



Analytical Literature Review on Business Intelligence System (BIS) Measurement

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Abstract:- Currently, Business Intelligence Systems (BIS) have been widely utilized in organizations. Although BIS have been well accepted as value creator by organizations, justification of BIS value is not always been clear in order to justify BIS investment. Therefore, to understand BIS value, organization started to measure their BIS. In addition, reviewing other researches shows that measuring BIS was used for managing BIS process as well as understanding BIS value. For understanding BIS value and managing BIS process, prior researchers applied different objective and subjective measuring methods. However, according to prior researchers, these methods did not provide reliable results. This paper analytically reviews prior BIS measurement methods to extract their critics. Additionally, review of Information Systems (IS) measurement context illustrated that measuring IS success is used for understanding IS value and managing IS process. BIS is an IS, therefore, this paper proposes applying IS success models can be used for measuring BIS success in order to understand BIS value and manage BIS process.

Keywords: Business Intelligence System, IS Success, BIS Success Measurement, Competitive Intelligence, BIS Value, BIS Process, Analytical Literature Review

1. Introduction

This study aims to analytically review prior works on BIS measurement and discover their critics. Then, the paper recommends that IS success models can be used for measuring BIS success in order to understand value and managing BIS process.

Through applying IS success models for measuring BIS success, the concept of BIS success will be discovered and importance of extracting proper metrics and measures will be explained.

Therefore, in order to achieve research objectives, which are critically reviewing BIS measurement literatures and proposing IS success models for measuring BIS, this paper includes following sections:

This paper organized in nine sections. Second section presents definitions of BI and BIS and clarifies differences between BI and BIS. Section three shows the growth of BIS utilization in organization during last 6 years. Section four describes importance of BIS measurements. Section five, reviews current BIS measurement methods especially from analytical aspect. Section six explains critics of current methods. Section seven illustrates how to use BIS success models for measuring BIS and discovers concept of BIS success. Section eight shows importance of extracting metrics and measure for measuring BIS

success and finally section nine concludes the paper.

2. Business Intelligence and BIS

Based on the review of literatures, the term “Business Intelligence” (BI) has been poorly defined [1-3]. Industry origin of BI refers to different software vendors and consulting organizations to suit their products, and some even use the term BI for the entire range of decision support approaches. Thus, scientific and professional literature reviews is included various definitions of BI [1, 3, 4].

2.1. Various definitions of BI

BI is defined as the process of gathering and analyzing organizational internal and external business information [5]. BI is an organizational architecture; it means that it is neither a product nor a system. BI is a collection of integrated operational as well as decision-support applications and databases that provide easy access to business data for the business community [6].

According to Raising and Hani (2004) research results, BI is a general term for tools, technologies, applications and platforms for supporting the process of extracting and describing business data, data relationships and trends. BI provides timely and accurate information for an executive to help him or her to understand organization business environment to make more informed and real-time business decisions [3]. BI is an organized and

systematic process on whole environmental information sources, which organizations acquire, analysis and disseminate information for decision-making and managing business activities [7].

Williams & Williams (2007) believe that BI is a set of business information and analyses within the context of key business processes, which lead to decisions and actions. In particular, their mean of BI is leveraging of information assets in key business processes to improve business performance [4].

The review of literature reveals that there is a related subject to BI, which researchers call it as Competitive Intelligence (CI). The term CI is used in the North American literature. CI systems are emphasizing on external information sources and exterior environment. On the other hand, European literatures consider the term BI as a broad concept of CI and other intelligence-related terms [2, 3, 7]. This research follows the European definition and focuses on the both external and internal environments. BI external environment includes: market Place, competition, suppliers, and customers. And internal environment includes: strategy, technology, culture and employees [3].

These BI definitions are not comprehensive since they introduce BI only as software or technology components. However, the essential point of BI is to understand what is happening within the business, as well as investigating an appropriate action to achieve organizational goals and vision. Moreover, these definitions do not clearly define the role of human factor within BI. The BI environment

encompasses all of the development, information processing, and support activities required to deliver reliable and highly relevant business information and business analytical capabilities [3, 4, 8] to improve organization abilities in making strategic and operational decisions.

2.2. Difference of BI and BIS

Although the BI term is new, it addresses very old managerial need to analyze the complex business environment for making better decisions [7]. BI aims to manage the stocks and information that are flow around and within the organization by identifying and manipulating information into condensed, useful knowledge and intelligence for senior managers.

BIS has ability of achieving asymmetry information and differentiation from competitors, respectively, and achieving competitive advantage in the market place [2, 3, and 9].

Therefore, this study defers between BI and BIS and applies definition of BI and BIS as: BI is the ability (services) organization to understand business environments situation and identify business weaknesses, strengths, threats and opportunities, in order to use strategic management methods to draw business future to gain competitive advantages and manage the business during its life cycle. However, the term BIS refers to a system that provides Business Intelligence for organization, using hardware, software, middleware, and communication equipment to transform business

data from quantity to quality, which is used by high-level managers.

