Suboptimal business intelligence implementations: understanding and addressing the problems

Janelle Boyton, Peter Ayscough and David Kaveri
Swinburne University of Technology, Hawthorn, Australia, and
Raymond Chiong
School of Design, Communication and IT, The University of Newcastle, Newcastle, Australia

Received 27 March 2015
Revised 29 March 2015
Accepted 30 March 2015

Abstract

Purpose – The purpose of this paper is to examine the failures of business intelligence (BI) implementations and to understand why they fail as well as what action can be taken to ensure implementation success.

Design/methodology/approach – The paper is based on a literature review of academic journals and case studies relating to BI, and the success and failure of the implementation of such projects. It focuses on four areas of BI projects to measure success: return on investment, non-concrete measures, project management measures and user satisfaction. The literature provides insights into what factors contribute to the success of a BI implementation and what factors contribute to the failure. Once the failures can be ascertained, a strategic approach to remedying the failure is discussed.

Findings – Implementation failure specifically relating to BI is a rarely discussed topic. This paper provides an understanding of why BI implementations fail and how organisations can ensure, prior to implementing such a solution, the considerations that need to be made to ensure that success is achieved from a technological, organisational and process perspective.

Originality/value – The paper uses empirical evidence from the literature to provide an understanding of why BI implementations fail. The factors contributing to BI failure are examined along with insights into how to succeed with a BI implementation.

Keywords Business intelligence, Business strategy, Project failure, Project implementation, Suboptimal implementation

Paper type Literature review

Introduction

Having its roots in the decision support technologies developed in the 1970s, the term *business intelligence* (BI) emerged in 1989 (Lawton, 2006). The expectation of BI systems is to "improve the effectiveness of the core business processes that drive business performance" (Williams and Williams, 2003).

While there are many BI success stories, failures in the implementation of BI are less frequently and less enthusiastically publicised. Feng *et al.* (2009) suggested that more than 50 per cent of BI projects fail to meet the expectation of accelerating the decision-making process for organisations – a principal motivation for investing in BI. Published user experiences of BI implementations suggested a continuum of success levels, from high to low. Though an implementation may not be considered an *outright* failure, it may fail to meet the high expectations of stakeholders within the business.

Journal of Systems and Information Technology
Vol. 17 No. 3, 2015
pp. 307-320

1328-7265
DOI 10.1108/JSIT-03-2015-0023

This paper, therefore, targets *suboptimal* BI implementations as those failing to meet the expectations of stakeholders and attempts to identify reasons for these failures. This is a highly relevant question for those organisations seeking to invest in BI and tap into the ever-increasing volumes of data becoming available to guide their decision making.

Several measures for determining success or failure are considered, including return on investment (ROI), user satisfaction, traditional project management measures and other non-concrete measures. Existing case-based and survey-based literature on BI implementations is then discussed, and a structure for categorising causes of suboptimal BI implementation is established, incorporating organisational, process-based and technology-based categories. Finally, these BI implementation problems are addressed by examining identified BI success factors under the same category structure.

Measuring success

Return on investment

ROI refers to the increasing of business value from the investment of building a BI capability (Su and Chiong, 2011). The alternate side to realising ROI is the failure to deliver on ROI. It is suggested that BI implementations have anywhere between a 50-70 per cent failure rate (Lupu *et al.*, 2007; Blanton, 2012), therefore failing to deliver any real business value to an organisation.

Research into the topic of BI proposes a number of means of measuring the success of a BI implementation. While ROI may appear to provide a concrete, quantifiable indicator, given the myriad influences and impacts a BI implementation may have on business performance, it is one that may be difficult to capture. As Lonnqvist and Pirttimaki (2006) pointed out, many of the benefits imparted by BI are non-financial, or even intangible, such as "improved quality and timeliness of information", and though these benefits should result in financial outcomes, there may be an appreciable time-lag making measurement difficult. Ghobakhloo *et al.* (2011) discussed the business value of investment in electronic commerce applications. When defining business value, Ghobakhloo *et al.* (2011) considered market efficiency, internal process efficiency and financial efficiency, of which ROI is one influence.

Economic benefits stemming from a business investment may be expressed as either reduced costs or increased revenues. An organisation may view a BI implementation as having improved its ability to forecast, its marketplace agility or its knowledge of customers, and reduced manual processing in management/executive reporting, but unless these benefits can be quantified as either reduced costs or increased revenues, the business will not be able to determine whether it is gaining optimal value from the investment (Williams and Williams, 2003).

