Critical success factors for business intelligence system implementation in public sector organisation

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Abstract: Business intelligence (BI) system offers competitive advantages to public organisations by gathering, storing and analysing large volume of data for effective decision making. Although, the rate of BI implementation within public sector organisations is increasing, still some of the BI implementation projects fail. Hence, this study aims to investigate the critical success factors (CSFs), which affect the success of BI system implementation in public sector organisations. This study structures previous research by presenting a comprehensive classification of CSFs in the area of BI system implementation success. The review of the literature identifies the large number of CSFs for BI success mostly related to private sector organisations. Moreover, prior studies indicate that there has not been enough research on impact of culture on success of BI system implementation. Finally, the main finding of this study revealed achieving success in BI system implementation in public sector organisation is associated with four factors namely culture of learning, decision-making culture, information sharing culture and collaboration culture under culture dimension.

Keywords: business intelligence; critical success factors; CSFs; public sector; qualitative study; case study; cultural factors.

1 Introduction

The business intelligence (BI) market has recently experienced extremely high growth as organisations continue to report substantial profits (Friedman and Bitterer, 2011). Despite positive feedback from private sector, the public sectors still struggle to recognise factors leading to the successful BI system implementation (Wowczko, 2013). To date several studies have been conducted to find out the factors which contribute to the success of BI system implementation project. For example, Yeoh and Koronios (2010) identified three main dimensions of CSFs for BI system implementation namely organisation, process and technology. However, there are CSFs for the success of BI system implementation which have not identified yet (Adamala and Cidrin, 2011) such as cultural factors (Foshay et al., 2014; Herschel and Jones, 2005). In addition, Işık (2010) and Kokin and Wang (2014) mentioned there is a need for more in-depth study on impact of cultural factors on the success of BI implementation even though cultural factors have been disregard in previous researches.
In public sector alike private sector, there is a strong interest in the usage of information and communication technologies (ICTs) to improve public service delivery (Bardhan and Mookherjee, 2000; Cordella and Hesse, 2010). Moreover, due to the wide range of activities in public sector organisations, they produce huge volume of data, thus an effective analysis is vital to take full advantage of the value of their information asset (Wowczko, 2013). According to Hartley and Seymour (2011), BI system is one of the IS product which has a significant role in addressing the needs of service delivery in public sector. Despite the criticalness of BI system in public sector, previous study on BI system mostly focused on private sector (Chen et al., 2012). Therefore, one of the potential contexts to conduct study on CSFs for BI system implementation is public sector (Wowczko, 2013).

To address this gap, a comprehensive research need to be conducted in order to explore CSFs which affect the BI system implementation success in public sectors in particular focused on culture dimension. Always there has been an erroneous impression that factors under technology dimension are the only important factors which affect the success of IS project. This study revealed how other CSFs particularly cultural factors impact the success of BI system implementation in public sector organisations. Moreover, the proposed framework would provide insight to stakeholders, different level of management and technical users to apply their resource by focussing on the key area which have greater impact on the success of BI project.

2 Literature review

According to Moss and Atre (2003), identifying CSFs is one of the important stages in BI implementation lifecycle which should be done before creation of high level project plan. Over the past few years, a considerable amount of research has been conducted into CSFs for BI system implementations. This section comprises a discussion of the CSFs for BI system implementation proposed in previous researches. Yeoh and Koronios (2010) conducted a qualitative research on CSF for BI implementation, they categorised CSFs in three main dimensions namely: organisational, process and technology. Olbrich et al. (2012) suggested a list including 27 organisational and environmental CSF. Işık et al. (2013) investigated the role of the decision environment in terms of the types of decisions and the information processing which needed in the organisation. According to Işık et al. (2013), success factor such as data quality, user access and the integration of BI with other systems are essential for BI success, inconsiderate the decision environment. However, decision environment effect the BI success through the BI success factor, such as the range of BI supports risk and flexibility in decision making. Popović et al. (2012) proposed a CSFs model which presents the critically of decision-making culture factor for BI system success through impacting on information content quality. He believed staffs with analytic decision-making culture are more eager to use information provided by BI system. Sangar and Iahad (2013) categorised CSFs for BI system implementation, in terms of the project life cycle approach in three stages, pre-implementation, implementation and post-implementation stages in two different dimensions organisational and technical. A study on organisation readiness for BI was done by Anjariny et al. (2012). They believed the readiness factor and CSF are the same in essence. Therefore, they reviewed all previous studies in CSFs for BI to develop the
readiness framework. They encapsulated all related SFs under same dimension to facilitate reforming the theoretical framework. Theses dimensions are management related dimension, user related dimension, business related dimension, project related dimension, infrastructure related dimension, teamwork related dimension and data related factors. Each of these dimensions includes number of factors. A summary of previous study is depicted in Table 1.

