The role of technology in the management and exploitation of internal business intelligence

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Abstract

Purpose – This paper aims to provide an introductory overview of internal business intelligence (BI) and the role that technology plays in its management and exploitation. BI represents the tools and systems that play a key role in the strategic planning process of a corporation, allowing the integration of applications, databases, software and hardware essential to users and enabling the analysis of information to optimise decision-making.

Design/methodology/approach – In reviewing the existing literature, this paper examines the core components, current trends and operational issues of a typical internal BI system architecture. The implications of these trends and their effects on business processes and culture are also explored.

Findings – The successful implementation of an internal BI system should include the core components and address operational issues, whilst also providing meaningful output to the organisation. It is contended, however, that to be truly successful, the internal BI system must be embedded within organisational processes and be adaptable to changing technologies, allowing the exploitation of the organisation's internal BI.

Originality/value – This general review is the first to provide a high-level overview of internal BI and explores the role of technology in the management and exploitation of internal BI.

Keywords Competitive advantage, Business intelligence, Big data, BI architecture, Data warehouse

Paper type General review

Introduction

A significant component for the success of organisations in today's information and data-rich society is the ability to exploit the data available and use it for the achievement of operational objectives (Weidong *et al.*, 2010). However, the organisation must have the ability to understand, analyse and transform this ever-increasing amount of data into meaningful and relevant information (Bures *et al.*, 2012). Business Intelligence (BI) is a method of using advanced technological tools to amass and analyse data and information about an organisation; to better understand the strengths, weaknesses, opportunities and position in the market; and to monitor the organisation's competitors (Balaceanu, 2007; Gullapudi *et al.*, 2012; McCarthy, 1999; Su and Chiong, 2011; Weidong *et al.*, 2010). The information outputs from BI enable employees at all levels of the

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organisation to make timely and informed business decisions based on reliable factual data (Intelligent Enterprise, 2002).

Because BI improves the quality of the information available to an organisation, it can be attributed with creating high-performance organisations through the minimal effort required to obtain relevant, intelligent and targeted information and knowledge (Weidong *et al.*, 2010). Hence, BI is fundamental to business today, providing organisations with the potential to make informed strategic decisions regarding their internal and external business positions and also to improve their business performance (Computerworld, 2008; McCarthy, 1999). Generally speaking, there are two key types of BI: external and internal.

External BI is based on data sourced from outside the organisation, which may have an impact on internal business decisions. External BI provides high-level data for strategic decision-making, from sources such as social media platforms, government reports or statistics, market reports and e-commerce, allowing an insight to competitor performance and consumer trends (Bures *et al.*, 2012; Chen *et al.*, 2012; Tonchia and Quagini, 2010). Organisations sourcing and utilising external data for BI must ensure these data are from a reliable source, and that the organisation has the capacity to analyse it (Collett, 2002).

Internal BI, on the other hand, refers to the analysis performed using data from within the organisation sourced from a wide variety of internal systems, such as an organisation's customer relationship management (CRM) system, finance system or company website. The data are generally stored in data warehouses, which connect all the company data in multiple databases to enable inclusive decision-making (Boateng *et al.*, 2012).

An example of operational efficiency gained from internal BI adoption can be seen in the case of Texas Children's Hospital (Microsoft, 2011). The hospital implemented a BI solution that integrated data from the electronic medical record system and the bed management system in near real time. Aggregating and analysing the data on patient flow metrics and bed availability gives hospital management and support staff the information they need about where the bottlenecks are at any one time (CHiME, 2014). The immediate problem areas can then be addressed by informed decision-making and resource allocation. This improves hospital services through a reduction of patient processing time, reduced wait times and the ability to treat more patients with the same level of resources (Microsoft, 2011).

The omnipresence of the Internet and the infinite amount of data being created daily from sources such as social media and consumer purchasing behaviours have led to the growth in BI architectures and tools for the storage, management, analysis and visualisation of data (Saarijärvi *et al.*, 2013; Schectman, 2013). The trends, such as big data, cloud technologies, self-service and mobile BI, are leading the way in the BI market. Big data in particular is a technology-driven trend, which has been designed to meet the demand created by the change in volume and variety of data available from Internet-based technology.

