Towards a Conceptual Model to Assess the Factors impacting the Non-financial Value of Business Intelligence

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***Abstract*----**This paper presents an in-depth review of current academic literature in order to identify and use the key non-financial factors impacting Business Intelligence (BI) value that are discussed by academics and industry experts alike to build and test a conceptual model that can contribute towards a better understanding of these factors and be used to evaluate BI value not only from a financial perspective but also from an intangible perspective. Building on the comprehensive literature review, a survey of BI investment and usage was conducted across a random stratified sample of companies operating in South Africa and Germany. A factor analysis conducted across a sample of 112 ICT experts found that the factors identified in the literature review reduced to three core factors, grouped as Information Quality, Information Accessibility and BI Culture and Capabilities which tested significantly using the PCA Direct Oblimin Factor Analysis method.

***Keywords*-----**Business Intelligence, ICT Value, Information Systems, Data Management

I. Literary Background

While Business Intelligence (BI) solutions are seen as a critical component of today's business world, little is understood regarding the non-financial factors that impact the value of a BI solution. Although the total investment in BI solutions by organisations is estimated to be in excess of $50 billion per annum [1], and the reasons for success and failure of business intelligence investments have been widely discussed, few concrete academic findings related to these successes and failures have been made [2].

Thus far a limited number of academic studies were found that explored the non-financial factors influencing the success of business intelligence investments and the links between these factors. The focus of many studies available are specific to the monetary quantification of BI value, however the quantification of non-financial factors are seen as quite complex.

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Zubey (2007) [3] speaks of the challenge faced by the pharmaceutical industry around the decision to invest in business intelligence. In particular, the question asked is "What organizational value am I creating with the capital investment required to implement a new business intelligence solution?" This dilemma is not unique to the pharmaceutical industry, but is a challenge faced by organizations on a daily basis.

Over the last three decades, IT investments were made to increase operation capabilities in businesses, with the need for large amounts of data to be processed as quickly as possible [4]. In order to assess viable investments, it had to be carefully reviewed in order to understand the return on investment and had to clearly demonstrate its ability to improve the efficiency of the business or growth of the business. Likewise, anything technological investment that did not provide as quick an impact on the business' bottom line as possible was not a viable option. [5]

Kohli (2008) [6] examines a number of factors that must be taken into account when deriving the benefit that information systems provide for a company, namely removing the doubt whether of information systems add as this has been sufficiently proven; the value created by information systems is conditional and works hand in hand with other organisational systems which includes people; the value of information systems manifests in a number of ways due to its newfound pervasiveness such as increased productivity, capital value and business process improvements; the presence of value across many levels such as individual, group, firm, industry, or process*;* the difference between value brought about by information systems investments as opposed to competitive advantage due to information systems investments; value derived from information systems investments is not always immediate, and a latency (lag) period can be experienced in the return on investment; a number of factors exist that are deemed important and necessary conditions in the value creation derived from information systems investments, including IS-Strategy alignment, organizational and process change, process performance, information sharing, and IT usage, among others; and finally that proving and attributing value to IT investments and isolating effects on a value-based variable are onerous and are dependent on to the subjectivity of primary data.

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Business Intelligence is a field that has given businesses the ability to assess and improve themselves data mining and information generation, which is recognised by Zuboff (1988) [7] who stated that the systems making it possible to automate also give a total view of an organization's operations coordinating many levels of data to allow for accessibility for analytical purposes.

Many modern academics agree with this analysis. According to Davenport (2006) [8], the ability to analyze data has become a critical capability for modern organizations, while Marchand, Kettinger and Rollin (2000) [9] relates the success of a firm to its capabilities to effectively manage and use information. Both authors refer to this as information orientation, which is the ability to manage information effectively through organizing, sensing, collecting and processing information. [6]

In this way, companies are in a better position to understand their data and convert this into usable information, with data mining fast becoming an asset for organisations in order to create better internal capabilities and new business opportunities. However, while we accept with confidence that an organisation can generate value from information, research in this field still remains infrequent.

Most return on investments for intelligence systems are only easily estimated using quantitative factors, mainly because an organisation is unable to capture many of the qualitative and intangible benefits that are expected [10, 11]. Despite this, it falls to managers to justify projects quantitatively as cost benefit analysis carry a pivotal position in the information systems advancement [12]. Sircar, Turnbow and Bordoloi (2000) [13] have demonstrated that while information systems investments have a strong positive relationship with sales, assets and equity, they do not with net income as there is a lack of tangible factors to which implementations can be associated.

