

THE MEASUREMENT OF BUSINESS INTELLIGENCE

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Based on a literature review, this article identifies and assesses measurement approaches for two different purposes: determining the value of BI and managing the BI process within an organization.

IN TODAY'S RAPIDLY CHANGING business environment, the need for timely and effective business information is recognized as essential for organizations not only to succeed, but even to survive. In this article, business intelligence (BI) refers to a managerial philosophy and a tool used to help organizations manage and refine business information with the objective of making more effective business decisions (Ghoshal and Kim, 1986; Gilad and Gilad, 1986). The term BI can be used to refer to:

1. Relevant information and knowledge describing the business environment, the organization itself, and its situation in relation to its markets, customers, competitors, and economic issues
2. An organized and systematic process by which organizations acquire, analyze, and disseminate information from both internal and external information sources significant for their business activities and for decision making.

Several related terms include competitive intelligence (CI), market intelligence, customer intelligence, competitor intelligence, strategic intelligence, and technical intelligence. In North American literature, the term CI is frequently used and the external environment and external information sources are emphasized (e.g., Cottrill, 1998; Fuld, 1995; Kahaner, 1996; Vibert, 2004). In European literature, the term BI is considered a broad umbrella concept for

CI and the other intelligence-related terms mentioned above. Nevertheless, almost all the definitions share the same focus, even if the term has been defined from several perspectives (Casado, 2004), and they all include the idea of analysis of data and information.

The purpose of BI is to aid in controlling the vast stocks and flow of business information around and within the organization by first identifying and then processing the information into condensed and useful managerial knowledge and intelligence. As such, the BI task includes little that is new and addresses very old managerial problems; it is one of the basic tasks of many management tools; that is, analyzing the complex business environment in order to make better decisions. As Gilad and Gilad (1986) have stated, organizations have:

collected information about their competitors since the dawn of capitalism. The real revolution is in the efforts to institutionalize intelligence activities.

BI presents business information in a timely and easily consumed way and provides the ability to reason and understand the meaning behind business information through, for example, discovery, analysis, and ad hoc querying (Azoff and Charlesworth, 2004).

The BI literature suggests that much benefit can be derived from using BI (e.g., see Thomas, 2001). However, applying BI takes resources, and the benefits actually occurring in practice

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are not always clear. This article examines the measurement of BI for assessing the effects of BI activities as well as for assessing an organization's BI process.

The measurement of business performance has long traditions in organizations. In the BI literature, authors have identified BI measurement as an important task (Solomon, 1996; Viva Business Intelligence Inc., 2000), but a common view among scholars is that it is difficult to carry out (Gartz, 2004; Hannula and Pirttimäki, 2003; Simon, 1998). According to a recent survey, only a few organizations have any metrics in place to measure the value of BI (Marin and Poulter, 2004).

The objectives of this article are:

- To determine the major purposes of BI measurement
- To identify what types of measures are being used
- To evaluate the current measures and suggest how the measurement of BI could be improved.

The literature reviewed for this study includes publications on BI (and CI) and also literature on business performance measurement. An overall finding is that, in practice, the way BI is applied in different companies varies a lot. For one company BI may mean single-market research projects, whereas for another company it could mean a continuous process that produces various BI products and services that are used by several people. Case-specific issues are also likely to have an effect on how BI can be measured. In this article, BI is understood to be a systematic activity producing BI products and services. When there is a need to actively improve BI activities or to determine the usefulness of BI products and services, measurement is a potential tool.

WHY DO ORGANIZATIONS MEASURE BUSINESS INTELLIGENCE?

An important issue in determining how and what to measure is knowing the purpose of the measurement (Brooking, 1996; Sveiby, 1997). According to Simons (2000), performance measurement can be used for the following purposes: decision making, control, guidance, education and learning, and external communication. The user of the measures should also be taken into account.

According to the literature, BI measurements serve two main purposes. The first and most common reason for measuring BI is to prove that it is worth the investment (e.g., Sawka, 2000). Davison (2001) points out that CI managers need measures to justify their department's existence. Similarly, executives need to know whether it is rational for them to invest in BI, because it is still a rather new managerial discipline. Moreover, the BI literature includes a lot of unverified assumptions about the effects of BI. For example, Kelly (1993) obtained empirical evidence regarding the value of BI as estimated by practitioners. According to his study, the estimated average payback of all BI projects is 310 percent of cost, which seems quite high.

