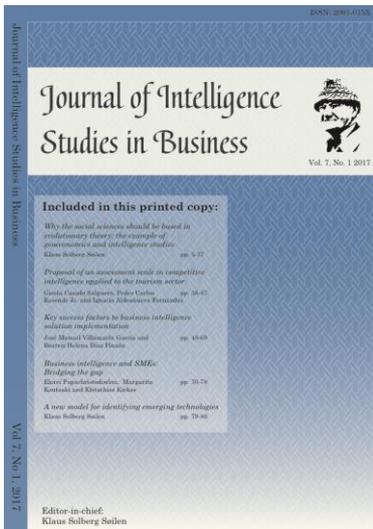


Journal of Intelligence Studies in Business



Journal of Intelligence Studies in Business

Publication details, including instructions for authors and subscription information: <https://ojs.hh.se/index.php/JISIB/index>

Business intelligence and SMEs: Bridging the gap

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To cite this article: Papachristodoulou, E., Koutsaki, M. & Kirkos, E. (2017) Business intelligence and SMEs: Bridging the gap. *Journal of Intelligence Studies in Business*. 7 (1) 70-78.

Article URL: <https://ojs.hh.se/index.php/JISIB/article/view/201>

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Business intelligence and SMEs: Bridging the gap

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Received 15 February 2017; accepted 1 March 2017

ABSTRACT According to research findings, small and medium enterprises (SMEs) are facing problems such as an excessively large volume of data, lack of information and lack of knowledge. Therefore, in order to make decisions on time, the managers of SMEs use mainly their experience, which implies a high risk of failure. Business intelligence (BI) is a useful and helpful tool, which brings many advantages and benefits to businesses. However, like any technology, it is accompanied by some limitations that must be overcome in order to help businesses to develop. This paper summarizes current research findings addressing the issue of the development and application of business intelligence systems for SMEs. The issues addressed are models for the estimation of the readiness of a SME to establish BI tools, alternative BI solutions for SMEs, benefits and challenges of BI in SMEs, implementation methods for BI systems in SMEs and finally, BI systems in cloud computing platforms. Research papers dealing with these issues are analyzed and the results are presented. This paper contributes to the understanding of problems and potentials regarding the development and application of BI systems in SMEs.

KEYWORDS Business intelligence, competitive intelligence, SMEs

1. INTRODUCTION

Despite the economic size of each company, access to relevant and important information is very important to ensure the success of the acquisition of a market share. Business intelligence is considered a very important tool to achieve such a goal. According to the Gartner's surveys, business intelligence (BI) and analytics systems are ranked as the top technological priority of companies in the last years worldwide. The main objective of BI systems is to facilitate the decision making process by providing quality information, based on the analysis of large amounts of internal and external data. However, BI systems are characterized by their difficulty and complexity to handle. Also, economic factors are the ones that make many SME's administrations fail to proceed to the acquisition of a system. Normally, the development and maintenance of a BI system

requires considerable funding. Moreover, the majority of SMEs do not have a specialized IT department. Many SMEs are run by the owners, who might not have advanced technological knowledge. It is known that the applications of BI are not primarily accessible to SMEs. The available systems are expensive, difficult to use and require excellent technological training of business staff. Commonly, these applications meet the needs of large enterprises, that have all the appropriate resources for their proper functioning.

Despite these limitations, better information provision, facilitated by a BI system, may lead to better decisions and become a consistent competitive advantage. A prerequisite is the successful confrontation of problems, stemming from the specific characteristics of SMEs. With the evolution of technology, BI suppliers have designed and

developed applications and tools to meet real small businesses needs. There are BI systems that are available online. These systems are affordable, easy and they belong to the category of cloud systems. Such solutions are suitable for SMEs, as they do not incur additional installation and maintenance cost. Tools and IT system applications are not considered a privilege of large companies, as the services offered are designed for the needs and requirements of SMEs, which can be just as competitive and successful. The present paper addresses a wide spectrum of issues related to the application of BI systems in SMEs. BI practitioners and SME managers might find this brief but concise summarization useful in their attempts to apply this cutting-edge technology in this specific business sector.