Non-concrete measures

Mohanty (2008) pointed to a number of concrete measures that may be directly attributable to the implementation of BI, such as increased sales and new customers, but he also suggested looking beyond the dollar value, including measures such as increased brand recognition. Measures such as these may be particularly suited to, and measurable by a specific business unit, such as leads developed for a sales department, consumer trends identified by product design teams or new marketing channels identified by a marketing department.

Lonnqvist and Pirttimaki (2006) presented a number of approaches to developing BI performance indicators, both objective and subjective, but the consistent thread across these approaches is that ultimately each organisation must determine the measures that best define the value the BI solution has returned to its particular business, and these measures will be derived from the kind of decisions BI is used to support. Mohanty (2008) echoed this by framing the question organisations should be asking as "What is the best way for the organization to evaluate whether a BI initiative can help identify and move it toward the goals more rapidly or with a greater likelihood of success?"

Project management measures

From a project management perspective, the success of a BI implementation may be measured in terms of quantifiable project goals and outcomes that are defined in the planning phase and measured in the closing phase. Newell and Grashina (2004) suggested that the traditional project management triangle assesses the delivery of functional and integration requirements (project scope) on time and budget. Provided these goals are met, it can be concluded that the implementation was successful.

User satisfaction

An alternate measure of BI implementation success is that of user satisfaction. Isik *et al.* (2011) presented a model that evaluates the success of a BI implementation project subjectively through a user survey. Their survey of 116 BI professionals measured whether the implemented product met their expectations and needs, and the willingness of the target user base to use the system and incorporate it into their planning activities. This entailed several aspects of effective project management such as properly analysing and defining requirements and system scope, and ongoing management of user expectations. The results are given in Table I as follows.

While the majority of users surveyed indicated overall satisfaction with their BI implementations, analysis of the data in Table I indicates that 2030 per cent of users were *not* satisfied. Arguably, this could be considered an indicator of lack of success.

The survey by Isik *et al.* (2011) also enquired into whether, as a result if the BI implementation, systems and appropriate data are available, when and where they are

BI satisfaction items	Strongly dissatisfied	Dissatisfied	Neither satisfied nor dissatisfied	Satisfied	Strongly satisfied
The BI that I am using overall	3.4	8.6	18.1	56.0	13.8
How well the BI that I am using provides precise information I need	0.9	10.3	10.3	56.9	21.6
How well the BI that I am using supports my decision making	1.7	10.3	18.1	50.9	19.0
How well the BI that I am using provides information I need in time	2.6	13.8	17.2	47.4	19.0
How user friendly the BI that I am using is	4.3	11.2	25.9	36.2	22.4

Source: Isik *et al.* (2011)

Table I. Results of a user satisfaction survey on BI implementations

required. The research identified that organisations were generally satisfied with the availability of the BI analytics, as indicated in Table II.

For the purposes of this paper, we consider any BI implementation with expressed major concerns in any category above to be suboptimal. This is viewed from the perspective of the number of responses for each measure of satisfaction.

Exploring BI failures

While there are many case studies and published papers that have identified the critical success factors in implementing a BI solution, there are also situations where BI implementations have failed. The reasons for failure are rarely analysed. Studies undertaken by the Gartner Group, TechRepublic and consultancy firm Price Water house Coopers indicated that information technology (IT) project failure rates vary from 25 to 40 per cent; however, it is unknown if BI projects form part of these figures. Lawton (2006) described the shortcomings of BI implementations, including the poor integration between systems, which have been incorrectly setup and therefore increase the complexity or provide BI analytics that are not appropriate for the majority of users in an organisation. Blanton (2012) discussed the successes and failures of BI implementations at Portland State University in the USA. The case study provided valuable insights into the shortcomings of the implementation, including the solution being run by IT, lack of delegation (roles and responsibilities) and poor governance. Blanton quoted a Gartner survey indicating that "more than 50 per cent of all business intelligence initiatives […] fail within 18 months", with Lupu *et al.* (2007) further indicating that 60-70 per cent of BI implementations fail due to technological, organisational and cultural issues. They cited a case study where an enterprise resource planning (ERP) system for a Romanian Oil company failed due to a number of reasons, including the lack of business direction or input, a project driven by IT and poor data management. Given the high failure rates for BI implementations, it is necessary to explore the reasons for failure and how they may be negated.