Table 1  Summary of previous studies on CSFs for BI system implementation driven by authors

<table>
<thead>
<tr>
<th>No.</th>
<th>Author</th>
<th>Factors</th>
<th>Context</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Wixom and Watson (2001)</td>
<td>Management support, resources, champion, user participation, quality of data source systems, integrated data, development technology, team skill</td>
<td>Manufacturing, healthcare, retail wholesale, telecommunications financial, services/ banking insurance, government, utilities education, publishing petrochemical</td>
</tr>
<tr>
<td>2</td>
<td>Eckerson (2005)</td>
<td>Support all users via integrated BI suites, conforms to the way users work, integrates with desktop and operational applications, delivers actionable information, foster rapid development, provide a robust, extensible platform</td>
<td>No context (not examined)</td>
</tr>
<tr>
<td>3</td>
<td>Arnott (2008)</td>
<td>Committed and informed executive sponsor, widespread management support, appropriate team skills, appropriate technology, adequate resources, effective data management, clear link with business objectives, well-defined information and systems requirements, evolutionary development, management of project scope</td>
<td>A case study in insurance company in Australia</td>
</tr>
<tr>
<td>4</td>
<td>Rud (2009)</td>
<td>Collaboration culture, training and organisational development culture</td>
<td>No context (not examined)</td>
</tr>
<tr>
<td>5</td>
<td>Herschel and Yermish (2009)</td>
<td>Organisational culture, information sharing cultural, culture of continuous learning and improvement)</td>
<td>No context (not examined)</td>
</tr>
<tr>
<td>6</td>
<td>Vodapalli (2009)</td>
<td>Business driven methodology and project management, clear vision and planning, committed management support and sponsorship, data management and quality issues, map the solutions to the users, performance considerations and robust and extensible framework</td>
<td>Organisations in Denmark</td>
</tr>
</tbody>
</table>
Table 1  Summary of previous studies on CSFs for BI system implementation driven by authors (continued)

<table>
<thead>
<tr>
<th>No.</th>
<th>Author</th>
<th>Factors</th>
<th>Context</th>
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<tbody>
<tr>
<td>7</td>
<td>Hawking and Sellitto (2010)</td>
<td>Management support, champion, resources, user participation, team skills, source systems, development technology, performance, methodology, business content, governance, reporting strategy, interaction with sap, testing, data quality, involvement of business and technical, implementation partners, identification of KPIs, technical ERP and BI, SAP partners or user groups in Australia, USA and Europe.</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>Yeoh and Koronios (2010)</td>
<td>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 from Australia</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>Seah et al. (2010)</td>
<td>Knowledge sharing culture Chinese telecommunications companies</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>Olbrich et al. (2012)</td>
<td>Corporate strategy, financial, top management support, market dynamics, data source, IT budget, sophistication of IT infrastructure, degree of user involvement in IT projects Diverse industries</td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>Popović et al. (2012)</td>
<td>Analytical decision-making culture Medium and large-size business organisations conducted in Slovenia</td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>Olszak and Ziemba (2012)</td>
<td>Adequate budget, competent BI project manager (leadership), skilled (qualified) sufficient staff/team/managers, past experience and cooperation with a BI supplier, well defined users’ expectations (information requirements), 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</td>
<td></td>
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<td>No.</td>
<td>Author</td>
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<tr>
<td>13</td>
<td>Anjariny et al. (2012)</td>
<td>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</td>
<td>Malaysian organisation</td>
</tr>
<tr>
<td>14</td>
<td>Işık et al. (2013)</td>
<td>Data quality, integration with other system, user access, flexibility of system</td>
<td>Organisations randomly Selected in the USA</td>
</tr>
<tr>
<td>15</td>
<td>Sangar and Iahad (2013)</td>
<td>Top management support, clear goals and objectives, effective project management, culture of organisation, 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, skills in an organisation, system perceived usefulness and learnability, change management, committed management support and sponsorship, perceived contribution made by the BI to organisational performance</td>
<td>Literature review</td>
</tr>
<tr>
<td>16</td>
<td>Dawson and Van Belle (2013)</td>
<td>Management support, champion, resources, user participation, data quality</td>
<td>Financial services organisation in South Africa</td>
</tr>
</tbody>
</table>
Table 2  Classification of determined factors in literature provided by authors