3. Growth in BIS usage

Nowadays, BIS market is more common and still growing as the expectations of professionals who depend on BIS to help them navigate the increasingly complex world of global business and industry [10]. Technology Evaluation Centre (TEC), an IT solutions evaluation center, which work as a consultant and a research center carry out most research on BIS and its usage. TEC's research shows a steady increase in the utilizing or implementing of BIS. In addition, their research illustrate that the motivation is not only from large companies, even Small and Medium Enterprises (SMEs) aim to satisfy their data management needs and decision support processes by BIS. Figure1 shows the incremental rate of BIS implementation over the 6 years, from 2005 to 2011, the Figure shows TEC's final report in late 2012 and early 2013. Moreover, the TEC's research shows that there is stability in the demand of BIS solutions in the current competitive marketplace [10]. However, it is expected a slower but steady growth in utilizing BIS in the future [10, 11].

Based on TEC research, the growth trend is not only dedicated to large enterprises, many smaller companies are looking for tools to gain ability of BI by utilizing BIS in their organization to improve productivity and performance [10, 11]. Figure 2 illustrates the growth number of large enterprises and SMEs that are interested in BIS.

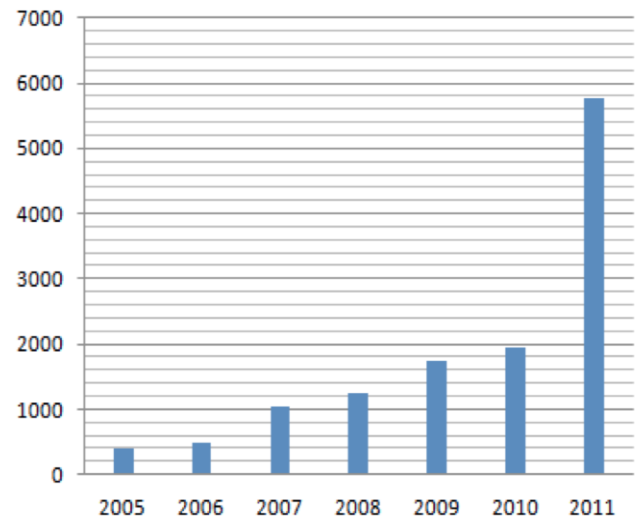


Figure 1: Growth of BIS projects during last 6 years [10]

Furthermore, TEC report illustrates that the interest of using BIS during 5 years, from 2005 to 2010, is increased at a steadier rate compare to other IT-based systems of organizations, such as enterprise resource planning (ERP) systems and human resource management (HRM) systems [11].

According to literatures, the opinion of utilizing BIS and their creation of value are generally accepted in the organizations especially in managerial levels [7, 10, 12]. Organizations believe BIS derives benefits by information quality improvement to enhance information quality and to achieve better information quality [3] from a data rich environment [3, 7]. Therefore, they bravely

begin to implement BIS [10,11].

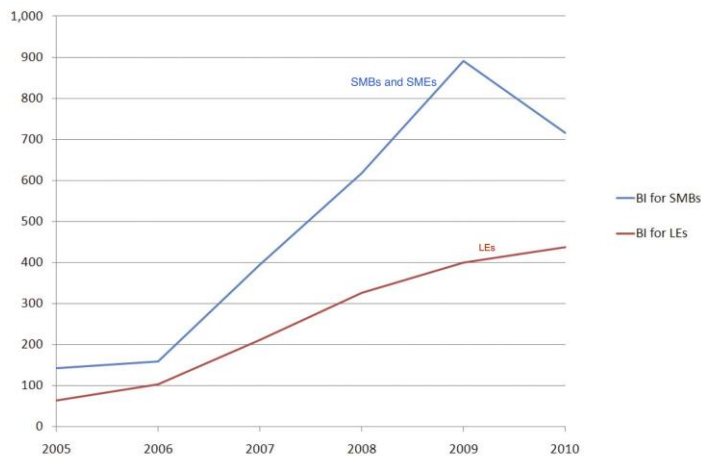


Figure 2: Interest of organizations for capturing BIS ability [11]

Generally, literatures emerge organization's reasons for moving toward BIS such as: achieving useful and high quality information [10, 11, 13, 14], obtaining a better perception on the environmental forces [10, 11, 13, 14], improving organization's performance, improving business processes, creating value and improving benefits, transforming from quantity to quality, cost and time saving [6, 10, 11, 13-15]. And some unverified reason such as: high amount of pay back and Return on Investment (ROI) of BIS projects. In addition, received benefits of BIS is known as improving of information quality or achieving better information quality goals [12].

4. Importance of measuring BIS

Organizations utilize BIS to transform data from quantity to quality and make information available for users on the tactical and strategic level of business decisions. However, despite the growth of BIS utilization, other reports show high amount of BIS projects failure. Reports reveal that 88 percent

of businesses don't know what they want from their BIS [16] and about 60 percent of BIS projects didn't achieve true value of BIS and were failed [17].