Examining the problems encountered in BI implementations

Yeoh and Koronios (2010) and Yeoh *et al.* (2008) discussed the success factors relating to BI implementation. However, these success factors should have their inverse considered, which would provide valuable insights into the shortcomings that may be experienced. Table III identifies some of the success factors according to Adamala and Cidrin (2011). To explore in further detail why a BI implementation may fail, the inverse for each success factor has been captured (Table III).

User access quality	Strongly dissatisfied	Dissatisfied	Neither satisfied nor dissatisfied	Satisfied	Strongly satisfied
Quality of the way a user accesses BI	3.4z	14.7	20.7	42.2	19.0
Access to the information a user needs in BI	5.2	8.6	13.8	40.5	31.9
How well BI fits the types of decisions a user makes using BI	2.6	6.0	22.4	49.1	19.8

Source: Isik *et al.* (2011)

Table II.
Satisfaction rating of BI availability

Dimension	Success factor	Failure factor (inverse)
Organisational	Committed management and sponsorship	Lack of organisational commitment to BI
	A clear vision and well-established business case	Unclear vision and scope, for example a business case does not identify metrics of success or does not exist
Process	Business-centric championship and balanced team composition	IT driven solution that has little or no business input
	A business-driven and iterative development approach	A non-business driven approach to exploration of requirements
	User-oriented change management	Changes are driven by technology
	Process re-engineering	Insufficient change to processes to support capture and administration of quality data
Technological	A business-driven, scalable and flexible framework	Technology-driven, lack of scalability and flexibility in solution
	Sustainable data quality and integrity	Poor data quality with no ETL approach

Source: Adamala and Cidrin (2011)

Table III.
Success and failure factors

Organisational failures. Williams and Williams (2003) stated that organisations need to go beyond the technical implementation of a BI environment to ensure success. Therefore, an organisation that is not clear on what BI will deliver and how it meets the organisation's strategic goals is likely to see the implementation fail. Yeoh *et al.* (2008) highlighted that the greatest challenge to any BI implementation remains with organisational and management buy-in. Watson and Wixom (2007) identified that organisations need to drive BI from the top-down and make BI part of the organisation's culture. Not aligning the capabilities of BI and its intended outputs with organisational goals makes it challenging to realise the positive aspects of BI (Vitt *et al.*, 2010). Parr Rud (2009) highlighted that difficulties may be encountered with the redesigning of organisational processes, management structure, measuring systems and operating a business in a continually changing environment by which she reasoned, a BI implementation may fail. Williams and Williams (2003) argued that strategic alignment, process engineering and change management are fundamental preconditions to a successful BI implementation. It can be argued that without an adequate structure in place, which encompasses changes to organisation, management and also operational and technical needs, the risk of failure is greatly increased.

Gilad (2011) identified a series of cases in the US automotive industry where organisations such as general motors holden (GMH) have failed to take advantage of strategic intelligence gathering and therefore missed significant opportunities to increase their profitability in their respective markets. Such organisations failed to realise the benefit of BI or implement an intelligence capability to understand what customers want and what their direct competitors were doing. In this scenario, there was a lack of BI capability that did not readily identify where the markets were heading and change to meet consumer demand. Gilad (2011) aptly summed it up with the comment "[c]ompetitors did not kill Detroit, ignoring changing buyers' needs did". Failing to make

BI an organisational-wide initiative in this case has proven to be detrimental to the automotive industry in the USA, with Gilad (2011) indicating that GMH's global market share reduced from 50 to 11 per cent due to their inability to respond to consumer demand. Williams and Williams (2003) pointed out that the value in BI is dependent on its operational impact, and the result of GMH not investing in a BI solution provides valuable insights into the failure at the organisation level to pick up changes to the market and respond appropriately.

Process failures. While organisational failure plays a major role in the implementation of a BI solution, Yeoh and Koronios (2010) identified "lack of business needs and requirements not being clearly defined […] silo information systems with multiple versions of truth and an information system-centric approach" as the main reasons for BI failure. Such failures point to a general lack of understanding of what the business needs are with an inability to deliver a solution that is usable. BI solutions that fail to align the technology driving the business with an understanding of its strategic path and needs (i.e. the requirements to make the BI solution successful) are at risk of failure.

