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EFFICIENT BUSINESS INTELLIGENCE AND ERP SYSTEMS WITHIN SMES

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Intelligence is based on how **EFFICIENT** *a species became at doing the things they need to survive.*

- Charles Darwin

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Abstract

In recent years, we were experiencing the exciting shift from the industrial age to the modern information-age, in which data is treated as a precious asset for the enterprises of any type, and information management are playing a crucial role among core competencies of successful organizations.
Nowadays, we have been introduced to the interesting technological phenomena like Artificial Intelligence, Augmented/Virtual reality, Blockchain and Cryptocurrencies, Big Data and Internet of Things, and many more, that supposed to bring ease and peace of mind for the humanity of modern age.
Enterprises and their executives have learned the value of data-driven decision-making processes and their criticality in bringing competitive advantage for their organizations. Accordingly, the usage of managerial support systems like ERP, CRM, BPM is going widespread among promising enterprises; and lately, the new technology has been added to this list, which is nothing but Business Intelligence, that is famous as "BI". This new platform, that is offering new options like data-visualization and analytics, brings impressive value-added to the critical process of decision-making among executives.

But, surprisingly, in the world of small and mid-size enterprises, the rules of the business game have not been changed completely and still, in most of the cases, are based on industrial-age that is facing obsolescence during these days. Thus, the aim of this thesis is to analyze the challenges of growing SMEs with traditional management systems in this fast-paced digitally connected world of intelligence. And try to figure out that would BI systems be a bona fide remedy for small and medium segments of enterprises.

To this end, in the chapter of the empirical case study, the designing and implementing phases of the data-integration system, which is conducted by the author of this thesis, for an Italian mid-size company that is active in the electronics and industry 4.0 segment of the market, called Seica S.p.A., has been explained.
The second part instead, is dedicated to the analyses of BI implementation projects and surveys within SMEs which is selected and assessed from the academic literature.
Since the BI technologies are relatively new even for large enterprises, there were extremely limited number of empirical case studies among academic literature in the context of SMEs, and it was a challenge to find the appropriate ones for the aim of this dissertation; these case studies that have been assessed based on Gartner's maturity model on the analyses chapter, in order to shed more light on the criticality of these data-driven decision-support platforms, within SMEs context.

Keywords:

Business Intelligence(**BI**), Decision Support Systems(**DSS**), Business Performance Management(**BPM**), Enterprise Resource Planning(**ERP**), BI maturity model, Small and Medium Enterprises(**SME**s)

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1. Introduction

> “You are not the product of your circumstances,
> but rather a product of your **DECISIONS**.”
>
> - *Stephen Covey*

Definitely, there is no arguing about the fact that, the first and foremost task of a leader is nothing but the art of decision-making; this is how a leader is distinguished from others. They are courageous enough to make the most difficult decisions that nobody else dare to make, as they know they are going to be wrong; but, if they’re wrong, they know what they want, they see it’s not working and they will change it, which means they will make another decision and will do something new and see if it works. That is the essence of how we grow.
If we analyze any business, and even our personal lives, the only force behind shifting a business is the force of decision-making. The art of decision-making is the force that shapes our personal, corporate and business destiny. And the secret which lies behind successful enterprises and entities is getting extremely good and making more effective decisions in both enterprise and personal aspects; so, decision making is the power.

During the critical process of decision-making, there are three main decisions that are made by any leader, business owners, and executives…

1. *What should I **focus** on?*
2. *What does this **mean**?*
3. *What should I **do**?*

For instance, at some stages in businesses, the focus of the entrepreneur of the business is increasing sales, and when the business is successful in the sales increase, after a short period, it eventually fails; because its sales are increasing, but not the profit!
There is a life-cycle to a business, and at different stages, the leader should change the focus accordingly. If a leader is going to make effective decisions, he got to know where he is on this life-cycle.

The moment in which the leader focuses on something, in particular, he is going to feel it, that means *“focus equals feeling”*. Thus, here, the role of a leader is, managing these feelings by managing his focus. The entrepreneur who leads other people, have to create a focus for the organization to be successful and have to find what our employees and other people are focusing on, which is affecting all the decisions in the company.
So, the moment that a leader gives a meaning to a particular issue, he will get a feeling; and based on that feeling, he is going to take an action, which completes the general decision-making process.

One of the biggest concerns of managers in this fast-paced competitive world is to be well informed, and more importantly stay in this condition, about their business situation through their industry’s market. For this reason, businesses are getting to know the value informed decision-making platforms, such as Business Intelligence and Extended ERP systems, and putting more stress on this issue day by day.

The main reason for enterprises to implement ERP systems is to integrate corporate data, from different data sources, and put them into a one unique data source and use them as a decision support system. Approximately, within last 5 years, defining performance metrics for Business Performance Management systems (e.g. Key Performance Indicators), adding real-time data analytics and dynamic reporting functions to the management integrated systems, not only is not a plus, but is a must-have function at each enterprise who needs to survive in this competitive digital world.
Nevertheless, implemented traditional ERP systems within enterprises does not seems competent enough to satisfy all those needs, and these traditional systems are facing some challenges from different aspects; Reporting Capability, Budgeting Capability, System Integration Capability and Practical problems, to name a few (Agostino 2004; Chou, Tripuramallu, and Chou 2005).
Thanks to the Business Intelligence platforms and extending the capabilities of traditional ERP systems from back-office task to enterprise-wide, organizations have the option of making timely and accurate decisions which leads to significant improvements in sales, customer satisfaction and decision-making areas (Chou, Tripuramallu, and Chou 2005).