On the other hand, implementing and utilizing BIS in an organization is expensive, complex and risky. Therefore, understanding the true value of BIS is very important for organizations. Organizations, which fail to capture true value of BIS, run the risk of falling behind other competitors that adopt BIS in their business. Understanding value is critical for organizations to evaluate the performed investment on BIS [3, 7, 18]. In order to justify the organization investment in BIS, they started to measure the value of BIS. The review of literatures illustrates that researchers applied different types of objective and subjective methods for measuring the value of BIS [3, 7, 18]. These methods will be discussed in section 5.1 in more details.

Additionally, review of literatures shows that BIS measurement performed where the organization wants to manage BIS processes [3, 7, 18]. Peter Drucker (a famous management guru) once stated, "If you cannot measure it, you cannot manage it", this statement shows the importance of measuring in management perspective. It means that measuring of BIS helps organizations to manage it. Therefore, researcher applied different methods to measure BIS in order to manage its processes. These methods are discussed in section 5.2.

Through measuring BIS, organizations aim to, firstly, understand the value of their BIS and

secondly, manage their BIS process [3, 7, 18]. In other words, first purpose of measuring BIS is to prove that BIS investment is worth. The second main purpose of BIS measuring is to help manage BIS process, that is, to ensure that the BIS products satisfy the users' needs and that the process is efficient [3, 7, 18]. Current measurement approaches for determining the value of BIS and measures of managing the BIS process are summarized in section 5.

5. Current methods for measuring BIS

This section aims to explore prior works in BIS measurement criteria since 1996 such as how BIS were measured previously and describes BIS measurement method in the literature. Therefore, this section tries to determine the major purposes of BIS measurement, to identify what types of measures are being used and to evaluate the current measures and suggest how the measurement of BI could be improved.

Prior researchers applied different subjective and objective methods for measuring BIS [7, 12]. A large part of the current methods that are found in the literature mainly focuses on proving the value of BIS but they also proposed these methods for managing BIS processes [3, 7, 19]. TABLE 1 has illustrated the goals and expected results of prior researches in measuring BIS.

Table 1: Goals and Expected Results of Measuring BIS

Goal of BIS measurement	Expected results
Understanding Value of BIS	<ul style="list-style-type: none">• To prove that BIS investment is worth
Managing BIS process	<ul style="list-style-type: none">• Efficiently produce valuable intelligence for the specific needs of the users

In the case of managing BIS process, the BIS professional is the key user for measurement information to efficient production of valuable intelligence for the specific needs of the users and again they focus on the determining value of BIS processes [3, 7, 19, 20]. In the literature, especially in the subjective methods, measurement for managing the BI process has not been discussed as much as measuring the effects of BI. A large part of the current measures found in the literature focuses on proving the value of BI. Of course, many measures are useful for both managing of the BI process and measuring the effects of BI. The main difference is in the purpose of measurement in which why some of the used measures are somewhat different [3, 7, 19, 20].

5.1. BIS Value Measuring Methods

As mentioned before, measuring BIS value is to prove BIS investment, this section explores different objective and subjective methods of

measuring BIS value. In addition, the section describes the problems that each method was faced.

5.1.1 Objective methods for measuring BIS value

Objective methods aim to show financial values of BIS. The value is created as a result of utilizing BIS [7, 19]. In these methods, two questions are proposed to assess the value of BIS: [7] 1. How much does it cost to apply BIS? 2. What are the benefits of applying BIS? It means: from the perspective of the measurement of the value, a good starting point is to consider the cost of BIS and the benefits achieved by BIS.

BIS first implementation takes an initial capital investment, also BIS processes use operational resources [21]. Calculating labor costs, information purchases and other expenses related to the BIS activities are necessary for calculating the cost of BIS. Total Cost of Ownership (TCO) method [7] was one of applied method for identifying all costs related to BIS activities so calculating the cost of BIS is easy (Davison 2001). However, measuring the benefits is more complicated. Many of the benefits consist mostly of non-financial and even intangible issues such as, enhanced quality of

information (Hannula and Pirttimäki 2003; Nelke 1998). Therefore, measuring benefits of BIS is not as simple as measuring the cost. Typical objective methods for measuring BIS are: Return on Investment (ROI), Net Present Value (NPV) and Payback Period Method (PPM).

These methods are typically used in assessing monetary value of any investment. The main problem of these methods for measuring BIS is related to BIS output. BIS output is intelligence; intelligence is kind of processed information and it is extraordinarily difficult to quantify information and measure the value of BIS accurately [3, 7, 20, 22].

Researchers agreed that measuring BIS is important [7, 12]. However, they identified that it is difficult to carry out [7, 12, 18]. Performance may differ depending on perspectives that it is examined. Traditionally, measurement aims to focus on financial aspects, but nowadays researchers consider this method as providing lagging information, which is not actionable [7] because applying a purely financial measurement cause other aspects of BIS (e.g. customers and employees) to be forgotten [7, 20].

5.1.2 Subjective methods for measuring BIS value

Herring (1996) proposed a method that is included four factors on effectiveness of CI: timesaving, cost savings, cost avoidance, revenue enhancement. In his final report, he synthesizes findings resulting from an extensive literature research based on a field survey, which involved interviewing representative practitioners on how the measurement of CI is carried out in practice, and his personal experience as a consultant in CI. [7, 20, 23]. His method was proposed for CIS, however, it is not clear how this method should apply for BIS and how BIS can be measured according this method [7, 20, 23]. Figure 3 illustrates that Herring’s research methodology includes three stages: starting, getting results and test.