Yeoh and Koronios (2010) considered the supporting processes such as scoping and planning as being imperative to the success of a BI implementation. Adamala and Cidrin (2011) quoted Legodi and Barry (2010) with a more detailed list describing the following reasons for BI implementation failure, most of which are related to non-technical factors:

- scope creep;
- uncontrolled finances;
- poor communications;
- stakeholder non-involvement;
- skills shortage;
- unavailability of tools and technology;
- uncontrolled quality of deliverable;
- poor, wrong or no leader;
- technical difficulties;
- legal difficulties; and
- privacy and data sovereignty issues.

Williams and Williams (2003) identified "change management as part of process improvement" as a missing factor in successful BI delivery and indicated that "process engineering lays the foundation for managing business value delivery". This missing element from BI implementations may help explain their comment that "a number of BI project failures can be attributed to ineffective change management" (Williams and Williams, 2003). Without structure in place, the use of information and analytical tools will not provide the necessary advantage that BI can bring to an organisation. Lack of structure and process is referred to by Cohen (2013) as "over information". Cohen (2013) commented that quantity of information and the power of the information will not solve business problems if the correct processes are not put in place. Williams and Williams (2003) aptly identified that having useful information is not the same as exploiting that information. Cohen (2013) highlighted

the case of the September 11 attacks, whereby over information with no process led to the US Government being unable to correctly derive a prediction of this tragic event from the copious data available. Cohen (2013) referred to organisations being in a constant change mode to renew themselves and to innovate. Such change needs to be inclusive of process and technological change. Software on its own cannot make the change to effectively use BI. It requires changes to organisational supporting processes from executives and managers.

Technology failures. Yeoh and Koronios (2010) indicated that BI solutions that are non-business-driven and are totally technology-driven tend to have a higher failure rate. Abdullaev and Ko (2007) pointed out that "BI implementation is often run by IT without adequate consultation" – that is, without involving the business personnel, executive, sales teams or marketing. This would explain the high failure rate with BI implementation that Yeoh *et al.* (2008) highlighted in a report by the IT think-tank group/Gartner referring to the limited acceptance of BI systems that are implemented by organisations. Adamala and Cidrin (2011) alluded to technology being merely a tool used to deliver BI and quoted Adelman (2003) with the suggestion that "build it and they will come" is not a mantra to guarantee success for BI implementations. A study undertaken by Yeoh and Koronios (2010) highlighted a number of cases where BI solutions had been implemented – of which, the solution that was driven by technology had failed due to lack of business input, as the outputs required by the business were not understood; therefore, the BI product was not accepted.

While a technology-driven approach to BI implementation can lead to implementation failure, the solution on its own can have other contributing factors that need to be discussed. A number of cases pointed to data quality as being an issue. Abdullaev and Ko (2007) indicated that "many enterprises incur millions of losses as a result of false knowledge discovered from dirty sources". Data coming from disparate sources with questionable quality affect the end reporting and analytics provided by a BI system, therefore making it difficult for organisations to make strategic decisions and eroding confidence in the BI solution. Lack of data governance processes can adversely affect the quality of data utilised by BI systems and therefore affect the reliability and reputation of the BI solution that has been implemented. Yeoh *et al.* (2008) summarised that assurance of data quality and integrity from source systems heavily impacts the success of BI implementations.

Addressing the problems

Suboptimal ROI in BI systems is not a rare phenomenon. Having examined the reasons for failure of BI implementation under the broad categories of organisational, process and technological failure, we will now explore the inverse of this question and outline in some detail the steps that should be undertaken to ensure BI implementations *succeed* and deliver the expected business value to the organisation. As noted earlier, the factors most strongly determining the success of a BI implementation are managerial rather than technical, and these non-technical factors present the greatest challenges and consume the most time in solving (Adamala and Cidrin, 2011). We will therefore explore these organisational and process-based factors in detail before presenting a brief outline of the key technical success factors.

Organisational success factors

The key organisational factors that must be in place to ensure a successful BI implementation include:

- acquiring committed sponsorship of the implementation from management; and
- ensuring that the project is aligned to organisational strategic goals, including creating a business case that clearly delineates the expected benefits of the implementation.

Management sponsorship. Gaining management support is the most important factor in a successful BI implementation, as it impacts directly on the resources allocated to the project and on the view users have of the expectations of senior management (and their consequent attitude towards the importance of the implementation). Yet gaining management and organisational commitment is also viewed as the *most difficult* challenge among the various challenges faced by BI implementation teams (Yeoh *et al.*, 2008). How can organisations meet this challenge?