In 1989, Howard Dresner, who is one of the Gartner group's analysts, presented the new terminology at that time, which is nothing but BI or Business Intelligence, with the aim of bringing improvement mainly in the process of decision-making, via *fact-based* systems. These fact-based systems mostly consist of following components (Chou, Tripuramallu, and Chou 2005):

"Executive information systems, decision support systems, enterprise information systems, management support systems, OLAP, and newer technologies such as data mining, data visualization, and geographical information systems."

Thanks to the mentioned-above BI's systems and architectures like data warehouses embedded with data mining and analytical capabilities, enterprises not only have the option to integrate different data sources from marketing to sales departments, but also, they can use BI applications to query financial views such as *Sales order entry*, *Accounts receivable*, *Bank reconciliation* and *General Ledger* (Rasmussen, Goldy, and Solli 2002).

There are countless benefits of integrating ERP and BI systems within an enterprise, since the focus of ERP systems, generally is on transactional systems which are not enough in this fast-paced digitally connected world. These integrated platforms can bring business value and competitive advantage form different perspectives, for example, cost reduction within different components of an enterprise like Inventory and IT infrastructure costs. Another potential upbringing value can be in the shape of effective communication with suppliers and customers through the process of undergoing projects (M. I. Nofal and Yusof 2013).
In the dynamic world of business, which everything is changing at a rate of a glance, especially within growing enterprises, BI systems are playing crucial role in efficiency part of the game and should ERPBI systems should and will evolve in a continual manner to fit the latest enterprise needs (Hou and Papamichail 2010; M. I. Nofal and Yusof 2013; Chou, Tripuramallu, and Chou 2005).

Since, the terminology of ERPBI is relatively new, it is hard to find many research studies or empirical cases within academic literature, and the main reason behind this issue could be the fact that, mostly large enterprises and especially not long ago are started to implement these platforms and their high levels of organizational hierarchy is a barrier for researchers to conduct a study on this issue.
Among very limited success factor models in the field of ERPBI, M. Nofal proposed a model in order to identify these criticalities. This model assesses the critical success factors of ERPBI platforms form three different perspectives (M. Nofal and Yusof 2016);

The first category is focusing on ***Organizational*** factors which are *Clear vision & Planning*, *Top Management Support*, and *Effective Communication*.
In the second category, the focus is on ***Process-related*** factors which are *Effective Project Management*, *Change Management*, *Team-work & Composition*, and *Training*.
Within third part, however, the focus is on ***Technological*** aspects like Data Quality & Integrity, and IT Infrastructure (M. Nofal and Yusof 2016).
This model shows that, in order to have effective and successful ERP and BI integrated platforms, the enterprise should focus on a variety of different enterprise-wide factors from different departments.

There is no doubt about the fact that, in the age of information, companies are facing economy globalization and this issue put additional pressure and more responsibility on the shoulders of executives since they have to be extremely dynamic and efficient within the decision-making process. Among enterprises, SMEs are an easy target for changes in business markets in comparison with LMEs, thus they need more consideration regarding economic volatility issues. Efficient business monitoring, complete awareness of recourses' usage within the enterprise, specially data-related recourses could be a possible remedy for SMEs in order to survive in the global business-battlefield (Tutunea and Rus 2012).

As professor René Gélinas emphasis, there is a subtle need to change the traditional viewpoints of SMEs' in the management's context (Gélinas and Bigras, n.d.):

"Growing numbers of SMEs are under pressure from large manufacturing enterprises (LMEs) to change their traditional management styles, both operationally and organizationally, replacing them with integrated systems that help increase the speed and fluidity of physical and information flows, help synchronize demand with supply, and help manage transactions more accurately."

There is not a unique definition of the specifications of SMEs, in the world-wide context, since there are variations regarding the size and the turnover amount of these enterprises within American and European business market;
Based on Carter's definition of SME, enterprises with up to 500 employees and $25 million in annual revenue are considered as an SME in the United States. On the other hand, enterprises with less than or equal to 250 workers with a maximum annual turnover of €50 million, or €43 million in the balance sheet are considered as an SME in the European market (Carter and Jones-Evans 2012).

As Forsman indicated, SMEs are playing a significant role in the future's economy, and accordingly, they should be treated with utmost care to be in their perfect productive state (Forsman 2008).
SMEs are playing a momentous role and considered as a backbone of the national economy in different countries (Hidayanto, Karnida, and Moerita 2012);
Based on Eurostat's, within the fiscal year of 2007, between 27 European countries and in the non-financial business economy sector, SMEs are constituted 98.8% of the nearly 19 million enterprises (*Europe in Figures, Eurostat Yearbook 2007* 2007), (Zach, Munkvold, and Olsen 2012). On the other hand, 51% of employment rate in the United States, 64% of employment rate in Canada alongside with 67% of employment rate in European Union, excluding financial market, belongs to SMEs (Snider, Silveira, and Balakrishnan 2009; *Europe in Figures, Eurostat Yearbook 2012* 2012).

Based on the 3000 survey result from different executives, which was undergone by MIT Sloan in collaboration with IBM, during the year of 2010 among 108 countries worldwide, the amount of 51% of all these enterprises belonged to the SME's category (LAVALLE et al. 2010).
Figure 1 illustrates the detailed distribution of enterprises who contributed to this survey, based on their turnover and the country of origin.