The second main purpose for the measurement of BI activities is to help manage the BI process: that is, to ensure that the BI products satisfy the users' needs and that the process is efficient (Herring, 1996). Namely, a BI process can be costly if the information gathered is not accurate or does not match the information needs. The users of a BI process measurement are likely to be the BI professionals in an organization and the typical measurement intent (e.g., guiding activities and learning) is to continually improve the BI products and services.

Table 1 provides a summary comparison of BI measurement for these two different purposes.

TABLE 1 Two Types of BI Measurement

Purpose for Measurement	Main Users of Measurement Information	Expected Benefits
Determining the value of BI	Executives justifying BI investments BI professionals BI service providers Researchers	Ability to cost-justify BI services and demonstrate the actual effects of BI Increased credibility of BI as a managerial tool Improved rigor in BI research
Managing the BI process	BI professionals BI service providers	Continuous improvement of BI products and services

The CIMM identifies various nonfinancial measures of tactical and strategic outputs, which can be considered quite useful in determining how successful the different aspects of a CI project have been.

CURRENT MEASUREMENT APPROACHES

Measures for Determining the Value of BI

Before discussing measuring the value of BI, we present a few observations on the concept of *value* in this context. First, one may pose the question: value for whom? The perceived value of some intelligence product, for example, is likely to vary depending on the subjective appreciation and need of the person(s) for whom the question is addressed. In the following discussion, value is assessed from the viewpoint of a company using BI (e.g., improved profit) or of the user of the intelligence (perceived usefulness). Second, it may even be suggested that BI has no value at all as such — that is, the value is created as a result of using the intelligence, by carrying out actions based on it. Kelly (1993) has also recognized the conditional nature of the value of BI: as one of his survey respondents stated, information must be integrated into a decision in order for its value to be assessed.

Keeping in mind the discussion above, the assessment of the value of BI requires that two main questions be answered:

1. How much does it cost to apply BI?
2. What are the benefits of applying BI?

A BI process takes operational resources; in addition, an initial capital investment is likely when BI is first implemented. Calculating the cost of BI (Davison, 2001) requires calculating labor costs, information purchases, and other expenses related to the BI activities. A method called total cost of ownership (TCO) can be used to identify all relevant costs related to an activity (Degraeve et al., 2004).

Measuring the benefits of BI is not as simple as measuring the cost. Many of the effects that BI is assumed to create consist primarily of nonfinancial, and even intangible, benefits such as improved quality and timeliness of information (Hannula and Pirttimäki, 2003; Nelke, 1998). Although the nonfinancial effects should lead to financial outcomes (e.g., cost savings), there may be a time lag between the production of the intelligence and the financial gain. Therefore, measurement in practice is quite difficult.

A typical method for assessing the monetary value of any investment is to calculate the return on investment, ROI. The problem in calculating the ROI for BI is that the output of the BI process is intelligence; in other words, some kind of processed information. The value of information is very difficult to assess (Kilmetz

and Bridge, 1999). Other methods for measuring financial value (such as net present value or payback period) also require determining the value of BI output, which is problematic.

In spite of the difficulties, Davison (2001) has developed a measurement model called CI Measurement Model (CIMM) that can be used to calculate the return on CI investment (ROCI). The value of CI is assessed for individual CI projects and the CI output is measured by assessing effects such as objective fulfillment and decision-maker satisfaction. The incremental value CI adds to a decision should be assessed in monetary terms. The input is calculated as a cost of carrying out the project. Thus, ROCI can be calculated using the following formula:

$$\text{ROCI} = (\text{CI outputs} - \text{CI inputs}) / \text{CI inputs}$$

The CIMM identifies various nonfinancial measures of tactical and strategic outputs, which can be considered quite useful in determining how successful the different aspects of a CI project have been. For example, Davison (2001) suggests that a measure of a CI project's output could be simply a comparison of whether the targets set at the beginning of the project have been met. However, that is a measure of the project — not of the effects of the project. Furthermore, the fact that the value of CI outputs in the ROCI formula is based on qualitative assessments suggests that the ROI calculation can be unreliable.

