

Business Intelligence as Decision Support in Business Processes

- An Empirical Investigation

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Abstract: Our concern in this paper is the role of business intelligence systems and the perceived business value of implemented systems and their contribution to facilitate the fulfilment of organizational goals. The study builds upon a survey answered by 43 respondents from different large companies in Scandinavia. The survey used questions on how visions, objectives, strategies are supported by BI systems, on how business values are derived from such systems, and on how design and implementation issues affect the solutions. The overall conclusion of the study is that there are markedly different levels of problems in the areas, most problems being found in integration of BI information and decision processes, and that there is room for large improvements and further work within everything from implementation to requirements engineering for business intelligence decision support systems.

Keywords: Business intelligence, decision support, business value, empirical study.

1. Introduction

During the latter decades organizational decision making has become increasingly complex due to the amount of accessible information that managers wish to incorporate in decision making activities has increased dramatically. Given the integration of information systems into business processes, organizational decision making may often experience a substantial amount of environmental pressure due to, for instance, information overload and sharper time constraints (Rasmussen 2000, Speier and Morris 2000). At present, one popular approach to deal with the increasing amount of data in organizations is to build data warehouses and BI-systems.

Systems or methods for supporting decisions come in many forms. For example, *decision analytical systems*, focusing on supporting problem structuring and evaluations of alternative courses of action, *optimization tools* focusing on finding an optimal solution for a well-defined system of constrained variables, or *business intelligence systems* (BI) aiding in the gathering and analysis of business information. See (Turban et al. 2010) for a comprehensive treatment of business intelligence. In this respect, business intelligence systems may be viewed as information systems with special focus on providing accessible business data, i.e., they can be viewed as type of decision support system with the capability of (easily and quickly) providing reliable and up-to-date information or key figures about the organization.

Since the 1990s, such BI systems typically employ three different technologies for supporting decision making in an organization: data warehouses (DW) for the gathering of business data, data mining (DM), and on-line analytical processing (OLAP) for data analysis (Shim et al. 2002). The benefits of a decision

support system may further vary. Already in 1981, Keen summarized the potential benefits of a decision support system (DSS) as they enable the following: facilitate a more rational treatment of decisions problems; yield a better understanding of the business; yield faster response to unexpected situations; facilitate ad-hoc analyses; yield new insights and learning; improve communication; enhance control; enhance team work; reduce time spent on planning; and better use of resources (Keen 1981). This basically remains true even today. However, the decision support function enabling better decision making and other more advanced uses of a BI system such as facilitating business strategies is hard to measure (Watson and Wixom 2007). The results of a previous study presented in (Stenfors et al. 2007), according to managers the strongest incentives for investing in a DSS are to increase the effectiveness of operational processes and to support strategic work and decision making. These benefits are indeed of a more qualitative kind, and the decision to invest in a DSS is therefore often based rather on estimated or perceived *values* than on actual costs. Further, the results from the abovementioned study indicate that managers view DSS and BI systems as support instruments to business process management. However enabling this support does call for the BI system to be systematically aligned or integrated with business processes to a greater extent (Bogdana et al. 2009). The more recent and wider concept of BPM (business performance management) is related to business intelligence as the utilization of BI systems can be viewed as an element of BPM, but where the use is supposed to be aligned with organizational strategy and determined by a program for how to implement this strategy (Frolich and Ariyachandra 2006).

But how does this need for a DSS manifest itself? Recent years have witnessed a remarkable increase of companies investing in BI systems, see (Hannula and Pirttimäki 2003). This makes it interesting to study the use and knowledge of the effects on the businesses of the companies utilizing, or having the ability to utilize, such systems. Further, studies of BI systems as a support for organizational decision making are relatively scarce. With respect to information systems in general, several studies have been carried out in order to identify factors behind a widespread use and end-user acceptance of a system within an organization. These factors are often user-related, such as user attitudes, their previous experiences, and user participation in development, but also context-related, such as top management support and conditions facilitating the use of information systems; see (Bajaj and Nidumolu 1998, Sabherwal et al. 2006, Riabacke 2006).