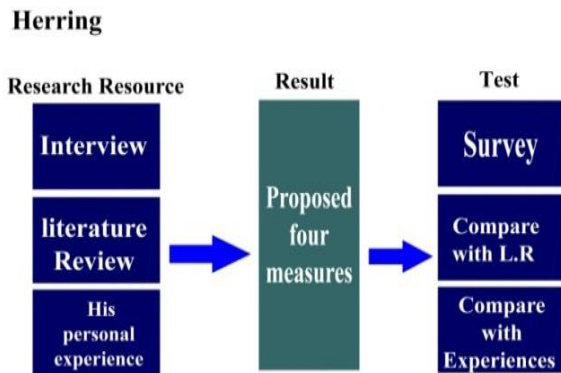


Figure 3: Herring Research Methodology

Sawka (2000) recommended a method that was applied four factors to measure the effectiveness of BIS. He applied Herring research methodology and mentioned that the best way to understand the effectiveness of BIS is evaluating contribution of BIS on a specific decision or action and then,

figuring out the benefits of the decision making by BIS. However, it is also evident that the contribution of BIS is difficult to determine. Therefore, Sawka’s recommended a measurement method that could not measure the value of BIS accurately [7, 12, 20]. His proposed factors for measuring BIS include: first, BI can help to avoid unnecessary costs regarding. Second, decisions based on good BI may lead to enhanced revenues. Third, BI information may help in improving resource allocation decisions and thus maximize investments into the most profitable purposes. Fourth, the direct link between a BI decision and business performance (e.g., stock price or customer satisfaction) could also be measured, although it may be very difficult to do so [7, 12, 20].

Davison (2001) applied subjective measurement to determine the value of CIS; this type of measurement illustrates the effects of BIS based on the customer satisfaction concept. He started his work by doing interviews and reviewing of literatures. He provides measures for evaluating the effectiveness of CIS output, as well as a method for calculating a so-called Return on Competitive Intelligence Investment (ROCI). His proposed ROI-measure is used for calculating a specific CIS project. In capturing the value of CIS output, Davison emphasis on the need to distinguish between strategic and tactical output by quoting Breacher (1999) who asserts, “The CIS profession develops tactical options and strategic directions”. According to Davison, strategic output possesses a forward-looking nature and serves the purpose of

long term planning, whereas tactical output is focused on short-term aims and can be measured directly. Figure 4 shows his assumed concept of CIS outputs measurement.

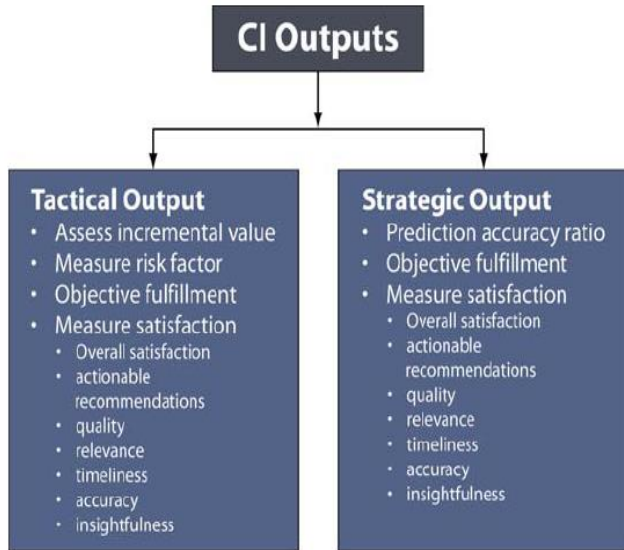


Figure 4: ROCII proposed measures Davison, L. (2001)

The ROCII proposes measures for both strategic and tactical output [13, 20]. The value of CI input can be measured by tracking the costs associated with the particular CI project, including variable costs (such as personnel time, information purchase, materials used and appropriate amount of fixed cost allocation). Having calculated the value of CI inputs and CI outputs (strategic and tactical), the ROCII can be calculated for a specific project, according to the following formula [13, 20]:

$$ROCII = (\text{Output Value [tactical]} + \text{Output Value [strategic]}) / (\text{Total CI Department Cost})$$