It is suggested that "a solid business case derived from a detailed analysis of business needs (will) increase the chances of winning support from top management" (Yeoh *et al.*, 2008). The details of the business case should identify benefits, resources, costs and risks, in a realistic and transparent manner, enabling properly informed decision making and the formation of reasonable expectations by senior management. It is also suggested that the adoption of a "[l]ow hanging fruits approach" (Adamala and Cidrin, 2011) in which the initial business target of the BI implementation is a problem with "the greatest visibility and monetary impact" (Yeoh *et al.*, 2008) will demonstrate to senior management an ROI in a short timeframe and, thus, help in gaining management support for further and associated BI initiatives.

Alignment to strategic goals. Beginning with an outcome in mind is a well-known strategy in successful project planning. Aligning the proposed use of the BI system to organisational strategic goals is essential in ensuring that the solution fits the problem or opportunity. Williams and Williams (2003) defined the following activities as essential to aligning the use of BI to strategic goals:

- understand the strategic, competitive drivers of the environment in which the organisation exists and related strategic goals; and
- determine the answers (and related questions) required to enable organisational activities (planning, budgeting, monitoring, controlling, etc.) to meet the strategic goals.

For organisations existing in an extremely competitive business landscape, for example, *competitive intelligence* (CI) may form a key part of the BI solution. CI is a specific BI application that draws on information about competitors within a specific industry, created and published externally to the organisation, to inform strategy, tactics and operations (Stair and Reynolds, 2013).

Bair *et al.* (2005) advocated that BI architecture be linked to high-level organisational strategy through an approach known as mission mapped Architecture. In this highly structured process, a high-level, business-driven mission statement is used to map a set of specific business and IT objectives. These are then "stepped down" to a set of criteria for the

BI implementation, which then form the blueprint for the technical architecture of the BI program.

Process success factors

Process improvement is important to all types of information systems. Christofi *et al.* (2013) in a study of ERP implementations emphasised that improving business processes is a critical factor for success. Key process-based success factors contributing to a successful BI implementation include:

- Ensuring the implementation is driven by business needs, rather than by IT assumptions. This requires properly gathering and understanding the business needs of the organisation, including consulting with end-users, to properly define the requirements of the implementation project; and balancing the implementation team to ensure that it includes representatives of the business units that will contribute to, take advantage of and be impacted by the BI implementation.
- Taking a phased, or iterative development approach, with a limited scope and separate budget for each iteration.
- Taking a top-down approach to change management, including training – paying particular attention to *management* training.
- Re-engineering business processes to take advantage of opportunities presented by the BI system following the implementation.

Business needs as drivers. BI implementations are often run by IT teams without adequate consultation (Abdullaev and Ko, 2007). The system must be responsive to the needs of the end-user, and this means users must be consulted. Without the involvement of end-users in the process, the BI team may overlook important and valuable insights into analysis and reporting requirements and items such as business rules, metadata, data dimensions and data context (Watson and Wixom, 2007). This should involve the identification and active involvement of subject matter experts representing the business units that will be impacted (Bennett and Evelson, 2013).

Yeoh *et al.* (2008) also suggested a key role for end-users in reviewing and testing the system. These key users should be empowered to take action quickly when technical and people-related problems are identified (Abdullaev and Ko, 2007). The active involvement of end-users in the implementation process also provides them with a sense of "ownership" of the system, which draws them into an important role in the change management process, in which they are more likely to accept and use the completed system (Hwang *et al.*, 2004) and may function as "change agents" in the change management process.

A phased or iterative development approach. Successful BI systems evolve in response to dynamic business requirements, through an iterative process of development, and this evolution requires an ongoing and consistent allocation of resources (Arnott and Pervan, 2005). The resources are not just required to support technical acquisitions and development, but are also a realistic requirement in overcoming organisational challenges that will be met as the use of the system expands and consequences of system use "ripple" through other business units (Yeoh *et al.*, 2008). Further, it is suggested that an iterative approach enables a smaller, and more achievable scope to be defined for each iteration, thus minimising the risks associated

with larger-scale change projects, and produces results in a shorter time, thus contributing to the likelihood of a more positive response and adoption by the organisation (Yeoh *et al.*, 2008).

Engineering business processes. As the value returned to a business by a BI system occurs after the point of implementation, it is critically important that the implementation includes the establishment of business rules and processes that will enable the organisation to exploit the business value of the BI system. While earlier parts of the implementation may be considered an "asset creation phase", process re-engineering activities sit within what might be termed a "value capture phase" (Williams and Williams, 2003).