It is well-known that up to 50%, some say even 70%, of all BI implementations fail in one or more respects, not delivering the value-for-investment expected at the outset. While there are studies on the pitfalls of developing and realizing BI systems, this study focuses on systems already in operation, their organisational context, and hurdles on the path to efficient and effective use of BI information. We will, in the paper conform to the common use of the concept of system, denoting the technical part of a BI effort. From a systems science perspective, the system boundaries are indeed much wider, encompassing the organisation and its control mechanisms. Not to interfere with colloquial interpretations of the system concept, we will refer to this wider concept as the BI scope.

BI is not about technology, it is much more. It is about providing an organisation with support for *better decision making*. Our hypothesis, from literature and interviews, is that far too much focus in the development and implementation of BI solutions in organizations is put on the technical parts of the system. Much of the effort is thus on the right hand side of the model shown in Figure 1, i.e. on the design and building of data warehouses, and on creating different types of reports. In comparison less effort seems to be put on structuring and understanding business processes and gaining insights into the decision making activities involved in these processes that are to benefit from the BI systems. In other words, the level of integration of BI systems into business processes could be much higher, yielding a better business value of the investments made in the system.

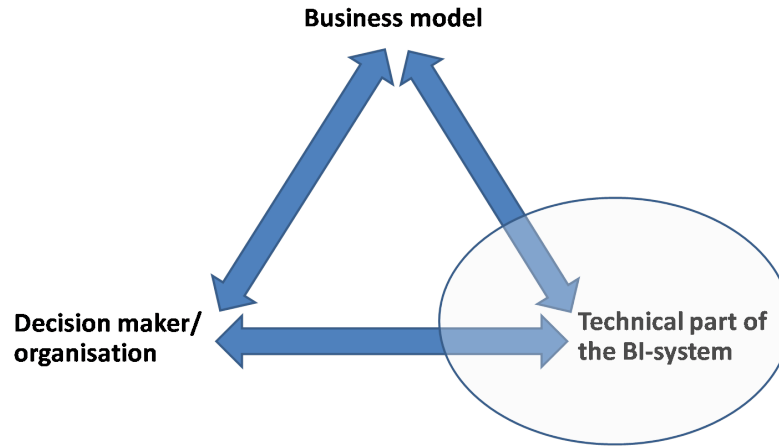


Figure 1: Objects of interaction in the use of BI applications and systems.

Thus, the main area of concern in this paper is to what extent this view is supported by studying the perceived values of BI systems use and the views on system design and implementation.

2. Study outline and method

The study was conducted using a quantitative method based upon a questionnaire. Of 1085 persons considered for the survey and accessible through a large and collaborative consultancy firm, 105 were selected for participation. Of these 105, 43 completed the questionnaire, yielding an effective completion response rate of 41%. Thus, 43 respondents from different large Scandinavian companies employing BI systems for decision making support, having a leading role in these, fully answered the questionnaire in which they had to estimate how well different statements regarding their BI solutions corresponded to their own perception of the reality in their own business. The respondents came from various business segments according to Table 1.

Table 1: Respondents' business segments

Business segments	Count
IT	5
Logistics	4
Banking and insurance	15
Real estate and construction	1
Consumer products	2
Energy	3
Pharma and health care	1
Industry	6
Public sector	4
Other	2
TOTAL	43

Table 2: Respondent's role (some have more than one role)

Role	Count
CEO	3
CIO	3
CFO	6
Other management	3
Head of Business Segment	4
IT Management	7
System owner	1
Requirements officer	3
System architect	4
Developer	4
Other	10
Total	48

The questions were divided into six categories 1 to 6, each comprising of six questions. The categories are:

- 1: *Visions, objectives, and strategies*
- 2: *Business values from BI systems*
- 3: *Requirements analysis and needs*
- 4: *Change management*
- 5: *Technical solutions*
- 6: *Decision making support*

Thus, each category consists of 6 statements which the respondents were asked to assess. The respondents indicated how much they agreed with each statement on a 1-to-7 Likert scale, where 1 was strongly disagreeing and 7 was strongly agreeing. The statements were designed so that a higher value indicated better integration of BI into the business processes. One example of a statement in category 1 is "*BI has a role in our strategic processes*". See the appendix for the complete set of statements. For each category, the aggregated results (modal scores) of all respondents are shown in two spider diagrams (one for each category cluster). Thus, the area in the diagram represents the degree of BI integration in the category according to the responses.