The objective of this paper is to provide the reader with a high-level understanding of the role that technology plays in the exploitation of internal BI. While focusing on the general aspects of internal BI, such as BI architecture and its core components, the paper will also provide the reader with information about the current internal BI trends and operational issues associated with internal BI implementation. Finally, this paper

addresses the effect of internal BI on the organisation's ability to achieve competitive advantage.

Internal BI architecture and its core components

Internal BI architecture

Commonly internal BI solutions are based on a centralised data warehouse, which collates and stores the data from different production databases such as the sales system, the finance system, and any legacy databases if applicable. The data are then manipulated using BI tools and are extracted to provide useful and succinct information to users for decision-making (Van der Lans, 2012).

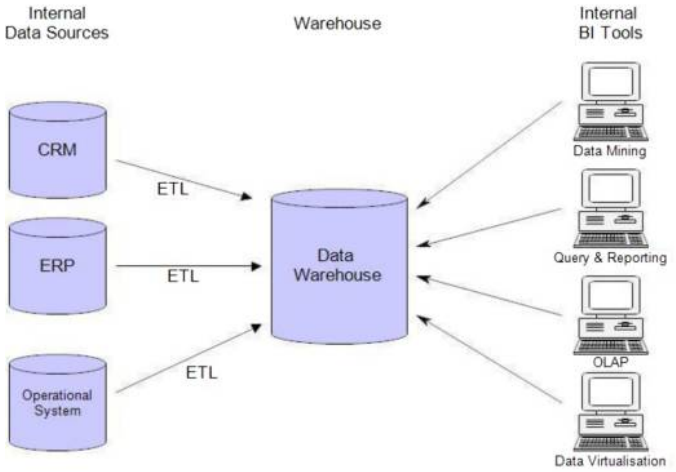
In a typical internal BI system architecture, the data are collected from internal operational source databases [e.g. CRM and Enterprise Resource Planning (ERP)] and imported into a data warehouse via a process called Extract, Transform and Load (ETL). Data are accessed in the data warehouse via internal BI tools and is displayed by front-end user applications. This process is outlined in Figure 1.

Core components of internal BI

The typical components of internal BI architecture include the source data, the ETL process and the data warehouse. These three common core components are the back-end infrastructure of an internal BI system. The following subsections provide a more detailed overview of each of them. The final core component of an internal BI solution is the BI toolset, which is the application software used for the transformation of data into intelligent information. This will be discussed in the next section.

Source data

The foundation for a typical internal BI architecture is the source data. These data originate from many different systems within the organisation. Common internal data sources include operational systems like Online Transaction Processing (OLTP)



Source: Redrawn based on Oracle (2014)

Figure 1.
A typical internal BI system architecture

applications, CRM, ERP, Supply Chain Management and other commercial packages or custom built in house applications (Eastwood *et al.*, 2005; Ong *et al.*, 2011).

Extract, Transform and Load

The next step in a typical BI architecture is to ETL the data from the source systems into a staging area. The extract involves identification of the specific data that are required and extracting these from the multiple disparate source systems. Transformation involves reformatting, summarising, cleansing and integrating the extracted data into a form that is suitable for upload. Reformatting is required to ensure that common data are standardised. For example, the state code for New South Wales may have a value of NSW in one data source, while, in another, it may be "New South Wales", and, in yet another data source, the value may be stored as a code like 02.

Ultimately, data stored in the data warehouse need to be consistent (Inmon, 2005). Once a design decision has been made, the values from the source systems must be reformatted in the transform step to adhere to the standard. During transformation, the data are also aggregated, summarised and cleansed, ready for upload. The final step in the ETL phase is loading, which involves importing the transformed data into the data warehouse and the operational data store.

Data warehouse

The data warehouse is a core component of the technical architecture being the main data source for the internal BI and decision support system tools used by an organisation (Balaceanu, 2007; Inmon, 2005; Ong *et al.*, 2011). The key characteristics of a data warehouse are that it provides a repository of data that is subject-oriented, integrated, non-volatile, time invariant and granular (Balaceanu, 2007; Inmon, 2005). In other words, it provides a single, stable, integrated source of data about the whole enterprise at a level of granularity low enough that enables it to be queried and analysed in multiple ways by different users.