<table>
<thead>
<tr>
<th>Dimension</th>
<th>Factor</th>
<th>Sub factor</th>
</tr>
</thead>
<tbody>
<tr>
<td>Organisation</td>
<td>Committed management support and sponsorship</td>
<td>Continuous management support</td>
</tr>
<tr>
<td></td>
<td>Clear vision and well established business case</td>
<td>Resource allocation</td>
</tr>
<tr>
<td>Process</td>
<td>Business-centric championship and balanced team composition</td>
<td>Well established business case</td>
</tr>
<tr>
<td></td>
<td>System development related factor</td>
<td>Business champion</td>
</tr>
<tr>
<td>Technology</td>
<td>Business-driven, scalable and flexible technical framework</td>
<td>Coordination between IT and business units</td>
</tr>
<tr>
<td></td>
<td>Sustainable data quality and integrity</td>
<td>External consultant</td>
</tr>
<tr>
<td></td>
<td>Technical skill</td>
<td>Iterative and incremental approach</td>
</tr>
<tr>
<td>Culture</td>
<td>Organisational culture</td>
<td>Scalable and flexible system</td>
</tr>
<tr>
<td></td>
<td>Learning and development culture</td>
<td>Integration with other system</td>
</tr>
<tr>
<td></td>
<td>Participative decision-making culture</td>
<td>User access</td>
</tr>
<tr>
<td></td>
<td>Power sharing culture</td>
<td>Data source quality</td>
</tr>
<tr>
<td></td>
<td>Support and collaboration culture</td>
<td>Integrated data</td>
</tr>
<tr>
<td></td>
<td></td>
<td>User skill</td>
</tr>
</tbody>
</table>

While previous researches emphasising culture in organisational level has an effective impact on the successful implementation and use of information technology (Gardner et al., 2009) its role in influencing on BI system success has not been scrutinised. Organisations often blamed cultural factors, when IS implementation fail, thus concept of culture is very crucial in the study of information system (Leidner and Kayworth, 2006). Technologies, such as BI system, influence on organisation way of doing task. BI system is mainly required data governance and business processes and new requirements including in users behaviour. These requirements might lead to challenge with current culture so organisations should analyse if some culture factors need to be considered in order to achieve the most appropriate alignment between technology and culture (Cabrera et al., 2001). From the analysis of previous literature on CSFs for BI, it is clear there is not a comprehensive research regarding cultural factors. Some researches (Anjariny et al., 2012; Sangar and Iahad, 2013; Herschel and Yermish, 2009) discussed and examined the critically of organisational culture, though they have not focused on culture dimension in details. Through analysis of previous literature, it deems four sub factors namely learning and development culture, participative decision-making culture, power sharing culture and support and collaboration culture under organisational culture factor contribute to the success of BI project. Review and comparison of previous researches on CSFs for BI implementation revealed that the CSF framework proposed by Yeoh and Koronios (2010) is the most comprehensive source for this study as it covers majorities of factors which mentioned by other researchers. Moreover, theory proposed by Hurley and Hult (1998) is selected to fill up the gap regarding cultural factor. These two theories guide researcher to categorise determined factors from previous studies. For this study, CSFs that found
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through literature are categorised in three levels: dimension, factor and sub factor. The CSFs, which found through literature review, are grouped into four dimensions: organisation, process, technology and culture (Table 2). Then sub factors under organisation, process, and technology are grouped into main factors based on CSFs framework by Yeoh and Koronios (2010). Also, sub factors under culture dimension are grouped according study by Hurley and Hult (1998).

• **Culture of learning:** skill acquired through the learning and it is one of the CSFs for success of BI implementations (Sangar and Iahad, 2013; Olbrich et al., 2012). Since the organisations learn through individual employees, their knowledge acquisition and application needs a culture of learning and development (Herschel and Yermish, 2009; Rud, 2009). Previous study shows how organisations are able to more effectively disseminate IT innovations throughout their organisations by proactively creating an organisational culture with values that foster the diffusion of IT values through continuous learning culture (El Sawy, 1985).

• **Decision-making culture:** the application of result of information analysis in decision-making process is part of the organisational culture (Watson and Wixom, 2007). Proper organisational culture, especially decision-making culture, reinforce the use of information provided by IS (Gottschalk, 2007). Popovič et al. (2012) conducted a research in terms of decision-making culture. He discussed how much decision-making culture affects the organisations use of information provided by BI system in their business processes. In decision-making, high quality information reduces uncertainty, enables organisations to rapidly react to business events, and supports companies in making changes in corporate strategies, plans and performance indicators. In fact, the decision-making culture will affect how much organisations use quality information provided by BI system in their business processes. In result improving the participative decision-making culture always improves the use of provided information by IS such as BI system.