Davison states that “the value of strategic output is impossible to evaluate and return on investment should be based on return on projects tactical output” [13, 20]. In addition, Davison method is

used for individual CIS projects. In this method, the CI output is also measured through: assessing effects of objective fulfillment and decision-maker satisfaction. In fact, the value of CI outputs in the ROCII formula is based on qualitative assessments. Therefore, researchers suggest that the ROI calculation based on Davison CIMM can be unreliable for CIS [7, 12, 20, 24]. Additionally, Davison's (2001) proposed CIMM method was applied for CIS however, it is not clear how this method should apply for BIS and how BIS can be measured according CIMM. Thus, Davison proposed method is not suitable for BIS [7, 20, 21]. Another subjective method for measuring BIS is Balanced Performance Measurement (BPM) Frameworks. These frameworks are suggested for identifying measuring factors and components of performance determination. Principles are similar in various balanced measurement frameworks [7, 12, 25], for example; Balanced Score Cards is a usual method from BPM frameworks. In this method, usually four important perspectives of this framework are defined as financial, customer, process, learning and growth [7]. When Herring introduced Balanced Score Cards method in 1996, he did not provide any evidence and details regarding to “how to do it for BIS” [7, 23]. BSC is a very flexible framework, since it provides four basic perspectives including measures that can be designed according to the specific demands of the company. Moreover, corresponding to the demands of measuring, additional custom perspectives can be added to the four perspectives (Kaplan & Norton,

1996)[20]. Even the BSC approach in tandem with all other approaches presented for performance measurement, it cannot solve the methodical problems of researcher purposes of BIS measurement [12, 20]. These problems are rooted in the difficulty of inferring causality[20]. BSC focuses on direct benefits and researchers that have tried to establish a causal relationship to evaluate BIS by examining BIS impacts on business. Consequently, it is difficult to fulfill the criteria of concomitant variation, as cause and effect do not occur together and are often significantly delayed [3, 7, 20].

Additionally, BSC is used for measuring BIS dashboard. BIS dashboard is User Graphic Interface of BIS, which is applied for representing objective of each perspective (financial, customer, process, and learning and growth) in the form of Key Performance Indicator in BIS dashboard [26].

BIS' professionals are the main users of BIS measurement who want to understand the efficiency of available resources allocation, quality of the BIS processes outputs and satisfaction of the system users and effectiveness of BIS in achieving organizational goals [7, 12]. Information Builders a company that produce BI products and services suggested that "in measuring BIS for managing BIS processes, three characteristics of intelligence should be measured: deploying ability, scalability and usability". Nevertheless, these characteristics mainly describe some properties of the software part of BIS, not entire BIS [7].

Dorothy Miller suggested a model of maturity of

BIS [27]. Then, after few years, Popovič (et al) used this model and suggested measurement measure for measuring BIS value; he applied a model, which called BIS maturity model. His proposed measures were used for measuring BIS users' satisfaction by information. In other word he focused on BIS use and user satisfaction by BIS information not all the BIS [3, 28].

Other methods that companies applied for measuring the value of their BIS are as following: comparing the cost of consultants to the results obtained by the CIS division, quantifying the strategies, deals that the CIS team that has been involved and compares the win/loss ratios to those deals where they were not involved [7, 12]. These methods are for measuring individual CIS project and are not suitable for BIS [3, 7, 20, and 21].

5.2. Measuring Methods for Managing BIS Process

In the case of managing BIS process, the BIS professional is the key user of the measurement information. The aim is the efficient production of valuable intelligence for the specific needs of the users and again they focused more on the determining valuably of BIS processes [3, 7, 19, 20]. In the literature, especially in the subjective methods, measurement for managing BIS process has not been discussed as much as measuring the effects of BIS. A large part of the current measures found in the literature focuses on proving the value of BIS. Of course, CIMM is useful for both managing the BIS process and measuring the effects of BIS. The main difference is in the purpose of

measurement, Furthermore, this method had own problematic area in measuring value of BIS therefore, the result could not be reliable for managing BIS process [3, 7, 19, 20].

6. Critics of current BIS measurement methods

This study critically reviewed prior works related to BIS measurement in literates. During sections 5.1 and 5.2, the critical area of previous methods was explained. TABLE 2 illustrates a summarized list of current BIS measurement methods. This table contains method name, method type (subjective/objective), goal of method and description about its problematic area.

Table 2: Summary of current BIS measurement methods

Method	Type	Goal	Critic
ROI	Obj.	Measuring Value	<p>These methods are typically used in assessing monetary value of any investment. The main problem of these methods for measuring BIS is related to BIS output. BIS output is intelligence; intelligence is kind of processed information and it is extraordinarily difficult to quantify information and measure the value of BIS accurately [3, 7, 20, 22].</p> <p>Applying a purely financial measurement cause other aspects of BIS to be forgotten [7, 20].</p>
Net present value	Obj.	Measuring Value	
Payback period	Obj.	Measuring Value	

CIMM	Subj.	Measuring Value Managing BIS Process	<p>CIMM is for individual CI projects and in addition measuring of CIS outputs in this model is mainly qualitative and the model emerges that the ROI calculation can be unreliable [7, 12].</p> <p>Davison states that “the value of strategic output is impossible to evaluate and return on investment should be based on return on projects tactical output”. In addition, The fact that the value of CI outputs in the ROCII formula is based on qualitative assessments and quantifying it is difficult (Buchda, 2007; L. Davison, 2001).</p> <p>Davison's (2001) proposed CIMM method was applied for CIS however, it is not clear how this method should apply for BIS and how BIS can be measured according CIMM. Thus, Davison proposed method is not suitable for BIS [7, 20, 21].</p> <p>CIMM is useful for both managing the BIS process and measuring the effects of BIS. The main difference is in the purpose of measurement, Furthermore, this method had own problematic area in measuring value of BIS therefore, the result could not be reliable for managing BIS process [3, 7, 19, 20].</p>
Herring Method	Subj.	Measuring Value	<p>His method was proposed for CIS, however, it is not clear how this method should apply for BIS and how BIS can be measured</p>