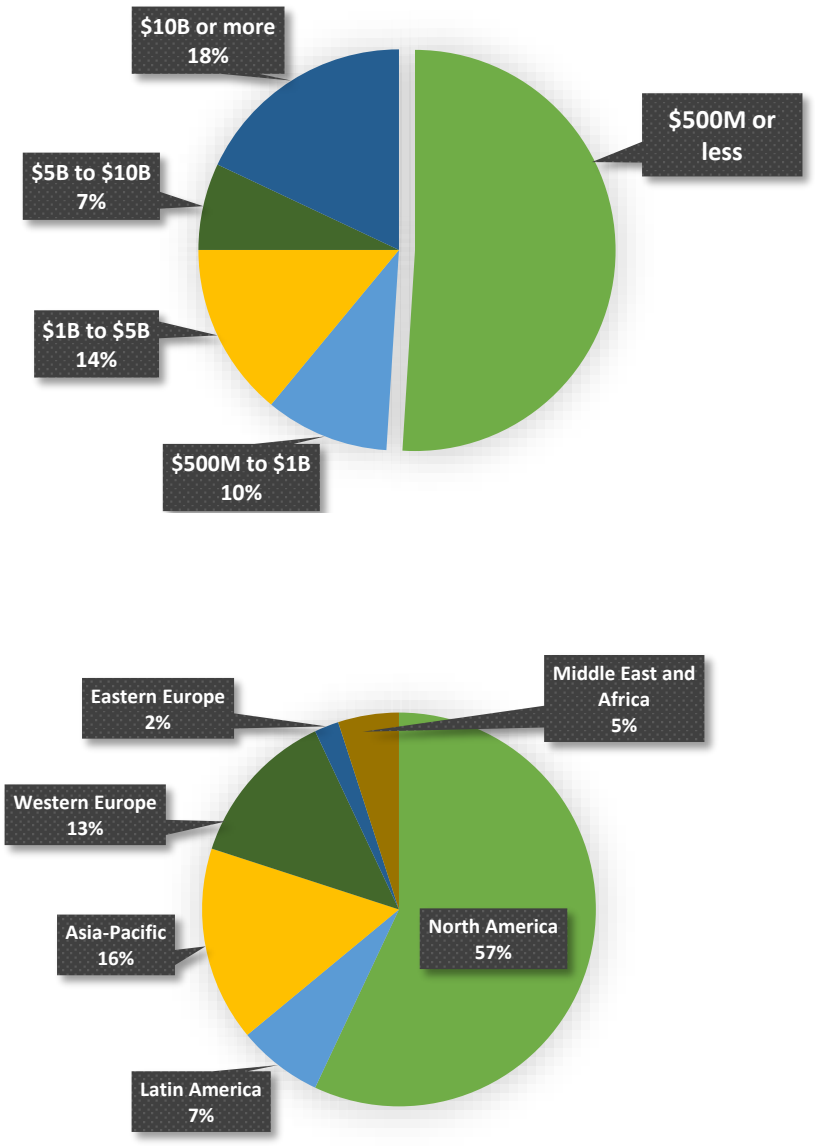

FIGURE 1- DISTRIBUTION OF 108 SURVEYED ENTERPRISES BASED ON THEIR REVENUE AND COUNTRY OF ORIGIN, MIT SLOAN & IBM, 2010

Having all these said, despite the pivotal and significant role of SMEs in different countries' economy situation, most of them are still struggling with implementing modern technological devices like ERP, BPM, and BI alongside with shortage of financial and human resources (Achanga et al. 2006; McAdam 2002). Recently, ERP and BI vendors, Like SAP and Microsoft, may see this opportunity within SMEs, that they provided SMEs with specific ERP/BI and DSS systems just design to fit their needs.
But more importantly, here, the main issue to tackle is the distinct characteristics of SMEs that totally different from large enterprises, which are the ownership, structural and cultural differences (Wong and Aspinwall 2004).

These specifications of SMEs may have a considerable potential to affect the adoption and implementation of effective ERP/BI and DSS applications in the context of SMEs and the main objective of this dissertation is shed more light in this critical issue.

2. Research Methodology

Within last decades, the act of "Researching" was misguided for collecting the information, following with documentation of the founded facts, and information frisking (Leedy and Ormrod 2012). But the modern definition of research is, first, defining the research objective by drafting research questions, which will give the researcher a systematic view through the objective and will support the process within a supportive framework, then in the next step, founded data will be analyzed and managed by them. These factors will guide the researchers to concentrate on their ideas easier, managing their efforts, and accordingly employing the suitable research-approach to fit each phenomenon of interest (C. Williams 2007).

Among three common research approaches, which are quantitative, qualitative, and mixed, the **qualitative** perspective is employed by the author of this dissertation. As Creswell mentioned, "*quantitative research is the process of collecting, analyzing, interpreting, and writing the results of a study, while **qualitative** research is the approach to data collection, analysis, and report writing differing from the traditional, quantitative approaches"* (C. Williams 2007; Creswell 2011).

Based on Leedy and Ormrod categorization of qualitative methods, there are five different type available (Leedy and Ormrod 2012), which are:

- ***Case Study***
- Ethnography Study
- Grounded Theory Study
- Phenomenological Study
- Content Analysis Study

There are some definitions available in the literature about case study research approach which discuss the *generalization* problem of this research method since in their opinion the nature of this approach is religiously exploratory (Dul and Hak 2007). In order to provide a remedy for this obstacle, authors like Yin (Yin 2013), stated that the generalization problem of single case study approach could be overcome with the strategy of "multiple case studies". Thus, authors like Ragin (Ragin and Becker 1992), mentioned the fact that, case study researchers have to back and forth among different approaches (hybrid nature), which it is quite tricky and daunting to untie them.
But the complete definition of case study approach, however, in comparison with definitions mentioned above, is the following (Dul and Hak 2007):

"*A case study is a study in which,*

a) One case (single case study) or a small number of cases (comparative case study) in their real-life context (not manipulated) are selected, and
b) Scores obtained from these cases are analyzed in a qualitative manner."

