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Factors Contributing to an Effective Business Intelligence Product

Konstantin Taskov
University of North Texas

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FACTORS CONTRIBUTING TO AN EFFECTIVE BUSINESS INTELLIGENCE PRODUCT

ABSTRACT

The purpose of this paper is to explore the effects of business intelligence consumer needs, internal intelligence sources and external intelligence sources on the value of the business intelligence product as measured by the quality of decisions made by business intelligence consumers, the willingness of these consumers to confirm decisions already made and their ability to scan the external environment for threats and opportunities. An exploratory factor analysis and simple linear regression tests confirmed that there is a positive correlation between the quality of internal and external business intelligence sources, the clarity of defining business intelligence consumer needs and the effectiveness of the business intelligence product as seen by business intelligence consumers.

KEYWORDS

Business Intelligence Process, Business Intelligence Product.

INTRODUCTION

In his book The Art of the War (1520), Machiavelli emphasized the importance of the continuous quest for uncovering opponents’ secrets. Today, business intelligence (BI) enables organizations to scan and monitor continuously external and internal environments for threats and opportunities posed by emerging technologies, competitors, markets, suppliers, distributors, customers and legal issues (Cavalcanti 2005). Globalization has increased the quantity and diversity of products in the market, as well as the challenges faced by information technology (Cavalcanti 2005). The pace and nature of change has accelerated competitiveness on a global scale (Gibson, 1998). That acceleration makes the world of business a battlefield, in which the stronger, the more agile and more intelligent companies will prevail (Cavalcanti and Oliveira 2002). The importance of pro-activeness is emphasized by a study conducted with the fifty oldest companies in the US to discover reasons for their long existence. One of the reasons found was pro-activeness towards environmental signals (D’Aveni, 1995).

LITERATURE REVIEW AND DEFINITIONS

Porter (1986) defined intelligence as the analytic process that transforms information about the business environment into strategic organizational knowledge. Porter claimed that the objective of intelligence is to provide actionable information of the external business environment. Cavalcanti (2005) defined business intelligence as both a process and a product. The Society of Competitive Intelligence Professionals (SCIP, 2000), used the following definition of business intelligence as a process:

“…it is the process of ethically collecting, analyzing and disseminating necessary information, which is pertinent, specific, opportunistic and predictive of the business environment and the organization itself”.

This definition treats intelligence as a process that is supposed to deliver an accurate, opportunistic, predictable and actionable information as the final product. Cavalcanti claimed that information is simultaneously part of the intelligence process and its final product. The author differentiated between information and intelligence. Intelligence is a result of a refined analysis of information. The activity of business intelligence involves organizational members as well as connected organizational departments to collect, analyze and disseminate it in the organization (Cavalcanti et al. 2002). The process of business intelligence, according to Tudor-Silovic (1992), Miller (2000) and Shaker et al. (1998), involves collecting and capturing data, its compilation and transformation into information, the analysis which transforms that information into knowledge, and the communication and interpretation by organizational participants of the accumulated knowledge to yield actionable results.
Liebowitz (2006) believed that the process of business intelligence had a more internal focus than that of competitive intelligence. He defined business intelligence as an "active, model-based, and prospective approach to discover and explain hidden, decision-relevant aspects in large amounts of business data to better inform business decision processes". Business intelligence emerged in the 1980s, utilizing many of the principles of military and governmental intelligence practices (Prescott et al., 2001; Shaker et al., 1999; McGonagle et al., 1999). Increased global competitiveness pressured companies to develop well thought-out business intelligence processes that supported organizational flexibility and agility, and were proactive to external opportunities and threats rather than being reactive (Vedder and Vanecek, 1998).

Farrell (2001) estimated that 82% of US companies with annual revenues over $10 billion have an organized business intelligence system. He wrote that the companies best utilizing business intelligence were Microsoft, Motorola, IBM, Proctor and Gamble, GE, HP, Coca-Cola, and Intel. Shaker et al. (1999) claimed that the goal of BI was to detect relevant environmental changes, so that an organization could identify and react quickly seizing opportunities and addressing threats. BI should also forecast competitors’ strategies and provide insight for the reasons behind their actions.