			according this method[7, 20, 23].
Sawka	Subj.	Measuring Value	Sawka's recommended measurement method could not measure the value of BIS accurately [7, 12, 20]. His proposed factors for measuring BIS include: First, BI can help in avoiding unnecessary costs regarding. Second, decisions based on good BI may lead to enhanced revenues. Third, BI information may help in improving resource allocation decisions and thus maximize investments into the most profitable purposes. Fourth, the direct link between a BI decision and business performance (e.g., stock price or customer satisfaction) could also be measured, although it may be very difficult to do so. [7, 12, 20].
BSC	Subj.	Measuring Value	<p>BSC method is mainly a quality comparing method and measures were predefined in this method by researcher and these measures were not satisfactory. And these predefined measures were for individual CI system project and it is not suitable for BIS due to the difference between BIS and CIS.</p> <p>BSC approach, in tandem with all other approaches presented for performance measurement cannot solve the methodical problems of researcher purposes of BIS measurement[12, 20].</p> <p>BSC focuses on</p>

			<p>direct benefits and researchers have tried to establish a causal relationship to evaluate BIS by examining BIS impacts on business. Consequently, it is difficult to fulfill the criteria of concomitant variation, as cause and effect do not occur together and are often significantly delayed [3, 7, 20].</p> <p>Additionally, BSC is used for measuring BIS dashboard. BIS dashboard is User Graphic Interface of BIS which is applied for representing objective of each perspective (financial, customer, process, and learning and growth) in the form of Key Performance Indicator in BIS dashboard[26].</p>
Info. Builders Method	Subj.	Managing BIS Process	This method mainly describes some properties of the software part of BIS not entire BIS
Popovič measure	Subj.	Measuring BIS value	His proposed measures were used for measuring BIS users' satisfaction by information. In other word he focused on BIS use and user satisfaction by BIS information not all the BIS

The review of other researches and practical works illustrates that currently there is no reliable method for measuring BIS value and measuring BIS for helping in managing process. A reliable measurement method helps organization in understanding the value of BIS in order to prove that the investment is worthy. In addition, reliable measurement method helps organization in managing BIS process in order to efficiently

produce valuable intelligence for the specific needs of the users [3, 5, 7, 18].

7. Applying IS success models for measuring BIS Success and Concept of BIS Success

As mentioned before, BIS measurement serve two main purposes: first, proving that BIS investment is worth [3, 7] and the second purpose is to help managing the BIS process; i.e., to ensure that the BIS products satisfy the users' needs and it is efficient [3, 7, 23, 29].

Through studying the IS measurement literatures, researcher found that IS success models were used to understand the value of IS and efficiency of IS management actions in the area of IS measurement. Therefore, IS researchers focused on IS success for proving IS investment and managing IS [30-35]. BIS is an IS, therefore, measuring BIS success can be used for understanding BIS value and manage BIS process.

Information is the basis of economic decisions within the whole value chain, making enterprises dependents on the implementation of modern IS to stay competitive [36] by enabling real-time data access or providing business intelligence. Measuring that what makes an IS successful is important. However, no consensus among practitioners and academics exists on how to measure the success of IS [33]. Measuring BIS success (BIS as an IS) poses a challenge to researchers since it has a wide variety definitions depending on the perspective of evaluation [32]. Therefore, a multidimensional success model is

necessary to capture all stakeholders' perspectives [30, 32, 33].

Many IS success models have been developed, complicated the validation and comparison of the antecedents in IS success [32, 33]. However, previous research on IS success has proposed three models to be explored by Sebastian (2013), and one IS success model was introduced by Seddon (1997) and explored by David (2000). Therefore, IS success model in the literatures has found to be predominant; the IS success model that proposed by DeLone and McLean (D&M success model) [30] is the most widely used IS success model [32], which updated D&M success model [31], as well as the Technology Acceptance Model (TAM) [34]. Additionally, it was generally applied in the context of IS adoption [32, 33], and Seddon model of IS success (1997) [33, 35].

Studding on IS success models, the D&M success model [30], the updated D&M success model [31], and TAM [34] and Seddon IS success model [32, 37] helped researcher in understanding the IS success dimensions and criteria.

Review of multi-dimensional IS success measurements and models clarifies the D&M success models that still enjoy huge popularity. By now, the majority of IS success researches has switched to the updated D&M success model that were published in 2003 [33].

In this study, researcher follows updated D&M IS success model. According to D&M model and definition of success, successful Information System is a high quality information system, which

it is highly used by users and satisfies users. In addition a successful IS helps organization in achieving its goals [31, 33].