Herring (1996) has identified four measures of the effectiveness of CI: time savings, cost savings, cost avoidance, and revenue enhancement. However, it is not clear how these effects can be measured. For example, it may be difficult to distinguish which cost savings or new revenues result from BI and which result from some other, unrelated, managerial actions.

According to Sawka (2000), the effectiveness of BI is best measured by evaluating the contribution of BI to a *specific* decision or action and then looking at the benefit or detriment this specific decision brought to the company. His four measurable benefits are similar to those of Herring. First, BI can help in avoiding unnecessary costs regarding, for example, product development investments. 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.

Sawka's examples of how to measure the effects mentioned above are in the form of short case descriptions of specific projects. For example, in one pharmaceuticals company as much as \$600 million of additional revenues were derived from more effective marketing strategies designed in part through good BI. This example illustrates the importance of the decisions BI is used for. However, it is also evident that the contribution BI brings is difficult to determine. One might even argue that the above-mentioned example says little or nothing about the effects of the BI process — it is possible that a similar, better, or worse result would have been achieved if BI had not been utilized.

An alternative approach that may reveal the effects of BI more accurately is subjective measurement of effectiveness. It is based on the concept of perceived customer (here, the decision maker) satisfaction (Davison, 2001). In practice, the users of BI products are asked questions regarding the effectiveness of the products. The questions may relate, for example, to how much the confidence of the decision makers has increased as a result of the additional information provided by BI and the users' satisfaction regarding the insightfulness or the timeliness of the intelligence. A positive aspect of subjective measurements is that the results show how effective the users consider the intelligence products. However, subjective measurements do not provide evidence of any monetary value of the effects of BI.

The results of a survey carried out by Marin and Poulter (2004) include descriptions of how companies actually measure the value of their CI activities. One company compares the cost of consultants to the results obtained by the CI division. Another company quantifies the strategic deals that the CI team has been involved in and compares the win/loss ratios to those deals where they were not involved. In one case, the use of CI was measured using statistics on requests for information from a database of competitor information.

Measures for Managing the BI Process

As a managerial tool, performance measurement can be used in many ways. Traditionally, measurements have been used to show whether an organization's various processes meet the predetermined quality and efficiency criteria. Measures are also used to guide employees to focus their efforts on areas identified as most

important. Based on these descriptions, performance measurement can be characterized as a versatile tool for improving the quality of business processes. Therefore, it is rational to also consider using performance measurement in the context of managing the BI process.

In the literature, measures for managing the BI process have not been discussed as much as measuring the effects of BI. Of course, the effects of BI are created as a result of the BI process and thus are related. Of the measures presented in the previous section, Herring's four measures of the effectiveness of BI, total cost of ownership, and subjective measurements of effectiveness also seem useful for managing the BI process. The main differences are that, in the case of BI process management, the BI professional is the main user of the measurement information and the goal is to efficiently produce valuable intelligence for the specific needs of the users. Therefore, among the issues that are the most important are the efficiency of the BI personnel, effective allocation of available resources, quality of the BI products produced, and the satisfaction of the users.

Similarly, Davison's (2001) CIMM framework is mainly intended to assess the effects of BI, but the measures proposed can also be useful from the point of view of managing the BI process. For example, the measurement of user satisfaction regarding quality, relevance, timeliness, action ability, and the accuracy of the information produced provides insight into the quality of the BI products and services (produced by the BI process). Looking back at suggestions and predictions made based on BI, and assessing how accurate they have been, makes it possible to assess the reliability of the BI products (assessment of prediction rate). Further, the CIMM framework, which assesses the success of individual BI projects, provides information on which types of projects have been successful and why, and vice versa. This information can be used as a learning tool when designing future BI projects.

Information Builders, a provider of BI products and services, suggests that three characteristics of intelligence should be measured (Information Builders, 2004): deploying ability, scalability, and usability. These characteristics mainly describe the properties of the BI software being used; for example, how people with different needs and skills can utilize the software.

Williams and Williams (2004) have presented a method called "BI readiness assessment."

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which can be used to determine an organization's ability to utilize BI; for example, continuous improvement culture, information or analytics culture, and technical readiness. The data is collected with a qualitative survey. Other ways of measuring intelligence utilization seem easy to generate. For example, it seems possible to measure the proportion of managers that use BI tools or measure how often the BI tools are reviewed. According to a survey by Marin and Poulter (2004), some organizations have undertaken efforts to capture user access of competitive intelligence that is gathered and distributed by electronic means.