A key part of process engineering a BI implementation is based on asking a series of questions around what to do when BI has revealed a business problem or opportunity. The kinds of questions that need to be asked are:

Q1. Who needs to be notified?

Q2. What are the necessary decisions and whose responsibility are they?

Q3. What further information analysis is required; who is responsible, and what tools and conventions must be used?

Q4. What is the timeframe for decision making?

Q5. By what processes are decisions translated into actions?

Q6. Who is responsible for monitoring the impact of decisions?

The answers to the above types of questions form the basis for business rules, standard processes, etc. (Williams and Williams, 2003).

A top-down approach to change management. According to Williams and Williams (2003), "[p]rocess engineering lays the foundation for change management" because it establishes the rules and processes that will underlie the structure that then needs to be communicated in a change management process. A key component of the change management process involves training and supporting end users. This training and support must be viewed as ongoing. Just as the ongoing system evolution requires an ongoing and consistent allocation of resources (see above), so does the support and training of the user base. Training should focus not just on the technology but also on associated management issues and business rules (Yeoh *et al.*, 2008).

Williams and Williams (2003) characterised the change management challenge particular to BI implementations as "introducing structure in the use of information and analytical tools" to executives and managers and described them as "targeted user communities for many BI applications" who are "highly unstructured". That is, this group may not be accustomed to thinking or acting in accordance with business rules. Williams and Williams (2003) cited that "[o]rganisations must apply […] process control thinking to white collar activities". In organisations where management and executive activities are relatively unstructured, this structured, rules-based approach will represent a substantial shift, and this requires substantial change management, including user training, accountability and possibly, monitoring system use.

Technical success factors

From a technical perspective, the success of a BI implementation is most dependent upon:

- the selection of the right solution based on the organisation's business needs and organisational context;
- the solution being scalable and flexible;
- a stable, reliable source/back-end system for extract, transform and load (ETL) processes; and
- sustainable quality and integrity of the data that the system will analyse.

Selecting the right solution. A decision about the right software solution cannot be made in isolation from the answers gained in aligning the project to the organisation's strategic goals. Additionally, the solution needs to be aligned to the operational needs of the people that will be *using* it. A tool that is too complex for any user other than a business analyst is clearly not a good fit if other people are expected to use it. Are static reports acceptable or do users need to be able to "drill down"? Do managers expect to be able to run "what if" scenarios (Bennett and Evelson, 2013)?

The solution selected should be one that best fits the organisation's strategic goals and operational needs, has a proven track record of delivering ROI for organisations with similar BI requirements, can be successfully implemented in the context of the other considerations raised in this paper and requires an investment that is optimal against other available options.

Scalability and flexibility. The solutions architecture must be sufficiently flexible as to enable it to grow and respond to new BI needs as strategic drivers evolve (Williams and Williams, 2003). Embedding scalability into the BI architecture could include the ability to:

- add new business and subject areas;
- add users;
- process increasingly complex queries;
- increase data volumes; and
- integrate data from additional diverse sources.

Some strategies can be used to meet the above scalability requirements when initially establishing the BI architecture. These include:

- establish common foundation dimensions, across all business units and cubes, regardless of the business unit being processed (e.g. a standard customer profile);
- utilise vendor-supplied, pre-configured logical data models defining dimensional models, foundation dimensions, measures, ETL routines and on-line analytical processing (OLAP)-level aggregation;
- utilise an enterprise BI metadata repository to centralise and standardise data warehouse metadata; and
- minimise *ad hoc* user queries by creating a suite of standard reports that are scheduled around the organisation's needs and aligned to its key, regular information requirements.

It should, however, also be noted that a number of researchers have warned against implementing systems that contain a "surplus of different unneeded components" (Abdullaev and Ko, 2007) or are more complex than needed (Yeoh *et al.*, 2008), as this can lead to difficulty utilising the system and reduce acceptance among users.

Stable and reliable source systems. Yeoh *et al.* (2008) pointed to the need for a reliable system to support the ETL processes required to combine data from disparate sources into a data warehouse or data mart – a key precursor to BI processes (Simitsis *et al.*, 2005). The task of channelling data to the data warehouse or data mart is facilitated either by customised software or by an ETL package such as Oracle's Warehouse Builder, DataStage or Informatica's PowerCenter (Dayal *et al.*, 2009). Further, the reliability of the data sources themselves is a key, and consistency between them is a highly desirable factor. Yeoh *et al.* (2008) pointed out that changing source systems prior to a BI implementation will attract significantly less cost than doing so *after* a BI implementation. Therefore, a thorough review of the stability and consistency of source systems forms a necessary part of planning for a successful BI implementation.