As opposed to OLTP systems, which are designed to enable speedy updates, data warehouses are designed to be optimised for reporting and analysis functions commonly referred to as Online Analytical Processing (OLAP). To achieve this, the data warehouse is heavily de-normalised to facilitate the multi-dimensional view required by OLAP (Chaudhuri *et al.*, 2011; Sen and Sinha, 2005).

Internal BI tools

There are many internal BI tools available to businesses; the following are the major and emerging examples of reporting and analytical tools, including Query & Reporting tools, OLAP, Data Virtualisation and Data Mining. Each of these tools allows an organisation to study, filter, aggregate and summarise their current and historic data (Van der Lans, 2012). Nucleus Research (2014) suggested that organisations integrating data discovery tools within their broader BI system and creating room for expansion, whilst also enabling the maximisation of the value of data and analysis and meeting the needs of data analysts, will reap the most benefits from their BI system.

Query and reporting tools

These are the standard sets of tools that generate regular operational reports typically for assisting businesses in answering the "how" and "what" type questions (e.g. "How many items of each product type did we sell last month?"). The standard query and

reporting tools assist in managing day-to-day operations and can be used for creation of standard or *ad hoc* reports. Standard BI query and reporting functions can be performed with simple user-friendly tools like Microsoft Excel or Access QBE (Query by Example) or with sophisticated enterprise tools like Oracle BI (Microsoft, 2014; Oracle, 2013).

Online Analytical Processing

OLAP enables more complex queries and calculations to be performed than the standard query and reporting toolset. The technology uses a multi-dimensional view to query the data in the warehouse, which allows more advanced analysis to be undertaken. OLAP typically assists in answering the "why" and "what if" type questions asked by businesses (e.g. "Why did sales drop off more last quarter than they did for the same time last year?"). The multi-dimensional view provided by OLAP enables users to gain an understanding of the business from different perspectives. Analytical operations performed by OLAP include roll-up, drill-down, slice and dice, and pivot (Connolly and Begg, 2010; Ong *et al.*, 2011). Some common examples of OLAP applications include Sales Forecasting, Financial Modelling and Production Planning (Connolly and Begg, 2010).

Data virtualisation

Data virtualisation is a technique that allows the condensation of large datasets from databases and files, providing a visual format that can be scanned and understood quickly (Eldridge, 2014; Van der Lans, 2012). Whilst this allows for a simpler view of the data, users must still have the capability to understand and digest the resulting information (Eldridge, 2014). Data virtualisation tools are among the common offerings in commercial BI software. Some examples include Oracle BI Presentation Services and IBM Cognos Active Report (IBM, 2013; Oracle, 2013).

Data mining

Data mining is "the process of extracting valid, previously unknown, comprehensible and actionable information from large databases and using it to make crucial business decisions" (Connolly and Begg, 2010). In essence, data mining is the automated discovery of patterns, trends and relationships hidden within the data, and it goes beyond what is offered by OLAP (Chaudhuri *et al.*, 2011; March and Hevner, 2007). The main analytical operations involved in data mining include predictive modelling, database segmentation, link analysis and deviation detection (Apte *et al.*, 2002; Connolly and Begg, 2010). Data mining uses neural networks, evolutionary algorithms, decision trees, market basket analysis and regression techniques to produce predictive models (Chaudhuri *et al.*, 2011; Hu *et al.*, 2015; Viktor and Arndt, 2000; Wang *et al.*, 2011; Xiong *et al.*, 2015). An example of output from data mining is a detailed customer profile outlining consumer purchasing behaviour.

The last decade of data growth was largely driven from growth of the Internet. For example, social media data have led to the growth in BI architectures and tools for the storage, management, analysis and visualisation of data (Lo *et al.*, 2014, 2015; Schectman, 2013). This has resulted in new trends in utilising these data, such as big data, self-service tools, cloud technologies and mobile technologies.

Current trends in internal BI

Big data, self-service BI, mobile BI and BI on the cloud are the most significant trends currently influencing the internal BI market. This section provides an overview of each trend and some discussion about the importance and impact each is having on the businesses that adopt them.