Measurement can also be used as a tool in guiding the execution of individual BI projects while they occur. Hoadley (2004) has proposed a method he names the "Hoadley suite" for determining whether a necessary amount of data has been captured and for evaluating the cost of additional data collection. His method is based on assessing the completeness of the data (have all relevant aspects been covered?) and the timeliness of the data (is the data current?). Combining these two viewpoints makes it possible to assess the degree to which the data intended to be captured has already been captured. The method relies on qualitative assessments made separately regarding different data sources. This facilitates focusing BI activities on areas where much of the data has not yet been captured. Hoadley (2004) assumes that as the percentage of captured data increases, the cost of carrying out additional data collection increases in a linear relationship. Thus, the cost realized at a certain point of the project can be used to estimate how much the additional data collection will cost.

BUSINESS PERFORMANCE MEASUREMENT

Balanced View of Performance

Business performance measurement is an active research field, yielding a large number of publications annually (Neely, 1999). New practical solutions for applying measurements in various situations are also constantly introduced. Considering BI to be a similar activity to or a process like any other business process makes it possible to also discuss the application of the methods of business performance measurement in the context of BI.

The definition of performance is a good starting point when discussing performance measurement in the context of BI. Most authors in the field consider performance to be a

complex issue in which a measurement object's performance is examined from several different points of view (Kaplan and Norton, 1996; Neely et al., 2002). Performance may differ depending on the perspectives from which it is examined. The traditional way of measuring only financial phenomena is nowadays considered as providing lagging information that is not actionable. In addition, with purely financial measurement, issues that are important for many stakeholders (e.g. customers and employees) are neglected.

The balanced performance measurement frameworks can be used to identify the factors to be measured and, at the same time, to define the components used to determine performance. The main principles are usually similar in different balanced measurement frameworks (Lönqvist, 2004; Tuomela, 2000). First, performance measures are chosen based on the organization's vision and strategy. Second, success factors are chosen from several perspectives (e.g., the shareholder's and customer's) to provide a balanced and holistic view of the organization and other factors affecting its success. Third, measurement is focused on a limited number of critical success factors. Fourth, the measurement system is designed in such a way that there are causal relationships between the success factors. Fifth, the measurement system can be used as a tool in communicating and implementing strategy.

The most commonly used balanced performance measurement framework is the Balanced Scorecard. Usually, the four measurement perspectives of the framework include financial, customer, process, and learning and growth perspectives (Kaplan and Norton, 1996). Another, more recent, measurement framework is the Performance Prism. The prism shape represents the complexity and the different aspects of organizational performance. The Performance Prism of Neely et al. (2002) consists of five facets. The top and the bottom of the prism focus on the organization's stakeholders. The questions regarding stakeholder satisfaction and contribution are (1) Who are our key stakeholders and what do they want and need? and (2) What do we want and need from our stakeholders on a reciprocal basis? After these questions have been answered, the next step is to consider what strategies are required to satisfy the needs and achieve the contribution of the stakeholders. The next phase is to consider what processes must be put in place to enable the execution of the strategies. Finally, one

should consider what capabilities are required to allow the operation of the processes.

It also seems possible to use the idea of balanced performance measurement in the context of BI. For example, Herring (1996) suggests the Balanced Scorecard approach but does not go into detail regarding how to do it. There are many ways to design a balanced performance measurement system for BI, depending on the framework chosen. In practice, the measurement systems should be tailored according to the needs of the specific situation. Thus, only a general presentation of one possible approach will be presented in the following section.

Performance of a BI Process — What Should Be Measured?

The literature presents several BI process models. According to Pirttimäki and Hannula (2003), the biggest differences among them are the number of phases, structure of cycles, sources of information, storage methods of information, and type of information gathered.

A typical example of a four-phase BI process model includes the following related phases:

1. Identification of information needs
2. Information acquisition
3. Information analysis
4. Storage and information utilization

In the first phase, the organization must find out what kind of business information is necessary to resolve different problems and to make successful decisions. This ensures that only relevant information is utilized in decision making. The second phase, information acquisition, is driven by the business information needs and is considered a complex function because there are many different sources of information both inside and outside an organization.