3. Results

The results are presented in two formats. The first format compares, for each category and question, the number of respondents who assessed a score of below 4 (the neutral score) to the number of respondents who assessed a score of above 4. These results are presented in three bar chart diagrams, one for each pair of categories. The other format is in the form of spider diagrams showing the modal score of each question, i.e. the most common assessment for each question. As there were more than one mode for some questions, the darker areas represent the result obtained from minimum modal scores and the brighter areas the maximum.

3.1 Below neutral score vs. above neutral score

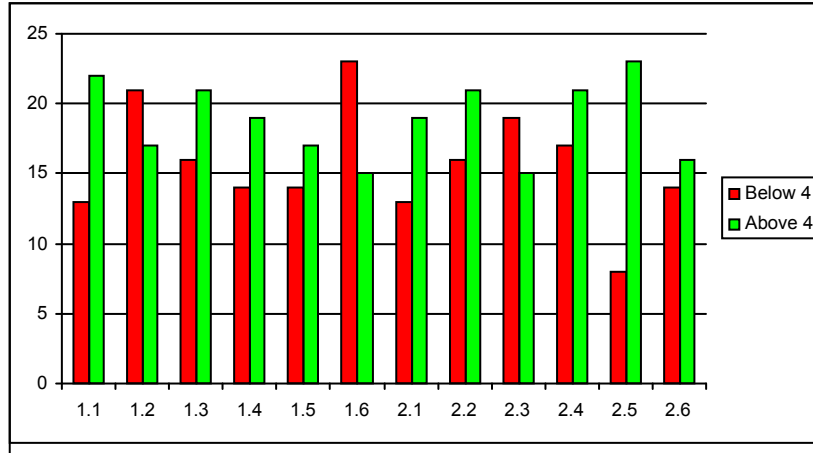


Figure 2: Number of responds below (red) and above (green) the neutral score of 4 for categories 1-2.

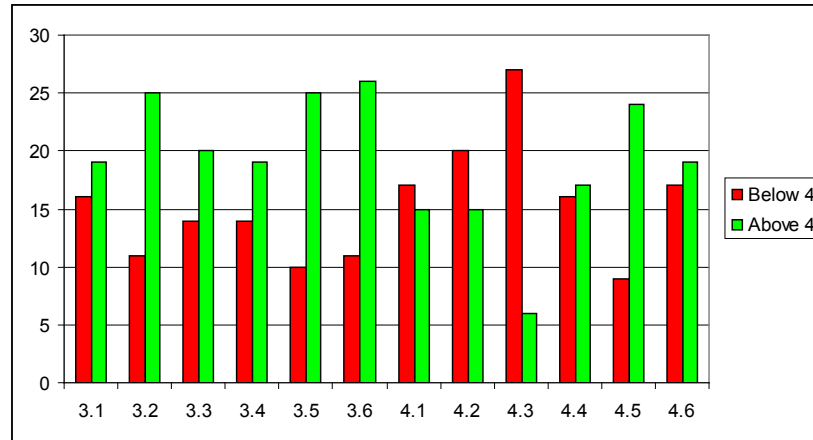


Figure 3: Number of responds below (red) and above (green) the neutral score of 4 for categories 3-4.