The chapter 5 of this dissertation, is based on empirical case study approach, which explains chronological steps of designing and implementing a data integration system for the management department of a fast-growing Italian SME, located in Piedmont province, which is active in the field of electronics. The designing and implementing project took around 7 months of dedicated work in the mentioned enterprise. During this period, some unstructured and casual interviews are done with executives of the enterprise regarding managerial support and decision support systems and applications within SME's context.

The fruit of these interviews and in-depth analysis of enterprise's different departments and production processes, within 7 months of time horizon, were some assumptions which lead to manifesting some major problems in the context of SME.

In chapter 3, in-depth analysis of research's key terms, which are ERP (Enterprise Resource Planning), DSS (Decision Support Systems), BI (Business Intelligence), and BPM (Business Performance Management), are available, based on literature review. This leads the manifestation of research questions which are the followings:

I. ***Defining the barriers of Business Intelligence systems' implementation within SMEs…***
II. ***What are the remedies for eliminating these bottlenecks to have a successful and effective BI/BPM system in SMEs?***
III. ***Finding the success factors, in order for BI systems to be successful within SME's context and the importance of these systems as an enterprise's competitive advantage in the modern information age…***

Since based on a single case study, it is not possible to generalize the results to the sphere of all SMEs, within chapter 4 of this dissertation, the number of 9 other implementations and analyzing Business Intelligence case studies were selected from the literature. These cases were selected by keyword search technique, thanks to the academic search engines like "google scholar" and "electronic library of Politecnico di Torino". The mentioned keywords are, "*BI*", "*Business Intelligence*", "*Decision Support Systems*", all within the context of SMEs and within the time horizon of last 5 years, 2012-2017.

Finally, in chapter 6 of this dissertation, based on inductive reasoning approach, there is comparative cross-case analysis available among all case-studies, which were introduced in chapter 4.

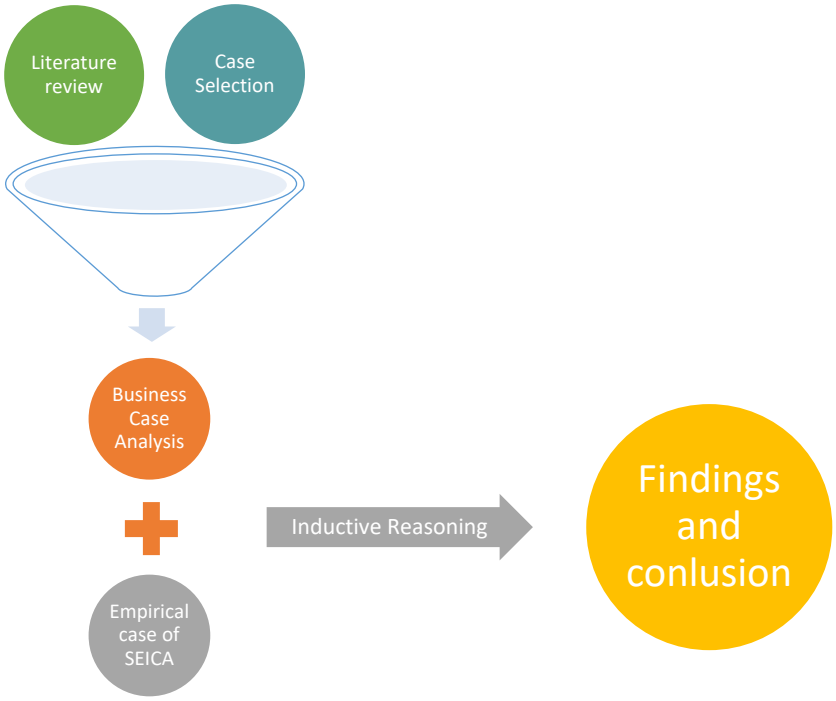

FIGURE 2- RESEARCH STEPS

3. Theoretical Background

3.1. ERP

When we google the term ERP, which stands for “Enterprise Resource Planning”, there are different definitions and understandings around this term based on the timeline and disparate needs of organizations and enterprises; But, there is something common in almost all the definitions and it is nothing but “Integration”.
As *Investopedia* (Staff 2005) interestingly explains ERP, it compares ERP with our body’s central nervous system and the reason for this comparison is the role of both is the integration of data flows from different parts and put them all together in one single place.

Nowadays, when we talk about ERP systems, it may seem like it is a relatively new and complex technological phenomenon but based on Oracle’s definition of ERP, it’s root is back to 1913 when Mr. Ford Whitman Harris used a new methodology called EOQ or “Economic Order Quantity”. EOQ is a paper-based technology and the aim of this tool was scheduling of manufacturing system.
Later in 1964, Black and Decker which was a toolmaker in that time, was the first company to computerize the EOQ concepts and adopted the new way of planning called MRP which stands for Material Requirements Planning.
As technology penetrated the industry more and more, during time horizon till 1983 the basic MRP evolved into a new way of planning called Manufacturing Recourse Planning or MRP II. The key role of this new system, thanks to software architectural modules, was integrating the core manufacturing departments and components into one single place; the components like a bill of materials, procurement, scheduling and contract management.
Thanks to the MRP II, different organizations understand if they fully leverage this powerful software system they could integrate their business data and increase their operational efficiency with improved production planning, reduced inventory, and less waste.
By the passage of time, during the 1980s, when computers started to play a crucial role in different industries and businesses day by day, MRP II usage expanded outside manufacturing to more departments like CRM (Customer Relationship Management), the incorporate finance and HRs data.