Prior research has shown that there is a great variety of external resources. Savioz (2004), Lichtenhaler (2004) and Vedder et al. (1998), stated that an organization needed to utilize all of the available external intelligence sources in order to improve the quality of the final BI product delivered to decision makers. They identified the following external intelligence sources:

a) Suppliers, customers, post docs in universities, external expert networks
b) External venture capital funds, listening posts and science and technology alliances between universities and companies from the industry
c) Journals, books, newspapers, proceedings, vendor literature, and government documents; and
d) Conferences, fairs, seminars and events, business and trade publications, technical journals, annual reports, speeches and press releases, online databases, and the Internet also identified by Farrel (2001).

Recognizing this diversity, Cavalcanti et al. (2002) divided business intelligence into three environmental segments:

a) Environmental Intelligence -- this type of intelligence includes technology intelligence, legal intelligence and economic intelligence. The goal of environmental intelligence is to provide an organization with enough information about the external environment.

b) Customer Intelligence -- this type of intelligence includes attitudes, needs and characteristics of customers.

c) Market Intelligence -- this type of intelligence includes competitors’ intelligence, suppliers’ intelligence and distributors’ intelligence. The purpose of market intelligence is to define the level of competition faced by an organization.

Cavalcanti (2005) empirically demonstrated the value of internal BI sources such as marketing and sales, production, research and development, finance and general administration departments. He found that intelligence products originating from internal BI sources had the highest contribution to business success in large Brazilian and European firms from different industries, when compared with BI products drawn from external sources. The researcher found that internal intelligence had a higher contribution to business profit and market share of these firms when compared to intelligence originating from external sources. Savioz (2004) and Scott and Rothberg (2005) identified the following internal BI sources:
a) Researchers -- employees from the R&D department have plenty to offer in terms of specific technology knowledge; engineers -- employees from technical departments who have experience and knowledge in the identified area of technology observation; BI specialists -- employees from the BI unit who execute the BI process and have knowledge of historical procedures involved in that process.

b) Archival intelligence data stored in Customer Relationship Management and Supply Chain Management internal database systems -- these systems contain intelligence data on suppliers, distributors and customers, which may yield valuable tactical and strategic insights to BI consumers. Any entity on the value chain of a company can be a valuable BI source.

Savioz listed three different phases of the BI analysis process:

1. Filter -- reduce the quantity of data by checking its relevance and quality from the perspective of BI consumers.
2. Integrate -- interpret data using professional expertise and the firm’s context, which produces information.
3. Assess -- evaluate the tactical or strategic meaning of the information for the company, which hopefully produces informative or actionable BI.

Farrell (2001) described the analysis phase of the business intelligence cycle as the transformation of collected data into informative or actionable information. Data are collated and synthesized according to the intelligence targets and priorities set by BI consumers. BI providers should be able to combine relevant information pertinent to the BI consumers’ needs from all external and internal data sources used. This phase involves evaluating the data for usability by considering its relevance, reliability, clarity, sufficiency, significance and timeliness.

Brenner (2005) claimed that decision makers in a technology-intensive company complained that they were provided with “data dumps” by BI providers. The lack of analysis of collected data by these providers negatively affected BI consumers’ satisfaction. McGonagle (2007) clearly stated that BI consumers do not have time to analyze the data and it is critical that high quality analysis is performed by BI providers. The author also emphasized the importance of the BI providers to proactively identify BI consumers’ needs and key intelligence topics and targets. Fiora (2005) asserted that BI providers who proactively communicate intelligence products to decision makers are more likely to satisfy them than BI providers who reactively supply only basic reports. He also stated that the consumer audience for BI was quickly expanding from high level executives to include lower level executives and frontline managers. Moreover, in the future larger numbers of employees would become BI consumers, which in turn would bring higher demands on the quality of intelligence products. For example, they would have to be broader in information scope and address longer-term time horizon to satisfy more diverse consumer needs.