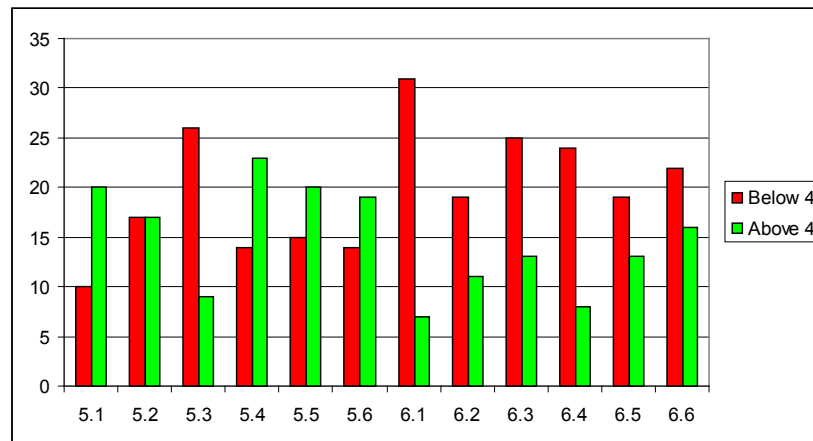


Figure 4: Number of responds below (red) and above (green) the neutral score of 4 for categories 5-6.

3.2 Modal scores

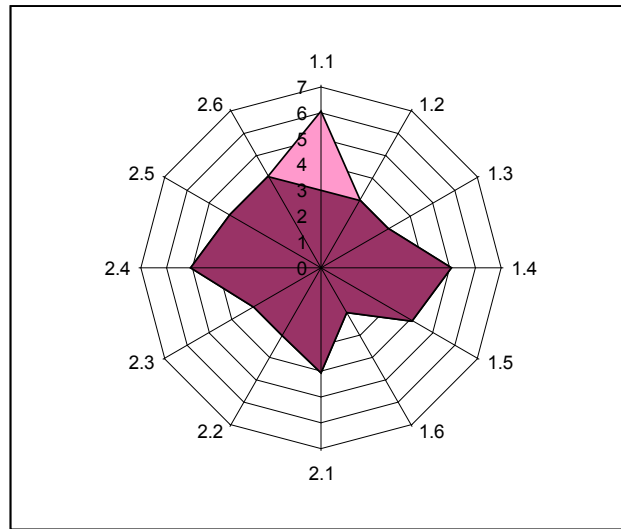


Figure 5: Spider diagram of modal scores for categories 1-2.

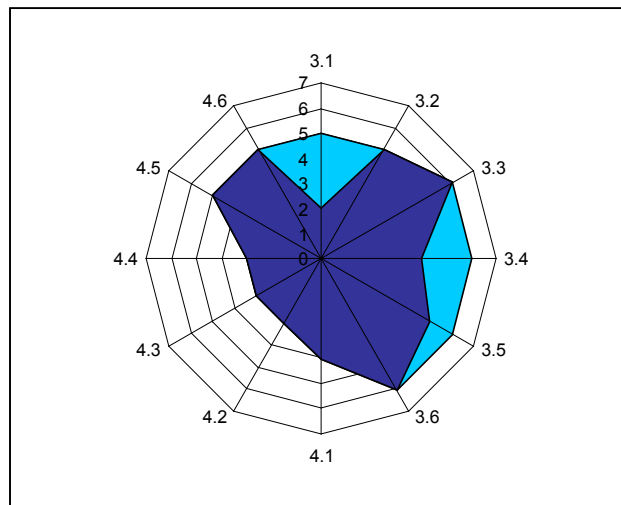


Figure 6: Spider diagram of modal scores for categories 3-4.

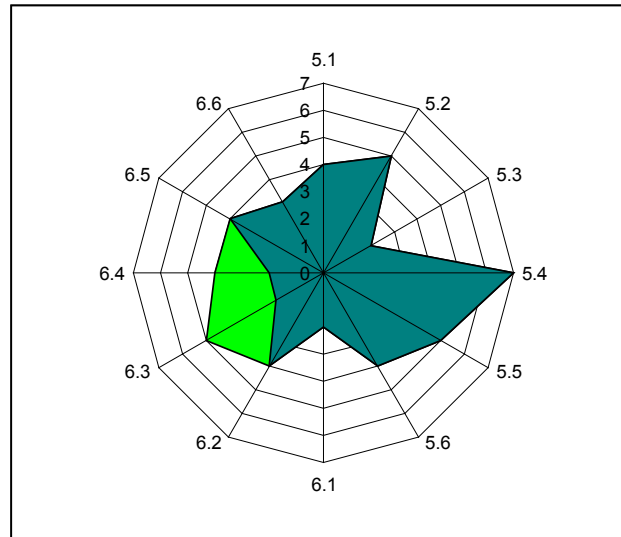


Figure 7: Spider diagram of modal scores for categories 5-6.