In the third phase, acquired information is analyzed and then packaged into different information products and services. The products and services are aimed at an organization's different user groups and information needs. Concerning the storage aspect of the last phase, the goal of a BI system is to make it possible for the decision makers to find the required business information as quickly as possible. Before the processed information can be utilized, information must be communicated to the critical decisions makers and disseminated at the right time with suitable tools. The main goal of the fourth phase is to share the knowledge analyzed in decision-making processes. In addition, the

utilization phase cannot be effective if one of the earlier phases in the BI cycle has failed. Therefore, feedback is critical to optimize each phase of the BI cycle.

To define the performance of the BI process and find out which aspects of BI should be measured, the Performance Prism approach is applied to the BI process in four steps below.

Step 1: Stakeholders' Satisfaction and Contribution.

The first questions to ask are: Who are the key stakeholders of the BI process? and What do they want and need? Another question to ask is: What does the BI process need from these stakeholders on a reciprocal basis? The two key stakeholders of a BI process include the users of the intelligence and the financial sponsor or manager of the BI activity (e.g., the chief financial officer). User satisfaction requires that users have useful information that is accurate, relevant, and timely. An effective BI process requires the definition of information needs by the users. In addition, to be able to derive any benefits from BI, users must actively utilize the intelligence. The sponsor of the BI activity wants concrete benefits (e.g., cost savings) to be achieved using BI and costs to be low. On the other hand, the BI process requires adequate resources and managerial support in order to function.

Step 2: BI Strategy. The second step to consider is what strategies are required to satisfy the needs and ensure the contribution of the stakeholders identified. This deals with choosing how to try to achieve the goals related to the users of the intelligence. The following steps are determined based on the decisions made in this phase. For the purposes of this example, we shall assume that the four-phase BI process described above will be used as the strategy for achieving the goals of BI.

Step 3: BI Process. The next step is to consider how to run the process to achieve the goals. It is possible to assign objectives to each phase of the BI process. For example, the criteria for the "identification of information needs" phase include efficiency of the identification procedure and relevance, amount, and necessity of needs identified. Similarly, the criteria of an efficient and effective "information acquisition" phase include costs of gathering information, reliability and quality of information compiled, and scope and timeliness of the information collection procedure. For "information analysis," they include reliability and

The first and probably most common way is to use a direct measurement approach and objective measures.

accuracy of analysis, elimination of useless information, quality of information analyzed, and time and costs associated with the analysis. Finally, the criteria for an efficient and effective "storage and information utilization" phase include accuracy of the knowledge, usability and costs of the knowledge storage tools, efficiency and cost of knowledge dissemination, and time savings and benefits achieved by the BI process.

Step 4: Capabilities. The final step to consider is which capabilities are required to be in place to allow the operation of the processes. Capabilities could include the resources available, the BI personnel's competencies, and the availability of suitable information technology. Naturally, the capability requirements are strongly related to the particular phase of the process in question; for example, the amount of time and money or the suitability of technologies and skills available for information acquisition.

It is also possible to identify various success factors of the BI process phases and then define the performance measures of each factor. This is discussed in the following section. It should be noted that some phases have overlapping success factors and not all of the factors should necessarily be measured. For example, in balanced business performance measurement, only the most important factors are measured (see Kaplan and Norton, 1996).

Designing BI Performance Measures

After we have identified the BI process success factors to be measured, we can define performance measures. Performance measures are usually designed for a specific situation, although some measures are quite standard (e.g., ROI). Performance measures should be valid, reliable, relevant, practical, and well suited to the particular measurement situation (Hannula, 1999; Lönnqvist, 2004; Neely et al., 2002). According to Kaydos (1999):

anything can be measured to a useful degree, especially in a business environment. The real question is not whether something can be measured, but whether it is worth the effort and money to do so.

There are also different ways to measure a particular factor. For example, Figure 1 shows different ways of measuring the "Effects of Intelligence Produced." The first and probably most common way is to use a *direct* measurement approach and *objective* measures. One

example is to quantify the strategic deals that the BI (CI) team has been involved in and compare the win/loss ratios to those deals in which they were not involved — an example mentioned earlier. A second way would be to design a *direct* and *subjective* measure, such as by asking managers to assess the effect of BI on their decision making.