Conclusion

In a world in which data are increasingly available, BI offers a practical means for businesses to gain insight and competitive advantage. However, BI implementations do not always guarantee successful outcomes. Implementations may be considered suboptimal based on a number of measures, including ROI, project management measures, user satisfaction and non-concrete measures such as increased brand recognition, new sales leads, etc. Whenever BI implementations have failed to meet the needs and expectations of stakeholders such as managers, users and eventually shareholders, they may be considered suboptimal.

This paper has explored survey and case-based literature to identify the causes of suboptimal BI implementations. The factors contributing to suboptimal BI implementations may be grouped under three distinct categories: organisational, process and technological. Organisational factors associated with management commitment and leadership, alignment of BI project goals with organisational goals, organisational culture and the ability of an organisation to cope with change can negatively impact a BI project undertaken by a company, leading to failure. Process factors such as not setting objectives and requirements, failing to plan the BI project and not managing changes contribute to the complete or partial failure of BI implementations and may lead to problems such as over information. Technological factors may also arise because the technical solution is developed without understanding the business concerns. Often the solution may be implemented by IT departments without consultation with the wider organisation. Data quality may also be an issue. This may cause the organisation (management) to be misled due to "false knowledge".

Finally, solutions were explored to address the organisational, process and technological factors that lead to suboptimal BI implementations. Organisational success factors include committed sponsorship of the project from management and the alignment of project goals to organisational goals. Improving business processes, addressing business concerns rather than using IT assumptions to develop BI systems, using phased or iterative development approaches and robust change management have been identified as process factors that could improve the chances of BI implementation success. With such large amounts of data, technological factors such as selecting the right software, having scalable solutions and system flexibility to meet growing business needs also, contribute to the success of a BI implementation. These findings, if followed, should reduce the risk of suboptimal BI implementation and provide a better likelihood of measurable success.

References

Abdullaev, S.R. and Ko, I.S. (2007), "A study on successful business intelligence systems in practice", *Journal of Convergence Information Technology*, Vol. 2 No. 2, pp. 89-97.

Adamala, S. and Cidrin, L. (2011), "Key success factors in business intelligence", *Journal of Intelligence Studies in Business*, Vol. 1 No. 1, pp. 107-127.

Adelman, S. (2003), *Impossible Data Warehouse Solutions*, Solutions from the Experts, Pearson Education, Boston, MA.

Arnott, D. and Pervan, G. (2005), "A critical analysis of decision support systems research", *Journal of Information Technology*, Vol. 20 No. 2, pp. 67-87.

Bair, J., Fox, S., Hunt, M. and Meers, D. (2005), "Aligning BI with business strategy: how a mission mapped architecture can help", DSSResources.COM, available at: http://dssresources.com/papers/features/bairfoxhuntmeers/bairfoxhuntmeers09102005.html (accessed 25 November 2014)

Bennett, M. and Evelson, B. (2013), *Best Practices: Maximise your Chances of Business Intelligence Success*, Forrester Research, Cambridge, MA.

Blanton, S.E. (2012), "DataMASTER: success and failure on a journey to business intelligence", *EDUCAUSE Review*, available at: www.educause.edu/ero/article/datamaster-success-and-failure-journey-business-intelligence (accessed 26 November 2014).

Christofi, M., Nunes, M., Peng, G.C. and Lin, A. (2013), "Towards ERP success in SMEs through business process review prior to implementation", *Journal of Systems and Information Technology*, Vol. 15 No. 4, pp. 304-323.

Cohen, C. (2013), *Business Intelligence: The Effectiveness of Strategic Intelligence and its Impact on the Performance of Organisations*, John Wiley & Sons, Hoboken, NJ.

Dayal, U., Castellanos, M., Simitsis, A. and Wilkinson, K. (2009), "Data integration flows for business intelligence", *Proceedings of the 12th International Conference on Extending Database Technology: Advances in Database Technology*, *ACM, New York*, pp. 1-11.

Feng, X., Richards, G. and Raheemi, B. (2009), "The road to decision-centric business intelligence", *International Conference on Business Intelligence and Financial Engineering*, *IEEE, Beijing*, pp. 514-518.