4. Analysis

The results differ markedly between categories of statements. In category 1, *Visions, objectives, and strategies*, there is good agreement for all except two statements. There seems to be a fairly good grounding of BI systems in the organisations' control documents and visions, showing a conceptual integration of BI as decision support and with an understanding of how the system may provide support. 1.2 and 1.6 did indicate the opposite, these two having modal scores of 3 and 2 respectively. Those two latter statements referred to specific management issues which were perceived to be less integrated with BI visions.

In category 2, *Business values from BI systems*, there was also a good agreement with the statements in general. There is a clear indication that the needs are being catered for and that perceived business values are derived from business intelligence information. The only exception here is statement 2.3 which deals with the source of promotion for BI solutions, indicating that the need of a BI system is not primarily perceived by the benefiting organisation but rather promoted by external sources.

In category 3, *Requirements analysis and needs*, all indicators show that there was good agreement with the statements. This implies that the most businesses indeed have a fairly good control over the design and implementation of BI systems from an organisational perspective.

In category 4, *Change management*, there was much less agreement with the statements. In particular, statements 4.1 – 4.3 indicated stronger disagreement with the statements, implying problems with integrating the information in decision making processes. The result for statement 4.5 is clearly positive, dealing with user involvement in general, whereas 4.4 and 4.6 indicate a neutral to agreeing position with the statements. The latter three are statements more typical to information systems in general.

In category 5, *Technical solutions*, most statements are agreeable for a majority of respondents. This category deals with technical issues on implementation as opposed to category 3 which deals with organisational issues. Like category 3, this is not overly complicated to deal with for accomplished organisations. There is, however, strong disagreement regarding statement 5.3, again dealing with top management. On the other hand, there is also disagreement among researchers on the involvement of

top management in these issues in contrast with involvement in organisational issues which are considered much more pivotal to success.

Finally, in category 6, *Decision making support*, we find the strongest area of disagreement, with all six indicators being disagreed with on an aggregate level. This clearly implies that the largest set of problems with BI systems lies in integrating them with decision making processes in the businesses, indicating problems with BI scope rather than the BI systems themselves. The same picture is painted by the modal scores, see Figures 5-7.

5. Conclusion

Of the six problem areas studied in this paper, clearly *Change management* and *Decision making support* are those that contribute most to BI systems not being as efficiently functional in an organisational sense as anticipated. The area *Visions, objectives, strategies* is mixed, with some problems, and *Technical solutions, Business values from BI systems* and *Requirements analysis and needs* are less problematic than the others. This indicates that the perceived value from a BI system does not lie in its decision support function and that there is little understanding in how to use it as decision support, i.e. a problem within the wider concept of BI scope.

In other words, when looking back at the triangle in Figure 1, we have found that most efforts done towards the integration of business intelligence systems in organizations focuses on the right hand side of the triangle in Figure 1, i.e. on the technical parts of the BI solution.

6. Discussion and outlook

While almost every for-profit organization builds business cases or similar around new investments in general, this is much more seldom done for BI systems, where the inability to measure its impact renders standard measurement models unusable. There is of course a reason for BI systems winding up in the state they are. One hypothesis that need to be further examined in a more qualitative investigation is that this is a result of that BI systems are treated as just another kind of traditional information systems. In contrast to operational information systems which directly support operational processes that often are rather well defined, BI systems have the capability to support follow-up and decision making processes which typically are less defined in an enterprise. Hence, for an organization, a BI system is complementary to an operational information system, serving as a support for managing the business at several different levels. Surely, decision processes could also be modelled using process modelling techniques, but not the same as operational business processes. However, when lacking another approach, it is understandable that BI systems are treated as "just the next information system" when it is being designed, implemented, and maintained. At present, the main objective when implementing a BI system seems to be that of simply getting it to operate, with too little emphasis on actually getting it to work within its context and thus provide value. This also supports the statement that the practice of BPM concepts is not widespread or mature in the responding organizations, or that the BI system is neglected in this practice. Therefore, too many organizations nowadays express a neutral or unhappy view on their BI systems. Avoiding this calls for another approach in the design phase, approaches stimulating how the information is going to be used and by whom, as opposed to approaches focusing on simply getting it implemented and usable.