• **Information sharing culture:** developing a culture which values and practices information sharing is a multiyear effort involving attention to the organisational, managerial and technical components of this behaviour. Within organisations, information sharing has been emphasised as an important driver of organisational performance (Yang and Maxwell, 2011). Moreover, it has been reported that a higher level of information-sharing within a firm enhance beliefs of information sharing usefulness (Choo et al., 2008; Jarvenpaa and Staples, 2000). Organisations that successfully improve information sharing culture among decision makers gain benefits through investing fewer resources to improve the content quality of BI system, which is a costly endeavour.

• **Collaboration culture:** research by Sheng et al. (2003) revealed that an organisational culture characterised by a spirit of teamwork is positively related to the success of IS project. Organisation needed to create a culture where people wanted to come to work together (Watson and Wixom, 2007). Thus, organisations should attempt to build a more collaborative and team-oriented culture to achieve success in their BI project. Rud (2009) noted collaboration culture leads to BI system adaptation therefore team collaboration deems as an effective factor in the success of BI system implementation. Apparently, previous studies have not focused on culture
dimension in details. For example, learning and development culture was indicated by Herschel and Yermish (2009) and Rud (2009) but it has not been examine in any context. Information sharing culture was discussed in previous research (Popović et al., 2014; Seah et al., 2010) while it has not been tested in any context. The role of decision-making culture was investigated by Popović et al. (2012), however, it was tested through effect of it on information content and access quality. Rud (2009) stated that collaboration culture is critical for the success of BI, while this factor has not been reviewed in any organisation.

Organisational dimension encompasses two factors that are committed management support and sponsorship, and clear vision and well established business case. Committed management support and sponsorship itself includes two sub factors, that are resources and continues support from top managements. Resources include the money, people and time that are required to successfully complete the project (Ein-Dor et al., 1980), therefore, factors such as budget, financial and staffs are considered as resources. Since top management allocate resources in the implementation (Nah et al., 2003) the resource factor is considered as a sub factor for committed management support and sponsorship. In addition, as Yeoh and Koronios (2010) highlighted continues support from top management is another sub factor for committed management support and sponsorship. Well established business case and clear vision are sub factors under clear vision and well established business case factor (Yeoh and Koronios, 2010). Process dimension encompasses two factors, which are business-centric championship, and balanced team composition and system development approach. Business-centric championship and balanced team composition has three sub factors namely champion, coordination between IT and business units and external consultant. According to Yeoh and Koronios (2010) external consultant will assist business champion and implementation team within complicated tasks therefore it considered as a sub factor of business-centric championship and balanced team composition. Another factor is system development related factor which includes two sub factors namely iterative and incremental approaches and user involvement. According to Olszak and Ziemba (2012) users should involve in BI project to prevent missing their business requirement. Users’ involvement within BI development cycle is critical for the success of BI. It considers as a sub factor of system development related factor as users should contribute during BI development.

Another dimension is technology which has three factors business-driven, scalable and flexible technical framework, sustainable data quality and integrity, and technical skills. Business-driven, scalable and flexible technical framework includes three sub factors scalable and flexible system, user access and integration with other business tool. User access is depended on the characteristics of the BI infrastructure (İşik et al., 2013) and applications therefore it is considered sub factor of business-driven, scalable and flexible technical framework. BI tool must be fit into an existing technical infrastructure and be integrated with existing system (Olszak and Ziemba, 2012). Since integration is related to infrastructure of system, it regarded as a sub factor of business-driven, scalable and flexible technical framework. Another main factor under technology dimension is sustainable data quality and integrity. It encompasses two sub factors data source quality and integrated data. Data may be internal or external to the organisation. The fully integrated data bring greater business value for organisation once their quality and integration assure (Yeoh and Koronios, 2010). Both of these sub factors as commented by Yeoh and Koronios (2010) are grouped under data quality and integrity. Technical
Another dimension which is considered critical for the success of BI implementation is culture. The studies on culture and IT adoption can be divided into two factors (Robey and Rodriguez-Diaz, 1989) national culture and organisational culture. Previous studies on BI only stressed the critically of organisational culture factor for the success of BI system implementation (Sangar and Iahad, 2013; Herschel and Yermish, 2009; Olszak and Ziemba, 2012) thus this study only considered this factor (organisational culture). According to Ke and Wei (2008) and Hurley and Hult (1998), cultural factors which determined through literature review namely learning and development, participative decision making, power sharing and support and collaboration are categorised under organisation culture factors. The literature on BI system implementation provides a platform for the development of a conceptual framework which comprising four dimensions, namely, organisational, process, technology and culture (Figure 1).