2. READINESS OF AN SME FOR BI

Hidayanto et al. (2012) conducted research to assess the readiness of a SME to establish a BI tool. For the development of the framework, the researchers used as their tools the Critical Success Factors and the Analytical Hierarchy Process. They focused on three categories of functions found in an SME. The framework formed by researchers primarily focuses on three main categories that are identified, which were developed and evaluated. These categories are organization where nine relevant factors were explored, process where four factors have been analyzed and technology where five factors were explored.

In this study the researchers initially make a theoretical presentation on the development of the model and then they proceeded to a more detailed description. Finally, the proposed framework is applied to a real case of a SME. Through this research, they explored and evaluated the critical success factors, namely the elements that are necessary to ensure the success of such a venture in the evaluation and acquisition of a BI system.

We chose the Analytical Hierarchy Process method for the development of the proposed framework, because this method allows the analysis of a complex problem in a more simple structure and selects the most effective solutions that lead the administration to better decisions (Taylor 2005, Cheng 1997). The researchers define the three steps of this method.

The first step is the decomposition of the model into three levels (objective, criteria and alternatives). In the second step, the comparisons between pairs of criteria and alternatives were created. The comparison was made with a rating scale of 1-9. The third and final step is the weight of each pair. This method was used to give the weight of each factor based on specific criteria and the better alternative was the one with the higher weight.

To be valid comparisons, the researchers chose values less than 0.1 (consistency ratio <0.1). Then, they began to develop a framework that would apply in a real and not virtual enterprise. The target frame raised the level of readiness of BI in an SME (level 1). Criteria joined the function categories of business (level 2), while the critical success factors were considered alternatives (level 3). For the purpose of the study, Hidayanto et al. (2012) used 18 factors based on the scientific literature references by Atre (2003), Williams and Williams (2004) and Yeoh and Koronios (2010).

For the category of organization, the critical success factors selected were committed management support and sponsorship, clear vision and well-established business case, strategic alignment, effective business/IT partnership for BI, BI portfolio management, continuous process improvement culture, culture surrounding the use of information and analytical applications, cross-organizational collaboration and decision process engineering culture.

For the process category, the factors chosen were balance team composition, availability of skilled team members, business driven development approach and iterative development approach and user oriented change management.

For the technology category business driven scalable and flexible technical framework, sustainable data quality and integrity, importance of metadata, BI and DW technical readiness and the silver bullet syndrome were selected.

Once the problem decomposition process was completed, the researchers proceeded to create pairs of criteria and alternatives, with the help of four specialists in BI. Experts, using the Delphi technique, gave values to results which arose from four comparisons: i) the inter-category pairwise comparison, ii) the pairwise comparison for organizational category, iii) the pairwise comparison for

process category and iv) the pairwise comparison for technology category. Finally, the validity of comparisons of each class of the consistency ratio was calculated (consistency ratio < 0.1) and the weight of each factor was calculated.

To give a more accurate and fair decision about the value of each factor in business, the researchers used the e-GP model (electronic government procurement) Readiness Self-Assessment. Thus, they evaluated the level of readiness of each factor using a scale (0-3) measuring each factor's readiness level.

The results of this research reaffirm the findings of previous research, mainly conducted by Williams and Williams (2004) and Yeoh and Koronios (2010). According to the BI experts the most crucial factors in developing BI systems are the following:

- Strategic alignment between business and IT. Consistency is required between business strategy, organization and processes and IT strategy, infrastructure, organization and processes.
- Managements support and sponsorship. The determination of the management to support the project secures the availability of resources such as funding and human skills.
- Clear vision and well established business. A clear strategic business vision is required. Such a strategic vision is needed for the establishment of a solid business case. Misunderstanding of the long-term vision and objectives may derail the BI project.

Other important issues are the composition of the BI team and the quality of the data. It is critical to include business experts who understand the strategic vision in the BI team so they can foresee the organizational challenges.

After the comprehensive development of the model, the researchers applied it to a real SME. They randomly chose an SME in Indonesia, which did not use a BI system. Through semi-structured interviews they assessed the level of preparedness of each factor separately and then multiplied it by the weight factor of the level of preparedness. After, they added all the results to give the final grade. The company managed to collect 58.05%. The result showed that although the company understood the importance of the

factors for the implementation of BI, it had to face some obstacles and then proceed to the implementation of BI.