Big data

Big data technology is enabling organisations to gather and store more data than ever before, which in turn is increasing the depth and breadth of data available to BI tools for analysis (Mohanty *et al.*, 2013). The term "big data" is often misconstrued as simply means "lots of data". However, the industry consensus is that big data is characterised by the three Vs – Volume, Velocity and Variety (McAfee and Brynjolfsson, 2012; Minelli *et al.*, 2013).

Big data technology needs to handle very large volumes of data that are constantly generated and flowing into the system at a very high velocity. Data can be machine-generated from everyday "smart" devices that constantly log single actions and events. Some examples include data generated using radio frequency identification devices, smart meters, toll roads, click stream data, GPS location data and social media uploads, to name just a few (McAfee and Brynjolfsson, 2012; Zikopoulos *et al.*, 2012).

Big data is also characterised by the variety of new and differing data types such as multi-media contents like text, audio, video, images, instant messages, Internet data from web pages, emails, documents and social media uploads like tweets and Facebook posts (Howson, 2013; Mohanty *et al.*, 2013). Advances in technologies like sentiment analysis, automatic speech-to-text transcription and content-based image retrieval for object recognition are enabling these more complex data types to be effectively processed (Mohanty *et al.*, 2013).

Newer database technologies like Hadoop and NoSQL are required to process the semi-structured and unstructured data consistent with big data (Zikopoulos *et al.*, 2012). This is very different to the highly structured, relational data generated from internal transaction processing systems traditionally used by BI tools (Minelli *et al.*, 2013).

The big data era for BI is only just developing, but it is gaining some momentum. Industries that have been at the forefront of this arena of BI development include national security and criminal intelligence, health, energy, gaming, and social media start-ups like Google and Facebook (Howson, 2013; Mohanty *et al.*, 2013).

Self-service BI

Self-service BI refers to the provision of user-friendly tools that allow users to create their own reports and perform their own analysis. This allows them to be autonomous and less reliant on a central BI specialty team (Horwitt, 2011). The development of data discovery tools is the technology behind this self-service trend, making the data available to users in a visual format that they can interpret without having to understand the underlying database infrastructure design (Howson, 2013).

Self-service BI improves business agility by making critical information more readily available to the end-user decision-makers. This removes BI bottlenecks and speeds up access to critical information, which in turn supports better and faster decision-making (Weber, 2013). When implemented properly, it ensures that the right users have the right tools and the right data to perform their roles as effectively as possible. Self-service BI,

however, must also be tightly controlled through data governance, security and user access controls to enable protection of the organisation's sensitive data (Yap, 2011).

Cloud-based BI

Delivery of BI functionality via the cloud, also known as Software as a Service (SaaS) BI, is another emerging trend (Howson, 2013). As with all cloud-based solutions, SaaS BI enables businesses to deploy scalable information technology (IT) solutions quickly and without the expensive upfront investment in capital infrastructure on top of the IT personnel required for ongoing support. Cloud computing is providing a way for small- and mid-sized businesses to deploy fast and cost effective IT solutions for all business functions including BI.

While multiple benefits exist, there are still some factors to be considered before deploying a SaaS BI solution. One of the biggest complexities for BI deployment, being the initial data design, is not mitigated because the delivery has moved off premises (McKendrick, 2013). BI solutions are usually complex undertakings with much analysis, design and integration effort required to ensure that business users get what they need from the system. These key challenges and in particular integration of company data from dispersed operational data sources are still needed for a SaaS BI solution (Johnson, 2014; McKendrick, 2013).

Security and privacy should be considered seriously before the deployment of a cloud-based internal BI solution. The most cost-effective cloud solution is the "public cloud", which provides the organisation access to an environment offering scalability and agility on a user pays basis. At a much greater cost, but for reasons of security, control, governance and efficient utilisation, organisations are opting for "private clouds" where the data are often located inside the company firewall (Johnson, 2014; Soni, 2014).