Figure 1  Initial CSFs framework for BI system implementation in public sector organisations proposed by authors (see online version for colours)

3 Research method

In this research, research objective is not only to test the explanatory power of the existing CSFs list in a specific case but also to extend it into a richer framework. Qualitative approach deems the most suitable way to conduct this study, since this study
aims to explore factors which are considered to be critical for successful BI system implementation in public organisation through the participant’s perspectives (Creswell, 2012) from the specific organisation (Yin, 2003a). Indeed, applying qualitative approach in this study enabled researcher to develop a more accurate framework by concentrating on the unique organisational context. Case study strategy is selected for this study as it provides an opportunity to look of the roots of issues, and to conceptualise and seek the underlying reality (Easton, 1995; Yin, 2003b). Through applying case study the real context of Malaysian public sector was investigated in details (Merriam, 1988; Yin, 2003b). The case study strategy provides better explanations, insights and understandings on this study and results in rich descriptions on the determined CSFs for BI system implementation (Miles et al., 2013). In this study, a multiple-case and holistic design was adopted, as multiple or collective case study will allow the researcher to analyse within and across each organisation as a unit of analysis.

Sequentially, semi structure interview was selected to conduct case study. Case studies were based on two agencies under Malaysia Ministry of Finance which successfully implemented BI system. The purposive sampling method was applied to select interviews. Interviewees were selected carefully as the skill of the interviewer clearly has an effect on the quality of collected data (Morse, 2008) and this will have a subsequent effect in achieving saturation (Guest et al., 2006). Mason (2010) commented the most common sizes in qualitative researches are 30, 20 and followed by 10. However, he stressed the most important factor which affects the sample size is when saturation is achieved. Creswell (2002) commented three to five participants is enough for a case study as saturation is achieved at a comparatively low level. In this study, 12 participants from key functional areas are invited for interview.

Qualitative content analysis is applied to analyse interview transcripts in order to reveal or model people’s information related thoughts. Qualitative content analysis enabled researchers to understand reality in a subjective and scientific manner. Through careful data preparation, coding, and interpretation, the results of qualitative content analysis assisted researcher to refine the research framework. The process of qualitative content analysis started from the early stages of data collection. The early contribution in the analysis phase assisted researcher to shift back and forward between concept creation and data collection. The eight steps listed by Zhang and Wildemuth (2009) were incorporated into content analysis: preparing data, determining units of analysis, developing categorise and codes scheme, test the coding scheme, test codes in small text sample, coding whole text, assessing code consistency, drive conclusion and writing the analysis report. The formal process of creating the coding scheme started shortly following the first few interviews. Firstly, the entire interview transcripts were typed and transferred into Microsoft Office Word documents. Then the units of analysis defined for the study. Such as most of the qualitative content analysis individual themes selected as a unit of analysis (Zhang and Wildemuth, 2009) were a word or group of words. Primary list of codes and categories were generated based on literature and previous theories. Researcher read and interpreted the small part of interview transcript and then expanded to whole text and highlighted all the concepts. Next, the concepts were placed in a matrix (to check the consistency). In addition, as suggested by Zhang and Wildemuth (2009), qualitative data analysis software ‘NVIVO version 10.0’ used to support content analysis. This software helped researcher to manage and code the data more efficient. After completing the content analysis, a cross case analysis was conducted to secures construct
validity. Cross-case analysis provides additional insight into CSFs of BI implementation by identifying similarities and differences between cases.

4 Analysis

The case studies and analyses were first conducted at IB and later at AG sites. Both cases had group of respondents with similar positions. Although, both cases are similar in terms of, organisation size, but purpose of BI implementation in these organisations is quite different which influence the different outcome of the implementation. This study found that the success of BI implementation in public sector organisation is impacted by four main dimensions of CSFs namely organisational, process, technology and cultural. Results of cross case study indicate the CSFs within two organisations from organisational and process dimensions somehow are similar while in the technology and cultural dimensions there are few dissimilarity. Next section would compare similarity and differences between factors of each dimension in both organisations.

4.1 Committed management support and sponsorship

• Continuous management support: according to interviewees from both cases top management support and sponsorship is fundamental for the BI project to succeed. Support from top management pushed the project ahead and provide the resources needed including financial and human resource for the success of BI implementation. A hand on top management support is a key effective factor in making the goals achievable for BI projects. According to AG case, contribution of high-level managements in BI project directly gave a feeling of safety to project team members. Due to top management involvement and attention, BI team members ensure they have enough support from organisation side if they face any problem. Contribution of top management should be long time not only in launching the project. According to AG and IB ongoing support from top management was significant during BI system project. In both organisations, support from the top management formed the top-down direction of the BI project. According to the IB case top management continues support and commitment indicated the importance of the project to whole organisation. Due to this user resistance decreased and usage of BI system increased which resulted in the BI project success. Also, results of IB case study disclosed, launching a specific committee to follow up the BI project process by top management is another factor which increase the pace of project. Therefore, according to finding from both case studies continuous support from top management guarantees the success of BI system implementation in Malaysian public sector.