By applying a similar model, businesses will be able to analytically evaluate their readiness and then they can decide whether they will be able to deploy BI software, as they may be confronted with unexpected situations that may arise during the project. Management should be aware of the real needs of the enterprise and adopt corresponding services to manage and support them.

3. BI SOLUTIONS FOR SMES

Tutunea and Rus (2012) study alternative BI solutions for SMEs. In their research, they tested and evaluated the available commercial BI solutions, open source solutions and IT systems tools offered for small and medium businesses. The software tested was available on the websites of companies that provide BI solutions. For the evaluation of commercial solutions, they set two criteria. The first criterion set was the complexity that characterized the provided solutions. The variables set for this criterion were the functionality, maintenance and system support, accessibility and user interface and the final purchase price. The second criterion was characterized as the reputation of the company that was on the market.

By conducting this research, they have concluded that, depending on company size, the management and some specific internal factors, there are three types of BI solutions that allow companies to choose the one that best fits their requirements and needs.

As a first choice, they ranked the solutions developed within the company and did not involve specialized BI providers. These solutions mainly focus on static or dynamic analyses of the data with the help of Excel spreadsheets, Open Office Calc, Lotus 1-2-3, computer graphics, and what-if type analysis. Such BI solutions are part of SaaS (System-as-a-Software) and have gained ground in their acquisition by SMEs. This is because the final purchase cost is low, it is easy to use and the installation time is very fast. Also, there is no further staff training. The products are hosted in a secure online platform where the company has access without leaking data.

As a second option, the researchers ranked the commercial BI solutions. Of the software that was tried, they found that there are two types of providers.

The first category includes specialized software companies that provide exclusive BI tools. Businesses rely on a specialized team to design the software according to their needs and requirements. Such providers are Information Builders, MicroStrategy, and QlickTeck.

In the second category, they identified companies that have a greater variety of interests. In this category are the BI solutions that are aimed at a particular sector such as education, banking or insurance systems. Such providers include Oracle, Microsoft, SAP, and SAS.

As a third option, they ranked BI solutions and open source solutions. The motivation that drives companies to proceed to the acquisition of such solutions is the low cost. Therefore, the architecture, the functionalities and their environment are considered to be the main criteria on which SMEs choose a BI tool. Providers of open source software are Actuate, Jaspersoft, Pentaho and SpagoBI.

Enterprises can choose a suitable solution, taking into account the quality of the information provided, data analysis tools and visualization, cost, accessibility and effectiveness of the decisions. Thus, companies depending on resources choose the best solution that will bring advantages

4. BENEFITS AND CHALLENGES OF BI IN SMES

In this section two surveys aiming at identifying the benefits and challenges of BI adoption in SMEs are presented. Also, through the research, they identified the sections of their application. For this purpose were used two research studies by Scholz et al. (2010) and Nenzhelele (2014).

Scholz et al. (2010) were able to identify the beneficial factors, challenges and types of SMEs that adopt BI tools. The authors study the adoption of BI by German SMEs by examining 214 firms in Saxony.

The method applied was based on references of other authors and researchers. The study was based on Exploratory Factor Analysis (EFA), which identifies the perceived benefits and challenges of implementing BI. Initially, to verify the suitability of the sample they used the KMO measure as proposed by Kaiser and Rice (1974). Then, they applied the MSA measure to validate the sample and then applied the PCA measure to extract relevant information. A number of factors have an impact on businesses, including applied

graphics and an Eigenvalue with $EV > 1$ according to Thompson and Daniel (1996, 200).

After identifying the strengths and challenges, they focused on identifying the type of businesses applying BI. For this, they used a cluster analysis, namely the k-means algorithm and the proximity measure ED. The numbers of clusters were defined by the use of a FC measure (Fusion Coefficient) (Toms et al. 2001).

To collect the necessary data, the researchers assessed 4960 Saxon firms, where the operators responded to an on-line questionnaire via e-mail, which covered a wide range of issues focusing on BI. The questionnaire was validated in two ways (Fowler 2001): it was originally created and written by experts in the field of information technology and then evaluated by conducting a preliminary test. In this way, they managed to ensure that respondent companies fully understood the terms and the importance of the questions in the questionnaire.