In order to develop good BI solutions that support organizations in reaching their overall goals, we must strive for a more holistic view on the implementation of BI systems, for instance by not implementing BI systems without having a proper treatment and understanding of the business processes and the related decision making activities. This means that the solutions must be based on knowledge from a number of areas in addition to database management and computer engineering, i.e. the balance between decision-makers, business models and the technical support system must be better managed. In most current BI

solutions there is a lack of balance in terms of focus on the different corners in the triangle. This calls for requirements specification and design processes focusing on and identifying the business and decision processes that are to benefit from the information provided through the system as well as the organizations overall strategy.

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Appendix

The questionnaire

The following three sub-sections show the statements in the questionnaire as they appear in the results section. They have been grouped into three clusters for presentational purposes.

Categories 1-2

- 1.1 The BI-systems support the work towards fulfilling the organizations objectives, strategies, and visions.
- 1.2 The BI strategy is well established at the organization's top management.
- 1.3 BI is an important part of the organization's strategy process.
- 1.4 We have a clear understanding of how the BI systems will aid us in reaching stipulated objectives.
- 1.5 We ensure that the technical solution, the organization, and the business objectives are consistent in our solution for BI.
- 1.6 BI and BI-related questions are a common issue on the regular management meetings.
- 2.1 The BI systems are tied to the needs of the organization.
- 2.2 The BI systems provide information relevant to the different business units and their needs.
- 2.3 It is clear who promote the needs for BI systems.
- 2.4 The BI systems support the organization's core processes.
- 2.5 The development of our BI systems is solely driven by our business needs.
- 2.6 We always create a "business case" prior to investments in BI systems.

Categories 3-4

- 3.1 Our BI systems provide information that is easy to understand and use in decision making,
- 3.2 The BI systems support the organization in reaching its overall business objectives.
- 3.3 We have a clear distribution of roles and responsibilities when designing our BI systems.
- 3.4 We have a clear distribution of roles and responsibilities when implementing our BI systems.
- 3.5 The ownership of BI system implementation projects lies on the using part of the organization.
- 3.6 Technical experts, users, and management are always involved in the design and implementation of BI systems.
- 4.1 We secure that the foreseen users utilize the information provided by the BI systems.
- 4.2 We have well established routines for how to prepare the organization and its users to use new technology and new information.
- 4.3 We have clear ideas on how new available information will fit with existing decision processes.
- 4.4 We allocate funds for education of personnel when investing in BI systems.
- 4.5 We secure that the users are involved in development and implementation of BI systems.
- 4.6 We secure that the organization and its individuals know how and why they are to use the BI systems and the information they provide.

Categories 5-6

- 5.1 We secure that the technical parts of the BI systems support stipulated business objectives.
- 5.2 The business put clear requirements on what is desired from the technical parts of the BI systems.
- 5.3 Corporate management is an active part in the technical requirements specification process for the BI systems.
- 5.4 The users are an active part in the requirements specification process for the BI systems.
- 5.5 There is a clear and structured user representation in the selection of technical solutions for our BI systems.
- 5.6 The users of our BI systems is an active part when deciding on presentation formats of the information provided by the systems.
- 6.1 We measure the business value generated by our BI systems in a quantitative fashion.

- 6.2 There are clear processes for how the information provided by BI systems are be used in operational decision making.
- 6.3 We use essentially all information accessible from our BI systems.
- 6.4 There are clear guidelines and processes for how to cope with information anomalies or deviations from expectations.
- 6.5 We utilize the information provided from our BI systems in a majority of the business decisions made in our company.
- 6.6 We continuously secure that our BI systems provide relevant information for our business units.