• Resource allocation: both cases confirmed the role of top management in recourse allocation in BI system project. In the AG, a steering committee was set up to monitor and allocate resources to the BI system project. In the IB case, CEO governed the allocation of resources.
4.2 Clear vision and well established business case

- **Well-established business case**: interviewees from both cases asserted the importance of well-established business cases in the success of BI project. According to the result of IB and AG cases, the business case should be comprehensive to consider all the requirement of organisation. It should demonstrate all the benefit of the project for organisation. The business case includes all benefit which public organisation gain through BI implement to ensure top management which BI project worth to be done. Based on AG case, business case can be used as a reference by public organisation to see whether the project meets its goals or not.

- **Clear vision**: In AG case interviewees asserted in the beginning of BI project the vision of the project should be set, and in each phase the project should follow vision in order to reach its goals. According to case study in AG vision for the BI implementation project was defined based on the reason of system implementation. Then the whole team members were informed about vision of the project. Besides in IB interviewees highlighted the importance of defining BI strategy in line with the organisation strategy.

4.3 Business-centric championship and balanced team composition

- **Business Champion**: result from data analysis in both cases revealed the crucial role of the business champion for BI implementation project. Both IB and AG cases demonstrated that the business champion must have a wide knowledge and insight about organisational business process. Interviewees from IB case mentioned the business champion should manage the implementation by his own power and make a pleasing environment for the project team members. Beside the business champion should have the adequate power to influence team member to work under his supervision. In AG case, participants stressed business champion commitment in the all stages of BI implementation especially during business requirement collection phase is vital for the BI project. Moreover, business champion is a person who is familiar with organisational strategy he/she can manage the BI project in line with organisational strategy. Based on the IB case, some of the business users reluctant to accept BI tool as they believe it is a substitute for them. However, this issue is solved by the project champion by using its power and defining strategy to manage user resistance. In fact, it is vital for BI project to be led by champion which has a business perspective to assist remove obstacles which maybe destruction the project overall success.

Coordination between IT and business units: according to both AG and IB cases IT and business units should contribute during BI implementation project. Indeed, the business champion is a moderator between IT and business unit. He is responsible for coordinating different units during BI project and due to the hierarchal nature of public sector, lower level must follow the rules which defined by BI champion. Therefore, commitment must come from management and also from a capable BI team including proper business and technical skills.
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• **External consultant:** in both cases IT department was responsible for the technical issue during project; however, they do not have enough expertise regarding BI system. Interviewees from AG and IB cases commented it is essential to provide external consultant services during project to assist team in area which they have not enough experience. According to evidence from both successful cases, assistance from experienced external consultants, who has a background of work with public sector organisation, is significant for the success of BI implementation.

### 4.4 Business-driven and iterative development approach

• **Iterative and incremental approach:** selecting the right and appropriate software development approach leads to the success of BI project. Identifying the overall methodology of BI project is a key part of perceptive to determine when, who and how is involved in the project, such as project team member and business users. Participants from both cases asserted applying iterative and incremental method speed the BI implementation project and save the time and money in public organisation. Using incremental development approach helped the IB case to manage the user requirement’s changes. Some requirements need to be added during the project as sometimes they miss due to the different reasons. According to AG case, the iterative and incremental method assists the project team to work over the determined scope by adding new or ignoring unnecessary requirements. It increases the user adoption, as there is high level of users’ contribution during the project. During an iterative and incremental development process, both IT and business units cooperate to control the business requirements.

• **User involvement:** BI users are the centre point during the development. In both cases, interviewees emphasised the importance of users’ participation in collecting the business requirement and testing the BI system. User centred method more focused on user satisfaction to achieve the goal of BI initiative. According to IB case user centred approach with better user participation in the system development can lead to better communication specially when in beginning of project there is not a clear picture of business requirements. In both cases, there is an agreement which the high level of trust should be built between users and BI team.

### 4.5 Business-driven, scalable and flexible technical framework

• **Scalable and flexible system:** from the conducted interviews, many of the participants from both organisations asserted the importance of scalable and flexible BI system. In both cases, interviewees highlighted which users’ requirement changes in future therefore the data warehouse should support the future increases of data. According to AG case, data warehouse should be expandable enough to accommodate data which has an increasing trend.

• **Integration with other system:** interviewees from AG discussed about adjustment of pre-existing infrastructure and BI system, they believe the BI system should be compatible with existing system, otherwise organisation waste a lot of money. Besides, participants from IB pointed out the BI tools selection should be done carefully in order to be matched with business requirement of organisation to prevent
wasting money particularly in public sector as they have budget limitation. Both organisation have integrated IS system, which provide required data and information for BI system.