Many studies have been conducted and frameworks built in order to assess value of business intelligence systems. Watson and Haley (1998) [14], Watson, Goodhue and Wixon (2002) [15], Sentry Market research and IDC study Power (1997) [16] present possible sources of benefits of such systems, while Wu (2000) [17] looks at the importance of evaluating both tangible and intangible benefits before a business intelligence project is undertaken and Morris (2003) [18] presents a comparative study of building versus buying a business intelligence system [19].

Webster (1994) [20] defines tangible as something that can be assigned an actual or approximate value. However, a definition such as this does not specify if the value attached is necessarily a monetary value or some other measure such as customer satisfaction [11].

The historical distinction between tangibles and intangibles lies originally with that of goods and services, with philosophers such as Adam Smith stating that while goods were material and could be stored, services were merely immaterial and transitory [11]. Remenyi, Money, Sherwood-Smith and Irani (2000) [21] attempted to differentiate by stating that a tangible benefits impact the organization's bottom line, while defining a tangible benefit as directly affecting the firm's profitability.

Hares and Royle (1994) [22] defines an intangible as something that can be measured with difficulty, and that it is difficult to differentiate clearly between the two, with the example that the Generally Accepted Accounting Principles (GAAP) stating that money spent training staff is an expense with no future value, but from a business perspective, the value of a skilled employee with the necessary training far exceeds the value of the training expense [11].

Determining the intangible benefits derived from information systems implementations has been a subject for investigation but no solid conclusions for both academics and practitioners could be found [23].

II. Value of Business Intelligence

A. Information Quality

The assessment of the value of information is a key factor in understanding the value of business intelligence systems. According to Petter, DeLone, and McLean (2008) [24], little unanimous consensus on the value add of business intelligence systems is available, while De Voe and Neal (2005) [25] say that the value of business intelligence systems is the ability to get the right information to the right user at the right time, while Thierauf (2001) [26] states that organizations with business intelligence systems implemented successfully experience better and timelier access to a number of factors that are not easily measurable in a non-business intelligence environment such as customer activities, marketplace trends, supply chain issues and other key performance indicators.

One of the key roles of business intelligence systems is to reduce the gap between operational data that is gathered and quality information that is output in an organisation in order to make strategic and tactical decisions. However, the more information available the slower the number of decisions made as compared to the appropriate amount of information that was required for the decision, and while intuition still plays a role in business decisions, it has become a more supplementary element with structured fact-based decision-making taking precedent [27].

Despite the differences in research contexts, goals and methods, most researchers are in consensus regarding the criteria to describe good quality information [27]. A number of conceptual frameworks and simple lists of information quality criteria exist in current literature from a management, communication, and IT perspective [28, 29, 30, 31]. (Eppler, 2003) [32] defines an information quality framework as providing a systematic and concise set of information can be evaluation criteria, a method to solve information quality issues, and the building blocks for information quality measurement and benchmarking.

In order to add value via quality information (Popovic & Jaklic 2010) [27] suggests that the organisation must ask itself whether the access to integrated data and the global view of a customer will the organisation better understand the customer and treat them differently; whether better information will lead to better negotiations with suppliers; will response times to market events be shorter due to faster access to information and therefore lower business risk and increase potential of business opportunities; will the number of users of quality information increase if proper formatting and access is in place and whether it will have an impact on the structure of the organisation and/or the execution of business processes?

If these questions are answered positively, true business value can be derived from a business intelligence investment as a result of increase information quality.

B. Information Accessibility

While seen as complex, it is necessary to use a storage area such as a data warehouse in order to gain a single integrated view of data sourced from disparate sources. As described by Wixom and Watson (2013) [33], a significant part of deriving benefits from a business intelligence solution is the data quality and system quality relationships, and the quality of the data storage solution and its data play a key role in this.

Eckerson (2003) [34] highlights that a number of different business intelligence tools are available as business intelligence is a diverse field and there is no 'on size fits all' solution, and different vendor solutions may be used in one organisation as they meet different organisational requirements [35].

In current literature, many academics look into the impact of implementation of intelligence systems [36, 37]. The value of such infrastructure lies in the support or failure to support key processes within the organisation [38]. Commonly used measure of performance for system quality includes system flexibility, integration capability, response time and reliability [39].