Based on the literature review thus far, the researcher proposes the following model:
The research model in Figure 3 has four major parts:

a) Inputs to the BI analysis;

b) Analysis of BI data;

c) BI product; and

d) Effectiveness of the entire BI process.

Inputs to the BI analysis include external and internal business intelligence sources and BI consumer needs identification. The needs identification guides the data collection from external and internal business intelligence sources.

The business intelligence data collected from external and internal business intelligence sources provides input to the BI analysis phase (Ferrell 2001, Lichtenhalter 2003, 2004, Savioz 2004). The research model displays three links between each input and the BI data analysis part. The three links will be tested by three separate hypotheses. The collected data is then analyzed by BI providers and transformed into at least informative and at best actionable business intelligence information from the consumers’ viewpoint. The research model displays a link between the BI data analysis part and the BI product part. This information is distributed to the ultimate BI consumers by varied communication channels. This is the stage that transitions the BI process into a BI product. The BI product is the output of the entire BI process and is evaluated by BI consumers to measure the effectiveness of this process. The research model measures the effectiveness of the entire BI process by three subjective measures, as reported by BI consumers. The subjective measures are the perceived quality of the BI consumers decision-making processes, their better justification for decisions already made and their improved environmental scanning. The author of this paper believes that these measures reported by Prescott et.al. (2001), Savioz (2004), and Vedder et al. (1998) capture the most important dimensions of the effectiveness of the BI product.

The research questions that emerge from this model are:

a) Do external intelligence sources provide valuable input to the BI process?
   H02: External intelligence sources do not provide valuable input to the BI process.

b) Do well-defined BI needs across organizational departments for BI products lead to a higher quality BI product?
   H01: A well-defined internal need across organizational departments for BI products does not lead to a higher quality BI product.

c) Do internal intelligence sources provide valuable input to the BI process?
   H03: Internal intelligence sources do not provide valuable input to the BI process.

d) Does a quality BI analysis lead to an effective BI product?
   H04: Quality BI analysis does not lead to an effective BI product.

SAMPLE AND STATISTICAL ANALYSIS

Prescott et al. (2001) asserted that very few studies have focused on the perception of BI consumers of the value that BI provides as an input to their decision making. They believed that the following measures can be employed for gauging BI effectiveness:

a) Activity based measures such as number of BI projects completed, number of BI reports written, number of BI requests handled, number of BI searches initiated and others.

b) Qualitative measures of BI effectiveness such as perceived quality and relevance of BI products by BI consumers.

The researcher’s total sample contains thirty business intelligence consumers and providers. There are twelve matching pairs of a business intelligence provider – business intelligence consumer for all companies in the sample. Nine linear regression tests (Please see Appendix) were performed via the SPSS software program using these matching pairs. First, an exploratory factor analysis was performed to examine convergent and discriminant validity of each independent and dependent construct from the proposed research model. Second, the researcher keyed the data from the questionnaires items that loaded on each variable into an Excel file and made sure that the data is aligned by a matching pair of a BI provider - consumer from each company. Next, the researcher computed the means for each variable within each company and used these variable means as a source for an SPSS data file. Finally, the researcher performed the nine linear regression tests and evaluated the significance of the results (please see Appendix).
Hypothesis 2 seeks to confirm that higher quality External Intelligence Sources contribute to an Effective BI product. The results failed to reject the Null hypothesis based on the significance level of F values of the linear regression tests of External Intelligence Sources on Confirmation of intelligence consumers’ decisions, External Intelligence Sources on Decision Quality of intelligence consumers and External Intelligence Sources on Environmental Scanning of intelligence consumers.