- **User access:** in both organisations participants agreed with the necessity of BI system access to data according to their requirements. BI tool empower users by providing access to relevant information according to specific user roles and responsibilities. Determining the level of user access is depends on the organisation policy, according to case studies result, public organisation prefer to define level of access for different users while other organisations may prefer to define open access for their staffs. In overall the adequate user access is a cornerstone of the overall user satisfaction with BI system and the success of system.

### 4.6 Data quality and integration

- **Data source quality:** case studies result in both sites revealed the success of BI tool ties with the quality of data. Both cases highlighted the importance of accuracy of data in the quality of generated reporting. Participants discussed how the poor quality data negatively affect the quality of the decision-making in their organisation. In AG case, interviewees’ emphasised on importance of preparing check list criteria for data quality from the beginning of project. Moreover, both cases, have implemented a data centre it will support required data not only for BI system but also for the other information system. As participants in IB case commented data centre decrease the data redundancy and improve the quality of reports.

- **Integrated data:** interviewees from both cases highlighted, the required data for public sector usually comes from different sources as they are connected to other organisations therefore data integrity is a main issue which should be consider by them. The data integrity checks and analyses through the ETL help to increase data quality. Beside as interviewees from the IB case commented design of data warehouse should be in the way, which delivers a reliable layer for data quality management.

### 4.7 Technology: technical skills

- **BI team skill:** both cases stressed the criticalness of technical skills for both BI team and users. They agreed which the BI implementation project should be assigned to a vendor that has skill full team. In IB, the contractor vendor selected carefully based on its previous successful experience, which proves the technical skills of its team. Moreover, as it mentioned by interviewees from AG case study, training sessions provided by the vendor aids organisation to obtain required knowledge regarding new implemented BI system. Based on finding from both cases it is apparent that having skilful staffs in public organisation is essential for the success of BI project.

- **User skill:** both organisations provided training workshop for their IT staffs that are in charge for BI, to gained skills regarding BI system. In the AG case as one of the interviewees commented the requirement for BI is dynamic and since new requirements lead to new BI system, which consequently demands extra user training. Constant support from IT department after the system was implemented.
assisted end-user in IB case to adjust to BI initiative faster. As they gain help from skilful staffs they work with the BI system more easily.

4.8 Cultural: organisational culture

- **Learning and development culture:** through both case studies, the role of culture of learning and development appeared critical for the success of BI. The level of which organisations spread and support the learning and development culture is important. In AG participants believe organisation can learn from failure and success story of their peers. In case B, interviewees highlighted the role of learning in changing process in their organisation. In both cases participant agreed which organisational learning occurs through individual’s learning which it formulate organisational strategy and changes during BI implementation. Most participants from AG discussed, when new BI system comes to their organisation some employees were not eager to work with it. It happened because they have not any prior experience about BI system, in this case, organisation with culture of learning and development ensure staffs which they are not in risk and they can acquire related knowledge from training course or workshop which support by their organisation. Presenting the culture of learning in organisation results in a learning atmosphere, which people eager to learn more, improve their skills, and adopt BI application. Interviewees from the AG indicated the significant role of managers in organisation as they can be the leader of development and learning in organisation. While in the IB most participants in the case study believed managers from public sector have this authority and power to force the culture of learning in organisation. Result of analysis in both cases showed formal training such as workshop improves learning and development culture in their organisation. Robust organisational learning culture results in faster development of BI and more skilful staffs.

- **Participative decision-making culture:** another factor influences the success of BI in both organisations is participative decision-making culture. In both cases participant agreed with the effect of management style on participative decision-making culture. Participants from the IB highlighted the requirement of shifting from hierarchal decision-making to more equal participants. The same idea emerged from AG, as they believe staffs from different organisational level should attend in decision-making. However, due to the autocratic management method in Malaysian public sector, portion of employee’s contribution in decision-making is low. They mostly generate reports for higher level and pass it to them. Indeed employees are not required to participate but they are involved in decision-making process. Beside in both cases interviewees argued that transferring from perception to the fact-based decision-making culture improve participative decision-making culture. Since fact-based decision ensures decision makers the evidence, which they use, are strong enough.