Mobile BI

The increase in popularity of touch-based tablets and smart phones has been the turning point for the current trend in the mobile BI market (Minelli *et al.*, 2013). The primary force behind this trend, without a doubt, has been the introduction of the easy-to-use touch-based Apple iPhone, iPad and Android devices (Howson, 2013; Motta *et al.*, 2014), allowing users access to their network at any time and from any location (Tona *et al.*, 2013). These user-intuitive software devices have enabled mobile BI to deliver more user-friendly self-service BI applications that are easily purchased and deployed (Minelli *et al.*, 2013), whilst also offering organisations the opportunity to use mobile BI to improve employee productivity, more efficient business processes and improved customer service (Motta *et al.*, 2014). Mobile BI, however, also has limitations including data volume, network and device limitations, interface and deployment limitations, as well as concerns regarding governance and security (MicroStrategy, 2013).

Mobile BI is not a standalone solution, but a complementary solution to traditional BI, providing users with self-service, efficiency, and the mechanism to make real-time decisions using organisational data that is readily available (Tona *et al.*, 2013). There are a number of mobile BI applications on the market offering varying opportunities, and within distinct market areas such as enterprise Apps and industry specific Apps (Chen *et al.*, 2012). IBM Cognos Mobile is an App providing access on the go for users of IBM Cognos. RoamBI allows users to access data from a selection of software including SAP,

Microsoft Reporting and Analysis Services, IBM Cognos, and Excel, whereas Birst is a SaaS enterprise system with a cloud-based option (Robb, 2013).

Operational issues with internal BI

There are a number of key operational issues that impact on the success of internal BI implementation, such as quality of data, limitations of user knowledge, alignment of the BI system with the organisation and the technologies used (Olszak, 2014). These operational issues are becoming increasingly important as organisations are storing more data about increasingly complex and dynamic business operations and, in turn, relying on these data to make informed business decisions (Inmon and Meers, 2001; Sen and Sinha, 2005; Vesset and McDonough, 2009). Other operational issues that affect BI implementation include organisational culture, an unclear project plan and vague expectations of the BI system (Olszak, 2014).

Quality of the source data

Wieder *et al.* (2012) confirmed that the quality of decisions based on BI outputs is directly affected by the quality of data in the warehouse. Data quality can be measured against a number of key attributes, which include accuracy, completeness, economy, flexibility, reliability, relevance, simplicity, timeliness, verifiability, accessibility and security (Stair and Reynolds, 2003).

Given that internal BI systems are centred around data analysis and reporting functions, the quality of data is a significantly more important issue for BI than for operational OLTP systems (Wieder *et al.*, 2012). Poor-quality source data lead to cost and time overruns during BI system implementation (Muhammad *et al.*, 2014), and can ultimately lead to poor decision-making, which in turn may have a negative impact on the business, its competitiveness and its profitability (English, 1999).

Maintaining integrity of the data warehouse

The main goals of the data warehouse are: data should be easily accessible, presented consistently, adaptive and resilient to change, secure, provide a foundation for business processes and accepted within the organisation (Kimball and Ross, 2011). The sheer size of an enterprise data warehouse in large organisations adds to its complexity. In addition, organisations are not only storing more data but also becoming more advanced in the way that data is being analysed (Vesset and McDonough, 2009, Butt and Zaman, 2013). Ensuring that the relationships between all the data in the warehouse are mapped out correctly is imperative (Inmon, 2005), and maintaining the integrity of the data warehouse is critical to realise the true value of the analysis performed on the data.

Issues with data integrity can arise when changes are made to an operational OLTP source system that is not reflected in the data warehouse. For example, a new product may be introduced into the OLTP system that adds a new data field to the database. This new field must be reflected in the data warehouse, otherwise the integrity of the data structure in the warehouse is compromised and essentially data are missing. Ultimately, the relationships within the data warehouse will be distorted if the data are incorrect (Butt and Zaman, 2011). This may impact on BI output, providing an incomplete and inaccurate picture.

Technical issues

BI systems are impacted by the same technical issues that impact all IT systems, although the nature of the BI architecture can often exacerbate these issues. Two of the main areas where technical issues may impact on internal BI, involve outages and performance.

Failure of the BI system may be impacted both by outages related to the BI system components and/or outages impacting the ETL processing or the operational systems, which provide the source data to the warehouse. The negative impact to business caused by BI system outages is growing, as BI is increasingly considered a mission critical system (Eastwood *et al.*, 2005).