<table>
<thead>
<tr>
<th>Independent variable = External Intelligence Sources</th>
<th>R-Squared</th>
<th>F-value</th>
<th>Significance Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>Confirmation of BI consumers decisions</td>
<td>.103</td>
<td>1.03</td>
<td>0.336</td>
</tr>
<tr>
<td>Decision Quality of BI consumers</td>
<td>.046</td>
<td>0.478</td>
<td>0.505</td>
</tr>
<tr>
<td>Environmental Scanning of BI consumers</td>
<td>.006</td>
<td>0.05</td>
<td>0.821</td>
</tr>
</tbody>
</table>

Table 1 (Hypothesis 2 results)

Hypothesis 3 seeks to confirm that higher quality Internal Intelligence Sources contribute to an Effective BI product. The results partially support Hypothesis 3 based on the significance level of F values of the linear regression tests of Internal Intelligence Sources on Confirmation of intelligence consumers’ decisions, Internal Intelligence Sources on Decision Quality of intelligence consumers and Internal Intelligence Sources on Environmental Scanning of intelligence consumers. The results confirm that Internal Intelligence Sources provide business intelligence that contributes to higher Decision Quality of BI consumers.

<table>
<thead>
<tr>
<th>Independent variable = Internal Intelligence Sources</th>
<th>R-Squared</th>
<th>F-value</th>
<th>Significance Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>Confirmation of BI consumers decisions</td>
<td>.300</td>
<td>3.85</td>
<td>0.081</td>
</tr>
<tr>
<td>Decision Quality of BI consumers</td>
<td>.345</td>
<td>5.26</td>
<td><strong>0.045</strong></td>
</tr>
<tr>
<td>Environmental Scanning of BI consumers</td>
<td>.192</td>
<td>2.145</td>
<td>0.177</td>
</tr>
</tbody>
</table>

Table 2 (Hypothesis 3 results)

Hypothesis 1 seeks to confirm that well-defined Internal BI needs contribute to an effective BI product. The results partially support Hypothesis 1 based on the significance level of F values of the linear regression tests of Internal BI needs on Environmental Scanning of intelligence consumers, Internal BI needs on Confirmation of intelligence consumers’ decisions and Internal BI needs on Decision Quality of intelligence consumers. The results confirm that well-defined internal BI needs contribute to higher quality Environmental Scanning of BI consumers.
### Hypothesis 1 Results

<table>
<thead>
<tr>
<th>Dependent Variables</th>
<th>R-Squared</th>
<th>F-value</th>
<th>Significance Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>Environmental Scanning of BI consumers</td>
<td>0.504</td>
<td>7.122</td>
<td>0.032</td>
</tr>
<tr>
<td>Confirmation of BI consumers decisions</td>
<td>0.081</td>
<td>0.618</td>
<td>0.458</td>
</tr>
<tr>
<td>Decision Quality of BI consumers</td>
<td>0.018</td>
<td>0.148</td>
<td>0.71</td>
</tr>
</tbody>
</table>

Table 3 (Hypothesis 1 results)

Hypothesis 4 seeks to confirm that a higher quality BI Analysis contributes to an effective BI product. The results partially support Hypothesis 4 based on the significance level of F values of the regression tests of BI Analysis on Confirmation of intelligence consumers’ decisions, BI analysis on Decision Quality of intelligence consumers, and BI analysis on Environmental Scanning of intelligence consumers. The results confirm that BI Analysis contributes to better Environmental Scanning of BI consumers:

### Hypothesis 4 Results

<table>
<thead>
<tr>
<th>Dependent Variables</th>
<th>R-Squared</th>
<th>F-value</th>
<th>Significance Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>Environmental Scanning of BI consumers</td>
<td>.617</td>
<td>14.49</td>
<td>0.004</td>
</tr>
<tr>
<td>Confirmation of BI consumers decisions</td>
<td>.293</td>
<td>3.72</td>
<td>0.086</td>
</tr>
<tr>
<td>Decision Quality of BI consumers</td>
<td>.206</td>
<td>2.588</td>
<td>0.139</td>
</tr>
</tbody>
</table>

Table 4 (Hypothesis 4 results)

**CONCLUSIONS**

The most important conclusion from the results is that all the variables in the proposed research model exist. Also, the researcher found that these variables possess convergent and discriminant validity (please see Appendix A). Each variable had only one dimension emerging after an exploratory factor analysis with the exception of Environmental Scanning of BI consumers which had two dimensions emerging but this was consistent with the findings of Savioz (2004). The researcher partially confirmed three of the four research hypotheses. The number of variables in the research model requires a larger sample size. The rule of having at least five subjects per each questionnaire item would require data collection from about 70 BI providers and 70 BI consumers. Future research needs to replicate the same statistical analysis with more subjects and also apply different statistical techniques. It is likely that with an increase in the sample size the hypotheses will be empirically confirmed and the validity of the result will improve.
APPENDIX
A.1) Structured questionnaire:

INTRODUCTION

THANK YOU FOR PARTICIPATING IN THIS SURVEY. PLEASE READ THE FOLLOWING DEFINITIONS BEFORE COMPLETING THE SURVEY.