- **Power sharing culture:** Both organisations believed BI system success subjected to the organisational culture, which influence the information sharing. They believed that applying reward system could assist organisation to boost culture of information sharing. Both cases highlighted that managers have a key role in improving knowledge sharing culture. They can define new policy in organisation, which
through that employee motivate to share their knowledge within organisation. Another fact, which emerged from the AG case, is the effect of friendly atmosphere in smoothing information sharing in organisation. It revealed within a friendly environment in organisation people can share their experience in working with BI software. Both cases indicated that within the culture of power sharing trust is one of the main elements. Trust in organisation measures through staff willingness to share their information with their colleagues. Study in IB represented the involvement of managers in organising information sharing in group improved the communication among them, facilitate the information sharing and boosted culture of knowledge sharing in organisation. Moreover, one of the interviewee from the AG asserted that high level management have great impact on power sharing culture in organisation by sharing their information with their lower level managers. This could have positive effect on other management and inspire them to share information with their lower level staffs.

- **Support and collaboration culture**: the evidence from both case studies revealed that support and collaboration culture is a critical factor for the success of BI implementation project. The case studies show developing a policy to motivate staffs to collaborate to each other is required to boost the culture of support and collaboration. According to IB case without support in organisation BI team cannot access their required resource. Indeed work in the organisation with culture of support will facilitate the project progress. Also according to the result of IB, an organisation with the atmosphere of collaboration which people can trust each other the rate of the success of BI will increase.

The finding from both case studies indicated that collaboration and support within organisations unit aided the BI project team during the implementation since they have support from different units and could get any information which they need. Besides, both cases highlighted the value of the collaboration and support between IT and business department. They believe this collaboration will not achieve unless organisation have a real support and collaboration culture. According to AG, integration of social network tool with BI provided a platform for users to share their idea and exchange the analysed data. It gives power to staff to support each other through the BI platform.

5 Finding

The finding reported in the stage of case studies of two Malaysian public organisations noticeably supported the CSFs identified through the literature. In addition, the case studies presented insight into two other factors that resulted in the success of BI systems. The case studies finding revealed the significance of BI strategy factor and its coordination with organisation strategy in impacting the success of BI system implementation project in Malaysian public sector. Also, the results of case studies indicate the importance of technical skill of both vendor and BI team in the success of BI implementation project. Figure 2 depicts the final framework according to the finding of case studies.

On the other hand, the participative decision-making culture in the both public organisations was not too remarkable. Due to the autocratic atmosphere of public sector
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organisation, staffs may participate in the decision making but they are not the decision maker. In fact, the decision makers are higher level managers which their duties have been defined according to organisation’s rule. In spite of outstanding role of higher level managers in decision making, contribution of participative decision-making culture in the success of BI system implementation in both organisations could not be ignored as participants in this study highlighted the importance of this factor. Besides in was seen that staffs which used BI system did not participate directly in decision making but they were part of decision-making process. Therefore, participative decision-making culture considered a critical factor for the success of BI system implementation.

Figure 2 The final CSFs framework for BI system implementation in public sector organisations (see online version for colours)

6 Conclusions and future work

The analysis of collected data through literature and case studies filled up the gap of current limited description of the factors that affect the successful implementation of BI systems in public sector organisations. The outcome of this study indicated factors that are critical for the success of BI system implementation and require to be addressed. It focused on those important factors that were overlooked whilst significantly impact the success of BI system implementation. As a result, this study has extended the previous studies by developing more comprehensive CSFs framework. The aim of implementing BI system in public organisation is to improve services provided to the population and this happens when organisation can grasps all the potential business value of BI system. The proposed framework specifies factors which impact the success of BI is vital for
improving the service delivery in the public organisation. Since there are limited researches on CSFs for BI implementation in public sector context, it is believed the results of this study can assists public sector organisations to implement BI system successfully. Understanding the factors from different aspect such as organisational and cultural is vital to guide the organisations during BI system implementation. Moreover, this may leads to better planning and informed decision-making for future or current BI system implementation. This framework has drawn on existing knowledge of BI system as expressed in the literature and reviewed through perspective of a range of relevant stakeholders in the BI system implementation project. The top management, project manager and team member that are contributed to BI system project may use the framework to better understand those factors that guarantee the success. This understanding of CSFs assists them to tackle issues related to the BI system implementation. The result of this study can be extend by investigate in relation between the CSFs. Moreover, the proposed factors can be measured through indicators one by one separately. As in this study the success of BI system is measures in general, achieving in each CSFs could be assess one by one. While this study contributes to theory and practice, there were some limitations that need to be considered. Limitations related to the research findings were mostly those connected with the transferability of the research findings. Although, transferability of the findings depends on other researchers, they should decide whether it is applicable to their research or not (Gasson, 2004). It is their responsibility to clearly determine the limitations of the research findings.

Another limitation of this study was related to the data collection. Since some of the public sector organisations have strict rules, therefore, they did not allow conducting study in their organisations. Besides, participants in case studies were not allowed to give some related documents with BI system to the researcher.

References


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