified the CSFs in BI system implementations, but also determined which factors is the most significant factor in the implementation process. The finding of this study can be used to identify and allocate resources to those factors that require to be considered for monitoring the BI system project effectively. Attending these factors improve the likelihood of a successful BI system implementation. The CSFs, in respect of critically (organized from the highest to the lowest) for implementing BI system in Malaysian public sector categorized in four levels as follows (Table 3).

Table 3 Four level of CSFs for BI system implementation

CSFs	Consensus%
Continuous management support	100
Scalable and flexible system	100
BI team skill	100
Resource allocation	90
Coordination between IT and business units	90
Organization culture	90
BI strategy	80
External consultant	80
User involvement	80
Iterative and incremental approach	80
Well established business case	70
Clear vision	70
Business champion	70
Integration with other system	70
Data quality and integration	70
User skill	70

Based on the finding of the quantitative Delphi study on BI project in Malaysian public organizations the most important factors were continuous management support, scalable and flexible system and BI team skill with highest level of agreement. Moreover, there are three import factors which can be rate as a second level of the important factor namely Resource allocation, organization culture and coordination between IT and business units. The remained CSFs (level three and four) are not critical as level one and two but they still considered as CSFs

for BI system implementation project. The third level of CSFs includes BI strategy, external consultant, User involvement, Iterative and incremental approach and Iterative and incremental approach. The lees critical success factor are well-established business case, clear vision, business champion, integration with other system, data quality and integration and user skill.

6.0 CONCLUSION AND FUTURE WORK

The CSFs framework is a valuable practical contribution of this study. This study has drawn on current knowledge of BI system as expressed in the literature and reviewed it through perspective the participation of a range of relevant stakeholders in the BI system implementation. The top management, project manager, and team member that are planning to implement enterprise level BI systems may use the determined CSFs to be better able to understand those factors that will enhance the likelihood of success. This understanding will assist them to tackle issues related to the implementation and other related IT concerns. This will allow the system to be successful therefore, organizations will gain maximum benefits from the system [27].

By applying the CSFs framework, the top management of the public organizations could decide on suitable action to be taken for each of the identified factors. Understanding the factors from different aspect such as organizational and cultural is vital to guide the organizations during BI system implementation. Moreover, this may leads to better planning and informed decision making for future or current BI system implementation. In order to understand the effectiveness of the CSFs for BI Initiative in Malaysia context, case studies through other methods of qualitative research such as action research, ethnography research can be done in the public organizations that already have implemented BI system. The CSFs framework can be examine within more number of public organizations from other ministries through the quantitative study. Since the collected data were mainly obtained from the IT Personnel and manager level business user of the organization might future researches will consider other stakeholders within the agencies particularly the end users. As increasing the number of respondent in study bring verity perspective that may leads to emerging ne factors.

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