Based on the paper written by Brent Snider (Snider, Silveira, and Balakrishnan 2009), we have different definitions of ERP during the evolution of this system;
The evolution of MRP can be clearly seen if we put the definitions in a chronological order as below:

1998, Davenport

> *ERP defined as "Complex pieces of software" and organizations need an enormous amount of resources for the implementation of the system.* (Davenport 1998)

1999, Bingi et al.

> *Also in this paper suggested that implementation failure might have fatal consequences.*(Bingi, Sharma, and Godla 1999)

2000, Markus et al.

> *We have ERP systems thanks to the expansion of traditional MRP II systems to incorporate business activities beyond the production department.*(Markus, Tanis, and van Fenema 2000)

2003, Mabert et al.

> *In this paper, ERP is defined as "…enterprise-wide online interactive systems that support cross-functional processes using a common database".*(Mabert, Soni, and Venkataramanan 2003)

2003, Jacobs and Bendoly

> *They describe ERP systems like "…corporate infrastructures, much in the same way that physical highway systems do."* (Jacobs and Bendoly 2003)

2018, SAP corporation

> *As SAP explains the definition of ERP in its website, the very basic role of ERP systems is the integration of different processes like supply chain, finance, procurement, manufacturing, HR, and others into a single system. But in the new ERP systems, we have visibility, analytics, and efficiency among all different components of a business. Thanks to the latest technologies like IOT (Internet of Things), data-driven decisions and live performance management can easily be made by enterprises since ERP systems facilitate the flow of real-time information across departments.*

If we compare these different definitions of ERP during the evolution of this system, we can see that from the 1990s to present the role of ERP systems has been changed from new and unreliable technology to one of the must-have and crucial systems in any company.

3.2. DSS

There is no doubt that today's world of business has a volatile and super dynamic environment and this leads managers and executives to deal with competitive challenges and opportunities in their decision-making process. On the other side, organizations have their own ways of responding to these competitive pressures generated from this environment.
Then, organizations will keep track of their activities and actions which are taken to cope with different challenging situations and will ask themselves lots of different questions like:

- How can we respond to the competition and make a prediction?

The way in which organization answer to these types of questions is playing an important role in the existence of them in this dynamic and challenging environment. In this part of the process, computerized support for decision-making plays a crucial role for the enterprises.

Here, in Figure 3, we can see the support model by (Turban, Sharda, and Delen 2014) which clearly depicted the mentioned process of decision-making in companies.

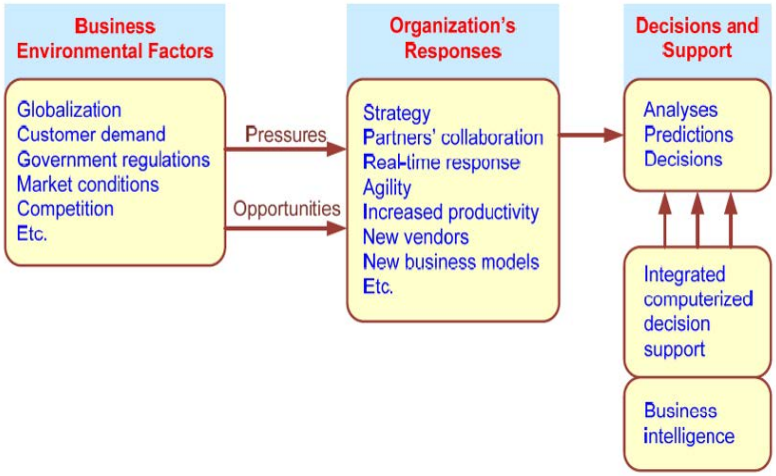

FIGURE 3- BUSINESS PRESSURES, RESPONSES, SUPPORT MODEL

We cannot deny the fact that decision-making is carrying utmost importance in the list of managers' responsibilities.

Surprisingly, even though managers face different situations and challenges in their business's lifespan, they take similar steps to make an effective decision each time! These steps are:

- Defining the problem.
- Constructing a Model.
- Identifying and Evaluating possible solutions.
- Recommending a potential solution.

These steps are the fundamentals of the decision-making process which Prof. Jahangir Karimi from University of Denver, Colorado, believes that they are virtually the same for almost every decision situation that we can think of ("Coursera | Online Courses From Top Universities. Join for Free" n.d.).

Although these steps are the same, in everyday challenges of making the decisions, managers are dealing with different categories of decisions. These categories are:

- Structured Decisions
- Semi-structured decisions
- Unstructured Decisions

In the first category which is expected from its name, problems have a high level of structure and for this reason, they usually fall into one of the known categories of problems that managers have the procedures to obtain the optimal or at least acceptable solution. These are problems like adjusting the suitable inventory levels which the objectives are defined clearly.
The next level of decisions is semi-structured decisions which are more demanding for managers because the decisions rely on standard solutions and human judgments at the same time. We can think of trading bonds and performing capital acquisition analysis as semi-structured problems.
The latter case which is also the most complicated one for the executives is unstructured problems. This kind of problems usually have a fuzzy and complex nature and recruiting a new senior-manager and budgeting a new product by R&D department are the examples as such.

We should consider the obstacles that managers have in this process like time and budget constraints besides lack of enough information or also on the contrary information overload. The management science by itself can solve the problems which are structured of a kind; but to solve the semi-structured and unstructured problem, executives must rely on computerized decision support systems, which called DSS, to be able to make decisions that are effective and efficient enough.
The ability of computers in analyzing and processing the data which is well beyond the capacity of the human brain has been proven since the early 1960s till today. Not to mention that when we are talking about DSS, we mean systems that support humans to make better and unbiased decisions, not the systems that make decisions by themselves.