Ghobakhloo, M., Sabouri, M.S., Hong, T.S. and Amirizadeh, K. (2011), "Electronic commerce-enabled supply chain process integration and business value", *Journal of Systems and Information Technology*, Vol. 13 No. 4, pp. 344-368.

Gilad, B. (2011), "Strategy without intelligence, intelligence without strategy", *Business Strategy Series*, Vol. 12 No. 1, pp. 4-11.

Hwang, H., Ky, C., Yen, D. and Cheng, C. (2004), "Critical factors influencing the adoption of data warehouse technology: a study of the banking industry in Taiwan", *Decision Support Systems*, Vol. 37 No. 1, pp. 1-21.

Isik, O., Jones, M.C. and Sidorova, A. (2011), "Business intelligence (BI) success and the role of BI capabilities", *Intelligent Systems in Accounting, Finance and Management*, Vol. 18 No. 4, pp. 161-176.

Lawton, G. (2006), "Making business intelligence more useful", *Computer*, Vol. 39 No. 9, pp. 14-16.

Legodi, I. and Barry, M.L. (2010), "The current challenges and status of risk management in enterprise data warehouse projects in South Africa", *2010 Proceedings of PICMET 10 Technology Management for Global Economic Growth (PICMET)*, *IEEE, Phuket*, pp. 1-5.

Lonnqvist, A. and Pirttimaki, V. (2006), "The measurement of business intelligence", *Information Systems Management*, Vol. 23 No. 1, pp. 32-40.

Lupu, A.R., Bologa, R., Lungu, I. and Bara, A. (2007), "The impact of organisation changes on business intelligence projects", *Proceedings of the 7th WSEAS International Conference on Simulation, Modelling and Optimisation*, *Beijing*.

Mohanty, S. (2008), "Measuring the value of intelligence in business intelligence", *DM Review*, Vol. 18 No. 12, p. 20.

Newell, M. and Grashina, M. (2004), *The Project Management Question and Answer Book*, American Management Association, New York, NY.

Parr Rud, O. (2009), *Business Intelligence Success Factors: Tools for Aligning your Business in the Global Economy*, John Wiley & Sons, Hoboken, NJ.

Simitsis, A., Vassiliadis, P. and Sellis, T. (2005), "Optimizing ETL processes in data warehouses", *Proceedings of the 21st International Conference on Data Engineering*, *IEEE, Athens*, pp. 564-575.

Stair, R. and Reynolds, G. (2013), "Fundamentals of information systems", Cengage Learning, *Mason, Ohio*.

Su, S.I. and Chiong, R. (2011), "Business intelligence", in Schwartz, D. and Te'eni, D. (Eds), *Encyclopedia of Knowledge Management*, 2nd ed., Information Science Reference, Hershey, PA, pp. 72-80.

Vitt, E., Luckevich, M. and Misner, S. (2010), *Business Intelligence*, Microsoft Press, Sebastopol.

Watson, H.J. and Wixom, B.H. (2007), "The current state of business intelligence", *Computer*, Vol. 40 No. 9, pp. 96-99.

Williams, N. and Williams, S. (2003), "The business value of business intelligence", *Business Intelligence Journal*, available at: http://decisionpath.com/wp-content/uploads/2010/12/The-Business-Value-of-BI.pdf (accessed 22 November 2014).

Yeoh, W. and Koronios, A. (2010), "Critical success factors for business intelligence systems", *Journal of Computer Information Systems*, Vol. 50 No. 3, pp. 23-32.

Yeoh, W., Koronios, A. and Gao, J. (2008), "Managing the implementation of business intelligence systems: a critical success factors framework", *International Journal of Enterprise Information Systems*, Vol. 3 No. 3, pp. 79-94.

Further reading

Kokin, S. and Wang, T. (2013), "Development of business intelligence success evaluation framework", *Journal of Applied Sciences*, Vol. 13 No. 9, pp. 1657-1660.

Watson, H.F., Celia, F. and Ariyachandra, T. (2004), "Data warehouse governance: best practices at blue cross and blue shield of north Carolina", *Decision Support Systems*, Vol. 38 No. 3, pp. 435-450.

Williams, L. (2007), "Leadership flaws add to IT project failures", *Computing*, available at: www.computing.co.uk/ctg/news/1862093/leadership-flaws-add-it-project-failures (accessed 22 November 2014).

Corresponding author

Janelle Boyton can be contacted at: janelle.a.boyton@gmail.com