In total they collected 452 questionnaire responses. Of these 452 companies, 214 already had a BI tool. In these companies, they applied the technique of cluster analysis, to find the kind of companies that implement BI.

From the research conducted, they managed to identify three main beneficial factors including improvements to data support. In this factor the main benefits are reduced effort of data analysis and reporting, reports are available faster and with better quality, easy access to information and flexible reactions to new information. The second beneficial factor was improvements to the decision process where the main benefits are that business decisions are being eased by more precise and current data analyses, risks and chances are supported in a higher level and the company's results are improved. The last beneficial factor is savings and it's characterized by savings on personnel in different departments that can be achieved, competitive advantages can be achieved and cost savings in IT that can be achieved.

On the other hand, they were able to identify the main challenging factors. These were the challenges depending on usage. The main challenges are that the handling of the solution is too complicated and reports are too complex, data is poorly structured, capabilities do not cover business needs and BI staff are not qualified enough.

Challenges related to data such as software errors, inadequate security function, range of BI tools and functions don't match with the business needs.

The last challenging factor is the interface challenges. In this factor the main challenges are limited data export and also that the data are not usually enough

Finally through the cluster analysis, they were able to identify four categories of companies using BI (Rapidly growing B2C, lightly regulated companies with a focus on collaboration, service-oriented B2B companies, and high-regulated product-oriented companies).

The research carried out by Scholz et al. (2010) showed that companies and organizations that do not have a BI tool should not only focus on the positive effects that could generate from its use. They should study and all those challenges and constraints that may arise, e.g. software errors, reduced resources, and unnecessary costs. Through cluster analysis, they concluded that product-oriented companies have better prospects in the application of BI. Also, through cluster analysis BI providers can identify the real needs of SMEs.

In the second examined paper, Nenzhelele and Pellissier (2014) identify which business areas mainly applied business or competitive intelligence and whether they understand the concept. According to Bernstein (2009) competitive or business intelligence is formed by processing the data, which produce information, processed information which produces knowledge and processed knowledge which leads to intelligence.

The data collection was done by using a questionnaire sent to a hundred SMEs in the greater region of South Africa. Their original purpose was to discover whether SMEs are aware of BI and then to identify the main challenges they face. Also, they tried to find the sections where companies apply BI. From the research, the researchers concluded that although companies understood the importance of BI, they did not apply an equivalent tool. Businesses using a BI tool asked about the main challenges and discovered that three restrictions are common to all businesses. The lack of time working with the system shows that small businesses do not have the needed time to manage a competitive intelligence system, the lack of human resources and economic factors were the main problems they face. The application

area is not located in a particular part, but somewhere independently. This is because SMEs have no formal organizational structure, but one very important role is the application of competitive intelligence in market research and marketing department. Apart from the various challenges and benefits identified, SMEs are trying to be more competitive to be able to achieve higher profits and more sales. In this case, it is stated that SMEs choose to spend more money and establish BI software in market research and marketing departments.

5. IMPLEMENTATION METHODS FOR BI SYSTEMS IN SMES

Frion and Yzquierdo-Hombrecher (2009) present a new competitive intelligence model for the management of large amounts of data and information entering business. Initially they conducted a literature reference which focused mainly on the concept of BI. The second method was based on their long experience in competitive intelligence systems and their application mainly in small businesses. Also, through their experience, they managed to develop and present a new information management model: the Acrie Model.

From the literature, research is found that studies and research are carried out based on large companies. For this reason, the authors noticed that there are many different ways and methods to apply competitive intelligence. The literature survey was completed with the presentation of the new method and the new competitive intelligence information management model was developed. The model was called the Method Acrie.

The basic principles of this model are less data, more inductive reasoning tests and analysis and less information, more curiosity about the problem, focuses on human behavior and on information approach through questions.

The method takes place in three steps. The first step is a formal command formulation and an informal discussion to reformulate the first vague intent. The second step is a question plan, which consists of three levels and is formed by ten questions. This is to help the manager reach his expectations in a specific field. The third step consists of ten seeking plans, one for each question.