Internal BI systems can also be impacted by performance issues, and this should be a major focus during system planning (Imhoff, 2013). The internal BI system should be able to process both quick and large operational queries (Imhoff, 2013). While users are prepared to wait a bit longer for a response from an internal BI reporting system than they are on an OLTP system, if the BI system is too slow, it will not be as widely used within the organisation therefore limiting its benefit (Wieder *et al.*, 2012).

Organisational culture and user issues

The full benefit of BI capability may not be realised as users are not always aware of what's possible from the BI or are limited by their creativity (Balaceanu, 2007). Whilst organisations often underestimate the skills and competencies required for successful BI implementation (Olszak, 2014), they limit their requirements to what they already know and need training to get the most out of the data so that the full benefits of the BI solution can be realised (Balaceanu, 2007; Vesset and McDonough, 2009).

Alternatively, such problems might reside in the much more challenging domain of organisational culture, which may have a significant impact on the acceptance and success of a BI system (Grublješič and Jaklič, 2015). Organisational culture reflects the values, beliefs, assumptions and agreements between managers and their employees (Belias and Koustelios, 2013; Rao and Kumar, 2011; Sangar and Iahad, 2013), and characterises the elements that bond the members of the organisation, and therefore, its operational capabilities (Belias and Koustelios, 2013). Organisational culture can be linked to corporate performance, the acquisition of knowledge and learning within the organisation (Belias and Koustelios, 2013; Borkovich, 2011).

For BI to be accepted, the organisation must have an information culture incorporating such behaviours as transparency, control and pro-activeness (Grublješič and Jaklič, 2015). While to be successful and competitive, the BI system must also align with the people, technology, organisational policies and to the culture of the organisation (Borkovich, 2011). The organisation not only requires an information culture but also full support from management and a customer-based focus (Grublješič and Jaklič, 2015).

Consequently, organisational culture can be viewed as a main reason for the implementation failure of change programs within an organisation (Linnenluecke and Griffiths, 2010), exerting its influence through shaping the behaviour of organisational members (Zheng *et al.* cited in Borkovich, 2011). Ultimately, successful BI implementation relies simply on the alignment of BI and business strategy (Olszak, 2014).

Privacy and security

The protection of sensitive information held within an organisation's data warehouse is an integral component of privacy protection and regulatory compliance of BI applications (Bhatti *et al.*, 2008; CIO Staff, 2013). The risks to data privacy, through data loss or systems breach, grow as larger databases are established and data are shared. Organisations must ensure that sufficient risk minimisation strategies are in place (Wright, 2011). Protecting information from unauthorised access is paramount with the information requirements of users based on specific authorisation levels (Bhatti *et al.*, 2008).

It is necessary for an organisation to instil an understanding of the relevance and importance of the security of the organisation's resources, so that the employees would "want" to apply the correct practices to be secure (Paulsen and Coulson, 2011). One security complication in internal BI applications is in regard to OLAP queries where the access control mechanism responds to both direct table access as well as materialised views of the data, and does not answer the query according to user privileges (Bhatti *et al.*, 2008).

BI systems have the ability to facilitate a culture of information security through the ability to monitor activities, set goals and provide accountability (Paulsen and Coulson, 2011). Security controls such as passwords can assist the organisation to develop a security aware culture, while BI controls can limit a user's ability to continue, unless certain security concerns are addressed (Paulsen and Coulson, 2011).

In summary, the operational issues that impact on internal BI systems are very similar to those that affect technology-based solutions generally within an organisation. Quality and integrity of the data, outages and performance issues, user-related or organisational cultural issues and privacy and security, are all issues that apply to technology-based information systems in an organisation. Similarly, the business cases used by organisations to justify the investment for internal BI solutions are similar to those used for many IT investments. Improving operational efficiency and organisational performance to increase or maintain competitive advantage is the justification for many IT investment decisions. The relationship between the pursuit of internal BI solutions and competitive advantage is discussed in more detail in the next section.