For DSS to be effective, it should be in line with manager's decision-making style. Based on Coursera.org ("Coursera | Online Courses From Top Universities. Join for Free" n.d.), these styles are "Perceptive vs Receptive", "Heuristic vs Analytic" or "Autocratic vs Democratic".

Herbert Simon's research in cognitive psychology demonstrates that decision-making process has these four phases:

- Intelligence
  - Define, confirm, classify and assign an owner.
- Design
  - Create models to solve a problem.
- Choice
  - Recommend a proposed solution to the model.
- Implement
  - Manage the application of a new process.

Figure 4 shows the detailed map of this process which depicted from the book of Business intelligence and Analytics (Turban, Sharda, and Delen 2014);

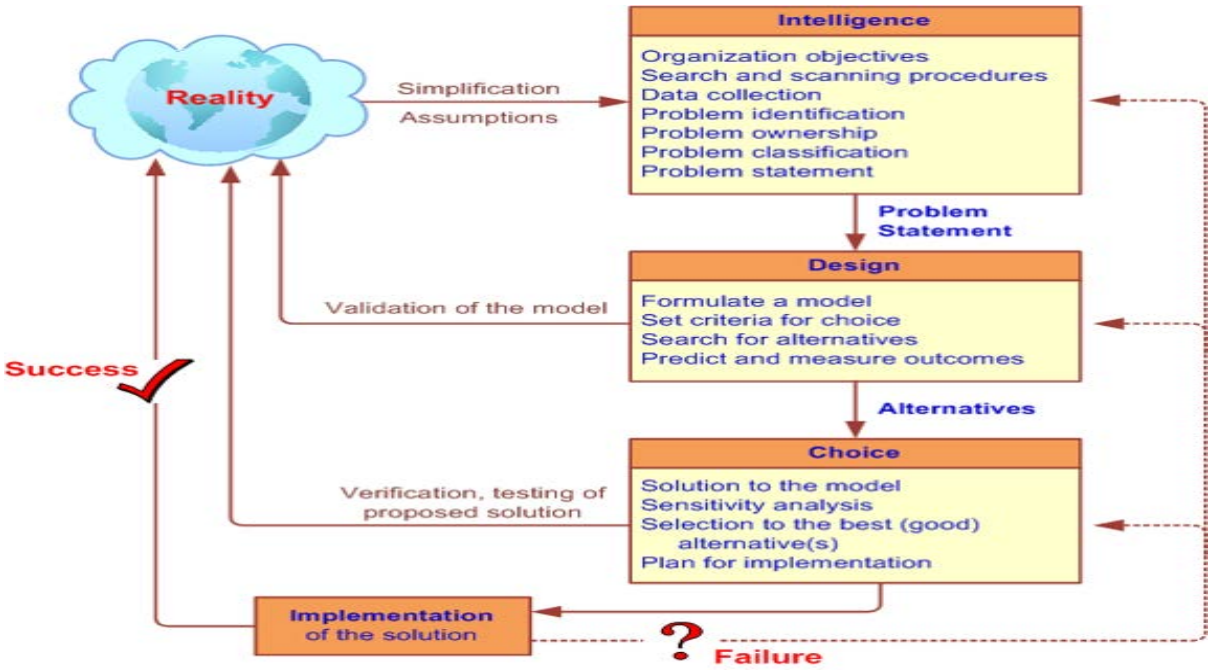

FIGURE 4- SIMON'S DECISION-MAKING PROCESS

Then we can analyze the different decision-making strategies which people use during this critical process.

The first strategy is the goal-confirmation; people have a different attitude toward the same problem and in the group thinking it can cause to make a biased decision by the group to avoid potential conflicts.
The other strategies that people usually use are optimized vs a satisfactory solution. In the optimized solution strategy, we are seeking the single best solution and people in this category are carrying normative approach. On the other hand, in the latter one people avoid perfectionism and implement a descriptive approach which follows incremental victories which are also attainable.

One of the setbacks in the optimization strategy is that in this strategy the decision maker should be completely rational which is not possible because of the limited capacity of human-beings in rational thinking.

The second strategy is “Elimination by Aspect”. In this strategy, the group choose a priority aspect and consequently eliminate the solutions that not satisfy this prioritized goal. In this way, managers and executives have the possibility to focus on their most important priority for their business.

The third strategy is “Mixed Scanning”. This strategy is like Elimination by Aspect but the difference is, here, executives identify devastating objections which cause problems for the proposed approach. Then through series of actions like processing and evaluating, decision-makers are able to reject those handicap objections until one alternative remains in the basket.
The final strategy is that executives can Eliminate or Minimize the risk. They may assess the risk of the unstable situation based on four scenarios; worst, best, average and most likely.