User satisfaction is used as a surrogate measure of IS success [31, 33, 38, 39]. The previous studies of IS show that user satisfaction is correlated with system quality and service quality [40], it means that user satisfaction increase when IS has high quality. In order words, D&M explained high quality of IS (high quality system, high quality services and high quality information) that are associated with high user satisfaction and lead to positive net benefits, this makes to call IS successful. On the other hand, low quality IS (low quality system, low quality services and low quality information) causes low user satisfaction and negative net benefits and this makes to called IS unsuccessful (ineffective) [31, 33].

According to the D&M updated model, IS quality depends on three dimensions (IS information quality, which are provided by IS data management system, system quality of IS that implemented, and IS services quality, which are provides by IS) [31, 33]. Therefore, a successful BIS is the BIS that provides high quality system, high quality services and high quality information that highly be used by users and satisfied users which causes positive net benefits.

8. Importance of Metrics and Measures for Measuring BIS Success

Before starting to measure BIS, the specific measurement matrices of BIS must be defined.

Terms metrics and measures are used sometimes interchangeably. Despite of this misuse, there are semantic differences between these two concepts. Understanding the difference of these terms, especially in the IS and BIS context, is helpful to create a reliable method. National Institute of Standards and Technology (NIST) of United States declares that the terms measure and metric have overlap “Measure is mostly use for more concrete or objective attributes but usage of metric is for more abstract, higher-level, or subjective attributes [41]”. Measure is a value that is gained with quantifying this value against a standard at a specific point in time [42]. For example, body temperature, blood pressure, total number of data packet that received by a node in a second and total RFID tags that a RFID reader can read in a second. Therefore, result of measure is quantity. However, metric is the quality degree in particular subject. Metric is based upon two or more measures [42]. Normally, a metric includes some measures and result of this metric is achievable through measuring the measures. For example: health is a metric it means that body is healthy when body temperature is 37.0 °C (98.6 °F), blood pressure is normal (below 120 over 80) and some other measures show normal quantified results, therefore, the body is healthy. Metric is mainly used for more abstract, higher-level, and subjective attributes measurement, so the result of metric is quality.

Therefore, for measuring BIS success discovering proper metrics and measures are necessary. Exploring these metrics and measures helps

organization in measuring their BIS in order to understand value of BIS and managing BIS process.

9. Conclusion

This study analytically reviewed prior researches on BIS measurement in order to understand their critics. Understanding critics and gaps of prior works and studding on IS measurement literatures led this study to propose IS success measurement methods for measuring BIS success. Therefore, for measuring BIS success this study defined concept of BIS success. Thus, the study explained the importance of extracting proper metrics and measures in order to measuring BIS success.

References:

- [1] Arnott, D.a.P., G., A critical analysis of decision support systems research. *Journal of Information Technology*, 2005. 20(2): p. 67-87.
- [2] Jourdan, Z., R.K. Rainer, and T.E. Marshall, *Business Intelligence: An Analysis of the Literature*. *Information Systems Management*, 2008. 25(2): p. 121-131.
- [3] Popovič, A., T. Turk, and J. Jaklič, Conceptual model of business value of business intelligence systems. *Konceptualni model poslovne vrijednosti sustava poslovne inteligencije*, 2010. 15(1): p. 5-29.
- [4] Williams, S.W., N., *The Profit Impact of Business Intelligence*. Morgan Kaufmann, 2007.
- [5] Okkonen, J., Pirttimäki, V., Hannula, M., & Lönnqvist, A, *Triangle of Business Intelligence, Performance Measurement and Knowledge Management*. IInd Annual Conference on Innovative Research in Management, May 9-11, Stockholm, Sweden., 2002.
- [6] Moss, L.T., & Atre, S. (2003). *Business Intelligence Roadmap: The Complete Project Lifecycle for Decision-Support Applications*: Addison-Wesley Professional. 2003.
- [7] Lonnqvist, A. and V. Pirttimaki, The measurement of business intelligence. *Information Systems Management*, 2006. 23(1): p. 32-40.
- [8] AB Sangar, N.B. A.Iahad, Critical Factors That Affect The Success Of Business Intelligence Systems (BIS) Implementation In An Organization. *INTERNATIONAL JOURNAL OF SCIENTIFIC & TECHNOLOGY RESEARCH*, 2013. 2(2).
- [9] Marchand, D.A., Kettinger, W. J., & Rollins J. D, *Information Orientation: The Link To Business Performance*. Oxford University Press, 2002.
- [10] Jorge García, K.B.K., *Business Intelligence and Data Management Buyer's Guide*. *Technology Evaluation Centers*, 2012. 1: p. 8-43.
- [11] Jorge García, R.A., *Technology Evaluation Centers, 2011 business intelligence buyers guide: "bi for everyone"*. *Technology Evaluation Centers*, 2011. 1: p. 5-15.
- [12] Popovič, A.T., T. Jaklič, J., Conceptual model of business value of business intelligence systems. *Konceptualni model poslovne vrijednosti sustava poslovne inteligencije*, 2010. 15(1): p. 5-29.
- [13] Davison, L., *Measuring competitive intelligence effectiveness: insights from the advertising industry*, in *Competitive Intelligence Review*. 2001. p. 25+.
- [14] McGonagle, J.J.a.V., C.M., *Bottom Line Competitive Intelligence*, ed. C.Q.B. Westport. 2002.
- [15] Davenport, T.H., & Short, J. E., *Information technology and business process redesign*. *Operations Management: Critical Perspectives on Business and Management*. 2003. 1: p. 1-27.
- [16] Cooter, M. "88% of businesses have not defined what they want from BI." 2009; Available from: (<http://www.computerworlduk.com/technology/business-intelligence/analytics/news/index.cfm?newsid=17169>).
- [17] Computerworlduk. *two-out-of-three-bi-projects-fail-claims-survey*. 2012.
- [18] Hannula, M., & Pirttimäki, V, *Business Intelligence - Empirical Study on the Top 50 Finnish Companies*. *Journal of American Academy of Business*, 2003. 2(2): p. 593-600.