It takes a few weeks to prepare a small company for the Acrie Method. When the preparation process is achieved, experts

implement the proposed model in the company. According to Frion and Yzquierdo-Hombrecher (2009), a small company is doing BI when the company is running an outgoing coordination prior to the five main skills of BI activity: questioning, information seeking, information treating, distribution and protection of information.

The large amount of data and information entering business is not always a good phenomenon. This is why the authors developed a new information management model. Through this model, the leader creates plans and plans with the rest of the team to help to reach a better result for the company's interest. This method is used by small and large companies, with various tools to suit the needs of each company individually and to ensure the continuous coordination of the five main skills of competitive (business) intelligence. The Acrie Method is a proposed model of information management that can manage data and also focus on people who are involved in this process.

6. CLOUD COMPUTING AND BI

In the present section two papers, which aim to present BI in cloud computing platforms are discussed.

Agostino et al. (2013) identified the key success factors in their study for the adoption of cloud BI for SMEs and their characteristics based on the needs of BI users and suppliers. Past approaches based on Scholz et al. (2010) and Yeoh and Koronios (2010) have discovered three categories of factors. The first category is distinct from the organization, the second by processes and third by technology. According to Rockart (2009), the critical success factors represent a number of areas where satisfactory results will ensure a competitive position for the individual, the enterprise or a company's section. Little has been said about the association of SMEs with BI software in a cloud level and therefore there is no framework to analyse their connection. The categories of factors to assess the SaaS software level cloud according to Godse and Mulik (2009) are functionality, system architecture, use, reputation, costs and risk.

Researchers' methodology consists of two stages. The first stage was characterized as qualitative. Researchers interviewed four experts (BI suppliers and BI users) in cloud BI software. At this level, they tried to identify

the weaknesses and the improvements through interviews given by BI users and suppliers. Critical success factors are divided into six categories: performance-functionality, integration, adaptability, reliability, support and cost of ownership.

The second stage was considered to be a quantitative stage. At this level, researchers tried to rank the key success factors for the adoption of a BI system. For this, an electronic questionnaire was created, which aimed to rank the importance of success factors. The use of cloud BI for SMEs was always a challenge for researchers, as the number of enterprises applying such a system was limited.

In this stage, scholars gathered information from 36 companies through a questionnaire on the issue of BI. The questionnaire was created by Bryman and Bell (2011).

The findings of the first phase were that the main factors for the adoption of BI systems was that they must have reduced costs, installation time and implementation and a quick response to user requests.

The results of the second stage showed that the main factors to be taken by an enterprise BI are the functionality of the system, continuous data access, rapid response to user requirements, a large amount of data management and implementation costs. Both stages have shown that users are looking for easy tools to use as they have the necessary expertise. The economic factor plays a very important role because SMEs have very limited resources. Cloud software is an economic solution, which outlines additional requirements adopted by SMEs.

Both stages have shown that users are looking for easy tools to use as they have the necessary expertise. The economic factor plays a very important role because SMEs have very limited resources. The cloud is an economic solution, which outlines additional requirements adopted by SMEs.

Sheshasaayee and Swetha (2015) present the challenges of BI software combined with cloud computing. The combination BI with cloud software has many important advantages.

The most important advantages are the speed of construction and speed of services, reduced costs of organization and payment of services depending on the use (Henning and Kemper 2010).

Over the years, it has been observed that the application of BI at the cloud level is increasingly of interest in the field of information technology. The goal of cloud services is the acquisition and provision of resources to meet the maximum requirements and needs of users.

According to scholars, cloud software consists of a three level structure: infrastructure, platform and software.

Cloud software is easy to use and flexible, but has some problems. The most common problems according to the scholars are the different compatibility models, risk performance, and the variable price and cost ratios.

According to Sheshasaayee and Swetha, BI refers to technologies that convert users' available data resources and exportable information into business solutions.

The cloud combined with BI is considered to be one of the most modern technologies in the field of information technology and this is the main reason it is facing some serious challenges. In studies, it is argued that the combination of BI and cloud software encountered some obstacles.