DSS is an umbrella term which is about computer-based decision-making systems which help lots of mid-level managers to deal with semi-structured and unstructured problems.
There are three main components in the DSS, which are:

- Data Management
- Model Management Subsystem
- User Interface Subsystem

Turban in his book about Business Intelligence illustrates these components clearly in details(Turban, Sharda, and Delen 2014). These figures below are borrowed from his book and are explaining these main components and their subsystems better than sentences:

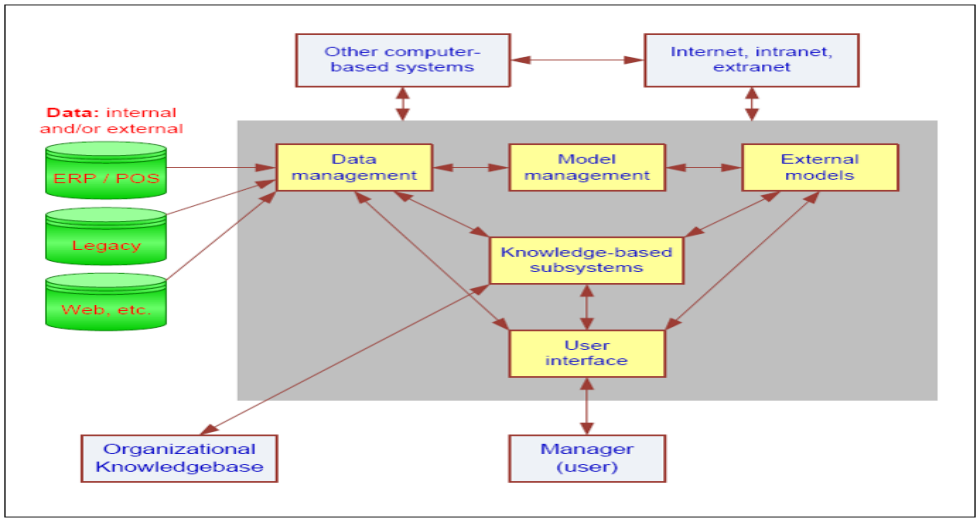

FIGURE 5- COMPONENTS OF DSS

Figure 6 is about Data Management subsystem and the role of this system is data extraction from different databases of the enterprise.

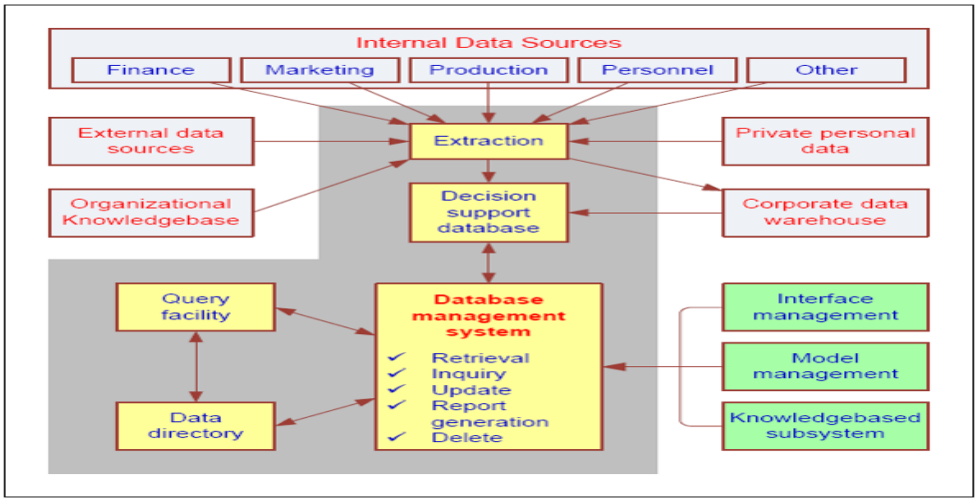

FIGURE 6- DATA MANAGEMENT SUBSYSTEM

Figure 7 illustrates the Model Management subsystem which oversees analytical tasks like financial management or any other quantitative task.

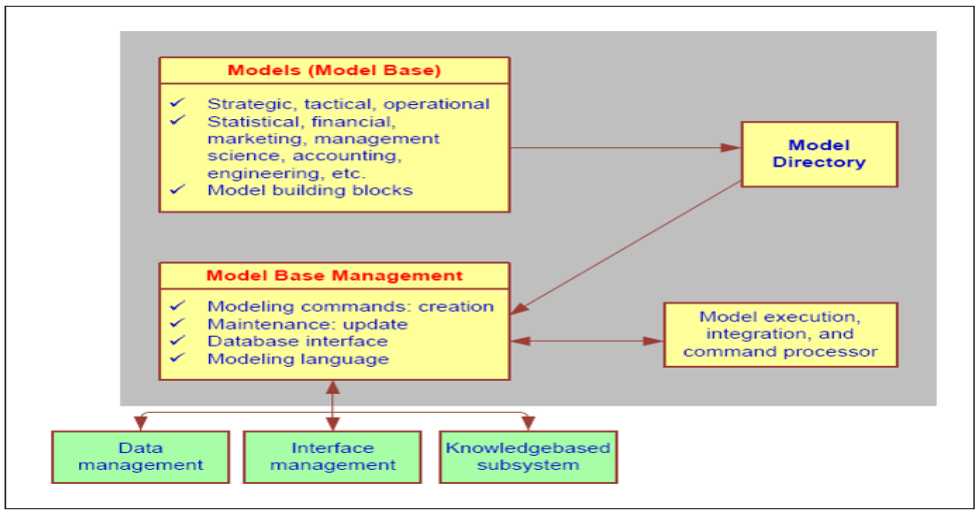

FIGURE 7- MODEL MANAGEMENT SUBSYSTEM

And finally, we have User Interface subsystem which depicted in Figure 8 that contains dashboards and other graphical interfaces and portals.