However, direct measurement is not always feasible. Indirect measurement (Kaydos, 1999) can be carried out by first identifying a factor that is somehow associated with the primary factor and then measuring it. For example, "Utilization of Intelligence" is an indirect factor related to the "Effects of Intelligence Produced" — utilization of the intelligence is a key precondition of the effects of BI. Also, "Utilization of Intelligence" can be measured both objectively and subjectively. An example of an *indirect* and *objective* measure is calculating the user activity on some key BI database. An *indirect* and *subjective* measure of the utilization of the intelligence can be formed using a survey in which users are asked how often they utilize the intelligence in their work.

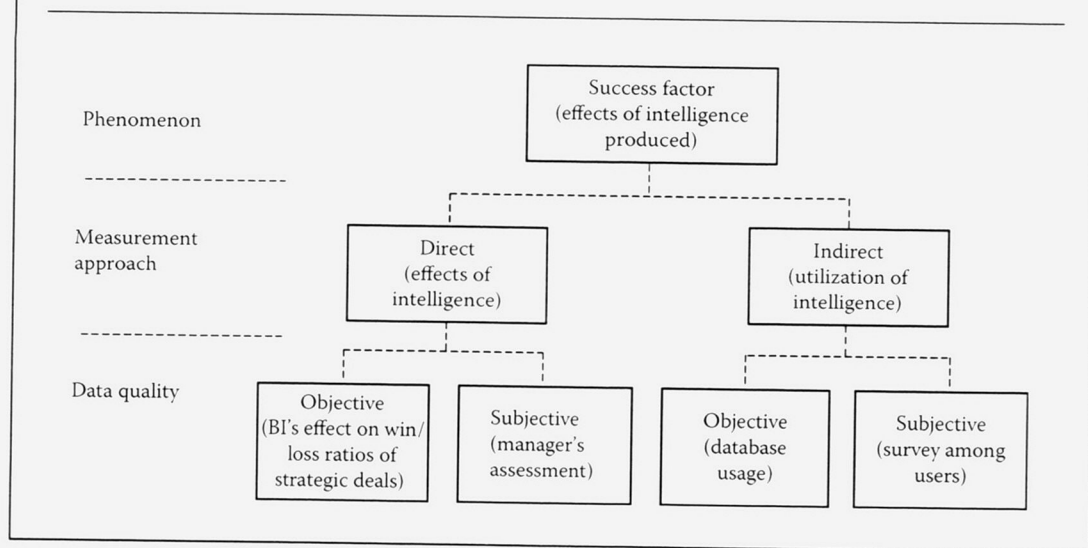
All of the performance measures presented in Figure 1 are nonmonetary (or nonfinancial). However, monetary performance measures are also quite common and have many positive characteristics. For example, it is possible to compare measurement results of different issues because the same measurement unit (i.e., a currency such as the euro) is used. However, as discussed earlier, in many situations it is difficult to apply monetary measures because some of the issues are nonfinancial in nature.

SUMMARY AND CONCLUSIONS

There are two main purposes for measuring BI: to prove BI is worth the effort and to help manage a BI process. Many measures can be used for these two purposes. However, the purposes are partially overlapping. A large number of the current measures found in the literature focus on justifying the value of BI. This is an important issue when the usefulness of BI is under initial consideration and also later when there is a need to determine if BI continues to provide valuable results. Many measures of the effects of BI seem problematic. However, there are also many that seem useful.

Measures intended for managing the BI process are applicable for the continuous improvement of the process. The literature discusses fewer measures for the BI process than for the effects of BI. In many cases, certain success factors

FIGURE 1 Different Ways to Measure a Success Factor of a BI Process
(Amended from Kempplä and Lönnqvist, 2003)



of the BI process have been identified, but the actual performance measures have not been presented. However, metrics related to the different phases of a BI process seem easier to measure than the effects. Therefore, it would seem to be easy to design new measures for this purpose.

The measurement approaches presented in the recent business performance measurement literature also seem quite useful for measuring BI. A balanced performance measurement system could cover both the effects of a BI process as well as the important factors of the process. However, we currently lack case studies to assess whether balanced performance measurement could be applied to the BI process.

On the basis of our findings, we encourage companies to start applying the measurement of BI in practice. The balanced performance measurement of BI is proposed as a potential measurement approach. Future researchers are encouraged to report practical experiences for the purposes of learning about possible problems and improving on the measurement of BI. ▲

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