ALL FORMS OF INTELLIGENCE ARE BOTH A PROCESS AND A PRODUCT. YOUR DEFINITIONS ONLY REFER TO THE PROCESS PART.

Business Intelligence is the process of ethically collecting, analyzing and distributing to management information that is pertinent, specific, opportunistic or predictive of the behavior of the business environment or of the organization itself.

1. DO YOU USE BUSINESS INTELLIGENCE IN YOUR ORGANIZATION? Yes No

IF YOU ANSWERED “YES” PLEASE CONTINUE WITH THE SURVEY. IF YOU ANSWERED “NO” YOU ARE NOW FINISHED. PLEASE RETURN THIS SURVEY USING THE ENCLOSED ENVELOPE. THANK YOU FOR YOUR TIME.

Please read each question carefully and circle the number corresponding to the response that best expresses your view.
1= Strongly disagree  
2= Disagree  
3= Weakly disagree  
4= Neutral  
5= Weakly agree  
6= Agree  
7= Strongly Agree  
NA = Not applicable or I don’t know

Strongly       Strongly
Disagree       Agree

BI PROVIDERS ITEMS:

External Intelligence Sources:
1. I use business intelligence on a continual basis.
2. I use external sources such as publications and conferences for acquiring business intelligence.
3. I use external sources such as publications and conferences for acquiring business intelligence.
4. External sources are reliable.
5. External sources provide actionable business intelligence.

Internal Intelligence Sources:
6. I use internal sources, such as company employee’s expertise and internal data warehouses, for business intelligence.
7. I use internal sources, such as historical data stored in supply chain management systems and/or customer relationship management systems, for business intelligence.
8. Internal sources are reliable.
9. Internal sources provide actionable business intelligence.

Intelligence Analysis:
10. I personally analyze business intelligence.

11. I use area specialists to analyze business intelligence and report their results to me.

12. My department employs quantitative analytical tools, such as patent analysis and trend extrapolation, for analysis of business intelligence.

13. My department employs qualitative analytical tools, such as brainstorming or delphi methods, for analysis of business intelligence.


15. My department participates frequently in the data analysis phase of the business intelligence process.

BI Consumers Items:

Business Intelligence Needs:

16. My department has an urgent need for Business/ Technology Intelligence.

17. My department and company may gain competitive advantage through the use of Emerging Information Technology Intelligence.

18. My department needs Business/ Technology Intelligence to justify purchases of new technology for the entire organization.

Informative and Actionable Business Intelligence Product:

19. My department has created a number of business intelligence reports in the last twelve months.

20. My department has initiated a number of business intelligence searches in the last twelve months.

21. My department has replied to a number of e-mails on business intelligence topics in the last twelve months.

22. Staff from our department has visited a number of web sites discussing topics on business intelligence.

Improved BI Consumers Decision Quality:

23. The quality of the decisions I have made has improved as a result of actionable or informative business intelligence.

24. My decisions have become more efficient as a result of informative or actionable business intelligence.
25. My decisions have become more effective as a result of informative or actionable business intelligence.

26. I believe that business intelligence I have been provided with is of high quality.

Better Justification for BI Consumers Decisions

27. The quality of business intelligence provided to me has allowed me to better justify a high percentage of the decisions I have made.

28. The quality of business intelligence provided to me has allowed me to confirm decisions that I desired to implement.

29. I believe that the business intelligence I have been provided with is of high relevance to decisions that I need to make.