- [19] Pirttimäki, V., Lönnqvist, A and Karjaluoto, A Measurement of Business Intelligence in a Finnish Telecommunications Company. The Electronic Journal of Knowledge Management 2006. 4(1): p. 83-90.
- [20] Buchda, S., Rulers for Business Intelligence and Competitive Intelligence: An Overview and Evaluation of Measurement Approaches. Journal of Competitive Intelligence and Management, 2007. 4(2).
- [21] Davison, L., Measuring Competitive intelligence Effectiveness: Insights from the Advertising Industry. Competitive intelligence Review. Vol. 12. 2001.
- [22] Kilmetz, K., Bridge, R. S, Gauging the Returns on Investments in Competitive Intelligence:A Three Step Analysis for Executive Decision Makers, Competitive Intelligence Review. 1999. 10(1).
- [23] Herring, J., Measuring the Value of Competitive Intelligence: Accessing & Communication CIs Value to Your Organization: SCIP Publications. 1996.
- [24] 2Planning For Productivity. 2008, NP Communications, LLC. p. 32-37.
- [25] Lonqvist, A., measurement intangible success factors: case study on design implementation and use of measures. 2004, Tampere University of Technology: Tampere
- [26] Stefano Tonchia, L.Q., Performance Measurement: Linking Balanced Scorecard to Business Intelligence. 2010: Springer.
- [27] Miller, D., Measuring Business Intelligence Success: A Capability Maturity Model. 2007.
- [28] A. Popovič, R.H., Pedro Simões Coelho, Jurij Jaklič, Towards business intelligence systems success: Effects of maturity and culture on analytical decision making. Decision Support Systems 2012. 54: p. 729–739.
- [29] Keil, O., Business Intelligence. Facility Care, 2011. 16(4): p. 8.
- [30] DeLone, W.H., McLean, E.R., Information Systems Success: The Quest for the Dependent Variable. Information Systems Research, 1992. 3(1): p. 60-95.
- [31] Mclean, W.H.D.a.E.R., The DeLone and McLean Model of Information Systems Success: A Ten-Year Update. Journal of Management Information Systems 2003. 19(4): p. 9-30.
- [32] Urbach, N., Smolnik, S., Riempp, G: , The State of Research on Information Systems Success - A Review of Existing Multidimensional Approaches. . Business & Information Systems Engineering, 2009. 1(4): p. 315-325.
- [33] Sebastian Dorr, S.W., and Torsten Eymann, Information Systems Success - A Quantitative Literature Review and Comparison, in 11th International Conference on Wirtschaftsinformatik. 2013: Leipzig, Germany.
- [34] Davis, F.D., Perceived Usefulness, Perceived Ease of Use, and User Acceptance of Information Technology. MIS Quarterly, 1989. 13(3): p. 319-340.
- [35] David Kurian, R.B.G., Justo Diaz, TAKING STOCK: MEASURING INFORMATION SYSTEMS SUCCESS, in ASAC-IFSAM Conference. 2000: Montreal, Quebec Canada.
- [36] Al-adaile, R.M., An Evaluation of Information Systems Success: A User Perspective - the Case of Jordan Telecom Group. . European Journal of Scientific Research, 2009. 37(2): p. 226-239.
- [37] Song, C. Validating IS Success Factors: An Empirical Study on Webbased State or Local E-government Systems. In: Santana, M., Luftman, J.N., Vinze, A.S. (eds.). in 16th Americas Conference on Information Systems. Association for Information Systems 2010. USA.
- [38] Melone, N.P., A Theoretical Assessment of the User-Satisfaction Construct in Information Systems Research. Management Science, 1990. 36: p. 76-91.
- [39] Gatian, A.W., Is user satisfaction a valid measure of system effectiveness?Information & Management, 1994. 26(3): p. 119-131.
- [40] Masrek, M.N.b., Measuring campus portal effectiveness and the contributing factors. Campus-Wide Information Systems, 2007. 24(5): p. 342-354.
- [41] NIST, Metrics and Measures. http://samate.nist.gov/index.php/Metrics_and_Measures.html, 2011([9/6/2011 12:34:20 AM]).
- [42] ITtoolbox, Measures, Metrics, and Indicators. <http://it.toolbox.com/blogs/dw-cents/measures-metrics-and-indicators-23543>, 2011([9/6/2011 10:34:20 AM]).

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