Competitive advantage and internal BI

A major justification for engaging in the pursuit of BI is a search for efficiency, not least in relation to resource management and cost control. Internal BI has the ability to influence business processes, which in turn influence organisational performance, therefore improving the organisation's competitive advantage (Elbashir *et al.* cited in Richards *et al.*, 2014). More specifically, it is claimed, BI and analytics enable organisations to provide information to employees to empower them to make decisions and to gain or sustain competitive advantage (CIO Staff, 2013). However, it is not only the uniqueness of the IT application that is essential to achieving competitive advantage but also the uniqueness of the organisation's resources and structure (Clemons & Row cited in Alalwan, 2012). Jet Interactive, an Australian company that operates the 13, 1300 and 1800 inbound call network, illustrates how the use of internal BI can achieve competitive advantage. Jet Interactive can provide their clients with access to a hosted BI system where they can perform analysis on their call data collected by the company.

The CEO of Jet Interactive believes that the BI implementation has provided the business with a "huge competitive advantage" (Yellowfin International, 2010).

A further example of internal BI in the pursuit of competitive advantage can be found within the automotive industry, where some car dealers use BI to track customer purchasing behaviours (Johnson, 2014). Data from the dealer management system are analysed through internal BI to project the preferred vehicle makes and models for the demographic area. The dealership stock profiles, e.g. the cars stocked for sale, are then based on these projections. By stocking the cars that customers want to buy, these dealerships possess a competitive advantage over a dealership that does not have the vehicle in stock and does not conduct analysis using internal BI.

Whilst internal BI can be seen as a principal source of competitive advantage for an organisation, the benefits can only be appreciated when the outputs are fully integrated into the decision making and business processes of the organisation (Grublješič and Jaklič, 2015). The system requires support by the core management processes that create the competitive advantage through the utilisation of the technology (Adcock *et al.*, 1993; Alalwan, 2012). For internal BI to be successful, it must advance from initial approval of the concept through to the system outputs becoming embedded within the organisation's routines and processes (Grublješič and Jaklič, 2015). Karim (2011) suggested that BI competitive advantage has shifted from those who use their expertise to implement the technology, to organisations that use BI to increase sharing of information and knowledge as well as improve business processes. In the long run, to achieve competitive advantage through the use of internal BI, the organisation must ensure that the strategic vision, products and services of the IT department are aligned with the strategic objectives of the organisation (Alalwan, 2012).

Implications

This paper has illustrated the key role that technology plays in the provision of BI tools and its ability to exploit internally sourced business data. Without the core components of technical infrastructure to provide support, BI tools are simply non-existent. Advancements in technology and user acceptance of technology have also contributed to current BI trends. With the increasing use and importance of the Internet and smart mobile devices, the ability of business to handle big data is becoming increasingly necessary.

Before implementing a technical BI solution, the operational issues need careful consideration. Security and privacy is an important issue, particularly in relation to self-service and mobile BI. Both self-service BI and mobile BI will increase the number of users connecting remotely via less secure mobile devices and this will require additional system security measures to be implemented. Cloud BI installations bring cost effective BI solutions to an organisation; however, the opportunity for a security breach may be great if the security of the cloud solution is not seriously considered. The technical issues associated with the various cloud BI solutions, such as system outages, affect the ability of the BI solution to provide timely outputs and may prove costly.

Because the exploitation of internal BI by management is an effective way to achieve competitive advantage, management must make sure that the policies and procedures are in place to ensure that the privacy and security of the data, the integrity of the data and the sources of the data are controlled. Management must ensure that the culture of the organisation is accepting and respectful of the powerful outputs a BI solution can provide.

Conclusion

Internal BI is not a "one size fits all" system and must be specifically engineered to meet the needs of each individual organisation. The technology used within the BI system allows each organisation to access high-quality and targeted information by minimising the processes involved in accessing the information (Weidong *et al.*, 2010). However, for the BI implementation to be successful, the use of the system must become embedded within the organisation's business processes and culture (Grublješič and Jaklič, 2015). The internal BI system must provide quality and meaningful outputs, which are utilised throughout various areas of the organisation.

Technology is the "backbone" of the BI system. The core components of the internal BI system architecture transform the source data, from one or many systems, into useable, integrated and clean data, while the internal BI tools provide the organisation with the means to analyse this data and generate functional outputs. Additionally, the new trends in internal BI are allowing greater opportunities for the use of technology to exploit internal BI. The principal trend currently influencing BI, big data, is challenging the mainstream BI installations due to the new and varying types of data to be processed. The fast changing, constantly increasing amount of data requires technology to keep pace and provides new avenues for organisations to exploit their internal BI.

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