The main challenges are the introduction of new technologies to the general public, the absence of idealized suppliers of specific software systems, the lack of control over the cloud services as all activities are done online and the movement of some compatible models that attempt to replace the actual abilities of cloud systems (Henning and Kemper 2010).

This together leads to the conclusion that cloud software is aimed at companies with reduced financial resources, such as SMEs, but is easy to use and functional. The functions that cloud BI offers have been designed specifically for the needs of SMEs.

7. CONCLUSIONS

Through studies and surveys, many researchers have reached the conclusion that SMEs are the largest part of the market, and therefore of the economy, in most European countries. They are the driving force of the economy as they provide the majority of jobs in the private sector, so they compete with larger companies. The main tool in the development and support of competitiveness among SMEs is BI. The decision support systems that are based on computer applications offer tools so that businesses can process data to extract information and to make better business decisions

Many researchers have researched the topic of BI in SMEs as well the benefits and challenges arising from the implementation of BI.

Hidayanto et al. (2012) shaped and developed a framework so that businesses can know in advance their level of readiness to adopt BI systems, as to avoid unpleasant results.

Tutunea and Rus (2012), undertook more commercial research. They focused on the available BI tools and their capabilities according to the type of business and their needs.

Scholz et al. (2010) found that the main beneficial factors from the application of BI are the improvements in data support, improvements in decision support and economic factors, while the main challenges they face are the errors and failures of software, the complexity of handling the failure of appropriate data and often inadequate data protection.

Nenzhelele and Pellissier (2014) were able to identify in which sections companies applied BI and what challenges the enterprises face. The main application areas are market research and the independent sector, since businesses have no formal and specific organizational structure. The challenges identified in this study proved to be the lack of resources, lack of time to learn and economic restraints. Decision support systems don't only have benefits but they also have challenges and obstacles.

Frion and Yzquierdo-Hombrecher (2009) created a new competitive intelligence model to help companies reach better decisions by managing a large volume of data. The proposed model (the Acrie Model) takes a lot of time to implement and, according to previous studies that have been conducted, SMEs don't have the necessary time to deal intensively with the software learning process.

Some researchers have focused on the new technology of cloud computing combined with BI. Agostino et al. (2013) identified the key success factors from adopting BI in cloud software. Through questionnaires and interviews given by businesses using similar systems and BI suppliers, they concluded that continuous data access, ease of use, reduced costs and quick installation time, implementation, and responsiveness are the main features that lead users to purchase software. But even this technology faces some

challenges. According to Sheshassayee and Swetha (2015), the main challenges of cloud software are the extra costs that may arise from their use, the limited checking services and the non-establishment within the general public.

The main tool to create and support competitiveness is considered to be BI or otherwise competitive intelligence. Decision support systems based on computer applications offer the necessary tools and the right infrastructure so businesses can process the data, extract relevant information and come to appropriate conclusions and therefore make better business decisions. Until a few years ago, the acquisition of BI systems by SMEs was considered difficult. Also, business owners did not consider it useful to obtain such a system. But over time, the evolution of technology and the continuous increase in competition, led to BI systems becoming a necessary tool for facing businesses' competitors and helping SMEs to evolve. However, SMEs have different needs compared to larger companies. This is the main reason BI vendors design and create software that is affordable, convenient and effective so as to meet the needs of smaller companies and organizations. Such technology is called cloud computing, and it is easy to use, economical and provides many features. Some of the advantages of using decision support information systems are the conversion of data into useful information in order to draw useful conclusions, the understanding of key elements in a company (e.g., customers, suppliers, or resources) and the use of a common code of understanding between different departments, the company's profit growth and the creation of a competitive advantage.

It is understood that BI is an essential part in the development of SMEs. Businesses will be able to make better business decisions and compete more effectively by choosing an appropriate system from a wide variety of programs based on the programs' weaknesses and challenges. Of course, the results from the use of the systems are not initially visible, but are perceived gradually. Businesses initially make slow but steady movements to become familiar with system tools. Then they take into account the system outputs that lead to decisions. Finally, once the companies are familiar with the system, all decisions are made by it. Once one knows the challenges and obstacles that may arise they will be in a

position where they are prepared to face any obstacle presented to reach a satisfactory result through the application of BI.

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