Improved BI Consumers Environmental Scanning

30. I have been able to achieve high-quality scanning of the external environment.

31. I have been able to detect threats in the external environment.

32. I have been able to detect opportunities in the external environment.

A.2) Results from the exploratory factor analysis:

<table>
<thead>
<tr>
<th>External Intelligence Sources Items</th>
<th>Loadings</th>
</tr>
</thead>
<tbody>
<tr>
<td>External Sources are reliable providers of Business Intelligence</td>
<td>0.968</td>
</tr>
<tr>
<td>I use frequently external intelligence sources</td>
<td>0.887</td>
</tr>
<tr>
<td>I use external sources such as publications and conferences for acquiring Business Intelligence</td>
<td>0.798</td>
</tr>
<tr>
<td>External sources provide actionable business intelligence</td>
<td>0.78</td>
</tr>
</tbody>
</table>

Table A.1

<table>
<thead>
<tr>
<th>Internal Intelligence Sources Items</th>
<th>Loadings</th>
</tr>
</thead>
<tbody>
<tr>
<td>I use internal sources such as company researchers, engineers and technology intelligence specialists for business intelligence</td>
<td>0.981</td>
</tr>
<tr>
<td>I use internal sources, such as company employee’s expertise and internal data warehouses, for business intelligence</td>
<td>0.980</td>
</tr>
<tr>
<td>Internal sources provide actionable business intelligence</td>
<td>0.263</td>
</tr>
</tbody>
</table>

Table A.2
My department has handled business intelligence requests on a regular basis in the last twelve months 0.959
I use business/emerging information technology intelligence on a continual basis 0.901
My department participates in number of yearly Emerging Information Technology Intelligence projects 0.87
Staff from our department has made a number of presentations on business intelligence topics 0.853

Table A.3

I have been able to detect BI opportunities in the external environment 0.915
I have been able to achieve high-quality scanning of the external environment 0.899
I have been able to detect threats in the external environment 0.995

Table A.4

I believe the BI provided to me is of high relevance 0.958
The quality of Business Intelligence provided to me has allowed me to confirm decisions that I desired to implement 0.942
The quality of Business Intelligence has helped me better justify decisions I have made 0.875

Table A.5

My decisions have become more effective as a result of informative or actionable Business Intelligence 0.897

Table A.6
The quality of the decisions I have made has improved as a result of actionable or informative Business Intelligence | 0.861
---|---
I believe the provided Business Intelligence is of high quality | 0.760
My decisions have become more efficient as a result of informative and actionable BI | 0.737

Table A.6

<table>
<thead>
<tr>
<th>Business Intelligence Analysis Items</th>
<th>Loadings</th>
</tr>
</thead>
<tbody>
<tr>
<td>My department uses qualitative tools for analysis of Business Intelligence</td>
<td>0.937</td>
</tr>
<tr>
<td>My department participates in the data analysis of Business Intelligence</td>
<td>0.896</td>
</tr>
<tr>
<td>My department uses quantitative tools for analysis of Business Intelligence</td>
<td>0.818</td>
</tr>
<tr>
<td>My department analyzes in an informal way Business Intelligence</td>
<td>0.736</td>
</tr>
<tr>
<td>I personally analyze Business Intelligence</td>
<td>0.518</td>
</tr>
</tbody>
</table>

Table A.7

<table>
<thead>
<tr>
<th>Business Intelligence Product</th>
<th>Loadings</th>
</tr>
</thead>
<tbody>
<tr>
<td>My department has initiated a number of business intelligence searches in the last twelve months</td>
<td>0.974</td>
</tr>
<tr>
<td>My department has created a number of business intelligence reports in the last twelve months</td>
<td>0.938</td>
</tr>
<tr>
<td>My department has made a number of Business Intelligence requests in the last twelve months</td>
<td>0.861</td>
</tr>
</tbody>
</table>

Table A.8
REFERENCES

14. Liebowitz J. (2006) Strategic Intelligence- Business Intelligence, Competitive Intelligence, and Knowledge Management AUERBACH PUBLICATIONS Boca Raton, FL.