In the perspective of data warehousing (or data marts) as the de facto storage area in any organisation, high quality data and business intelligence system improves the provision of data to reporting tools as part of the decision making process Wixom and Watson (2013) [33], which supports the need for a data storage area that contains high-quality data, can flexibly respond to users' requests and integrate data as required by users in order to create value from the investment.

Yeoh and Koronios (2010) [40] breaks down the critical success factors for the implementation of business intelligence systems into three key dimensions, namely organisational, process and technological. From an organisational dimension, it is key to have management buy-in and support as well as a clear vision for business intelligence in the organisation with its case being driven by the business.

From a process dimension, it is key that champions are identified within the business to drive the implementation as well as a business-driven development approach that is iterative. Finally, from a technological perspective, it is key once again that the system is driven by the business and the technical framework is flexible and scalable, with sustainable data integrity and quality [40].

C. Culture and Capabilities

Business intelligence solutions facilitate an organisation's information processing capacity which assists in them meeting their information processing needs [41, 42]. This is done by means of the combining of data storage, collection and knowledge management with analytical tools in order for management to use complex information to make effective business decisions [43].

According to Popovič and Jaklic (2010) [27], the presence of an analytical decision-making culture within the organisation is just as key as information quality and access to information to ensure business intelligence maturity and successful business intelligence investments.

While organisations can implement business intelligence systems successfully from a technological perspective, the anticipated benefits may not be realised due to neglecting the usage factor of the system [44]. Popovič and Jaklic (2010) [27] demonstrate in their study that the presence of an analytical decision-making culture will directly and positively impact the use of information on organisational business processes.

Business Intelligence capabilities can be broken into two distinct parts, namely technological such as data sources and data reliability and organisational which are those that impact the usage of business intelligence within the organisation such as flexibility and risk-taking level of the organisation [45, 46].

Pranjic and Gibson (2011) [47] identifies three models that can be explain the culture of information accessibility and usage in and organisation, namely Information Dictatorship where data is held by only a few in the know, Information Anarchy where very little if any control exists on the dissemination of data and Information Democracy where relevant information is available to employees according to their informational needs from a centralised data storage area.

III. Research Methodology

The study began with an intensive literature review in order to understand what factors have been identified in current literature. This was followed by a survey done across BI experts and CIO's in both South Africa and Germany that looked specifically at the assessment of the value of BI to organisations.

Once this was completed a statistical study was then conducted to analyse the factors identified and focused on the loading of each question in the survey in relation to the factors.

Two statistical methods were used to analyze the final data set, namely Principal Components Analysis (PCA) and the Principal Factor Analysis (PFA) using Promax and Oblimin analytical rotations. The best fit was found to be PCA Oblimin which was used for the final analysis.

Once this was completed a conceptual model could then be designed based on the findings.

IV. Implications and Conclusion

The factors that loaded strongest were Information Quality and Information Accessibility with a load factor of 0.62 and BI Usage, Culture and Capabilities with a load factor of 0.65.

The derived conceptual model can be depicted using the diagram below.

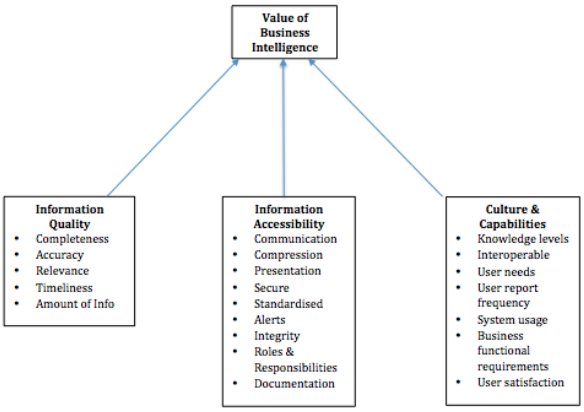

Fig. 1 Value of BI Conceptual Model

The model highlights the sub-factors that were tested and were found to constitute each of the overall factors. Information quality can only exist if there exists a combination of completeness, accuracy, relevance, timeliness and the amount of information available. Accessibility refers to the technology required to maintain and control the appropriate access to the information available. Finally, in order for the quality information and supporting technology to add value there must exist a culture of knowledge sharing as well as capability to make use of the data for the betterment of the business.

The findings of this study lead the way for further research into testing the conceptual model using empirical data in order to predict values of Business Intelligence systems in different environment.

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