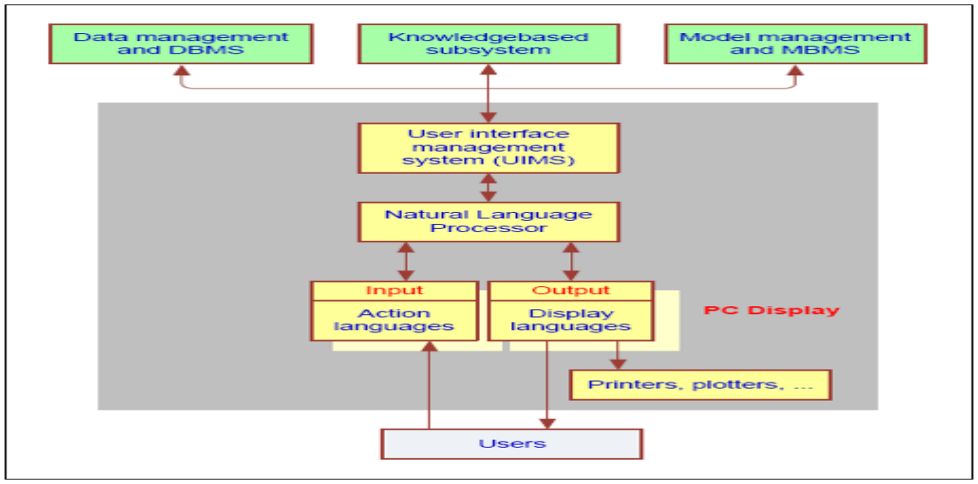

FIGURE 8- USER INTERFACE SUBSYSTEM

After understanding the components of DSS, we can switch to different types of DSS. Dan Power is the founder of DSS Resources (www.DSSResouces.com), a comprehensive website devoted to decision support. On his website, Power provides a contemporary classification system for DSS:

- Data-driven
- Document-driven
- Knowledge-driven
- Model-driven
- Communications-driven

Now we can evaluate the evolution of Decision Support Systems. There are many different and familiar applications that come through DSS during the evolution of this term, although each of which is a well-defined subgroup. Here is the evolution of DSS applications based on Turban opinion in his book (Turban, Sharda, and Delen 2014):

- Executive Information Systems – EIS

These systems are used to access news, stock prices, and information about competitors, customers, key performance indicators, and internal operations using dashboards and scorecards.

- Group Support Systems – GSS

These systems are generally used for idea generation, group writing and record keeping. Thanks to conferencing systems like Skype, which are widely used in enterprises nowadays, executives have the possibility to participate in international meetings without traveling expenses.

- Geographic Information Systems – GIS

In this modern age of technology, even elementary school children are using this technology which is embedded in their phones and tablets. When they try to search for near cinema or amusement park or McDonald's, they are using GIS and Global Positioning Systems or GPS at the same time. It gives the opportunity to marketing experts to make more accurate decisions based on customers locations and ethics.

- Expert Systems – ES

A good example of these systems is police call center of U.S. or 911. This call center incorporates the knowledge of different human experts in a narrow problem domain and thanks to these systems can solve problems which normally experts solve.

- Knowledge Management Systems – KMS

The famous example of these systems is Wikipedia which is known for almost everyone in the age of the internet. Companies use this system to identify similar past situations and the way they are treated.

- Enterprise Resource Planning – ERP, Customer Relationship Management – CRM, Supply Chain Management – SCM, which these latter three categories are known as Management Support Systems – MSS

These systems, use the information systems to help the executives of enterprises at the institutional level.

Decision support systems have huge capabilities which are depicted in Figure 9 from Turban's book of business intelligence (Turban, Sharda, and Delen 2014).

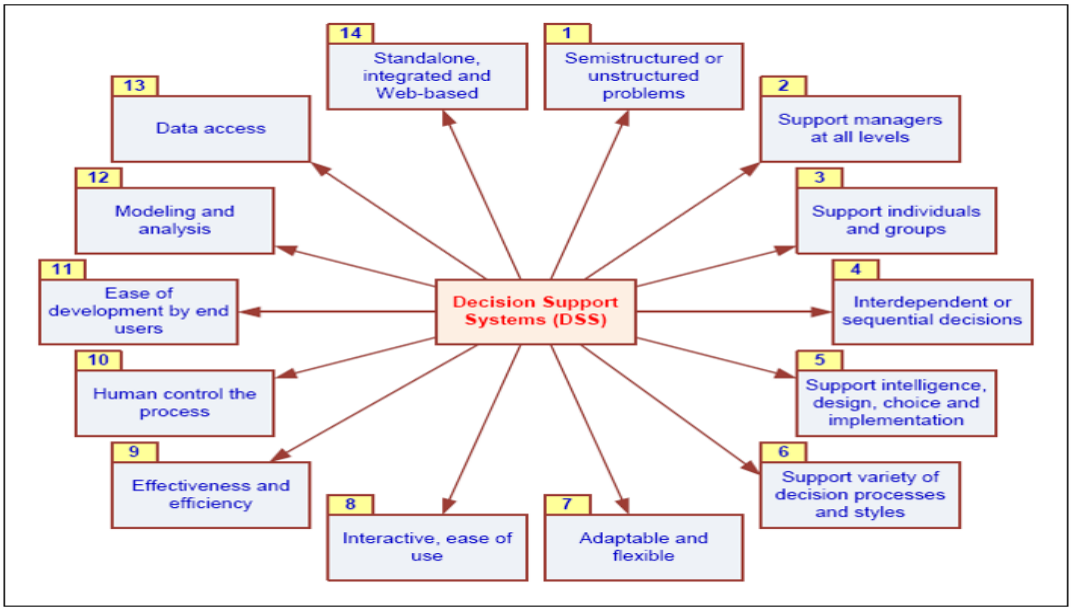

FIGURE 9- DSS CAPABILITIES

Since we've talked about Simon's decision-making support strategies, we can focus on element number 5 in Figure 9 which is about different phases of Simon's DSS support model. Figure 10 from Turban's book (Turban, Sharda, and Delen 2014), illustrates these four phases and the applications which are used in each phase to fully leverage the true potential of DSS :

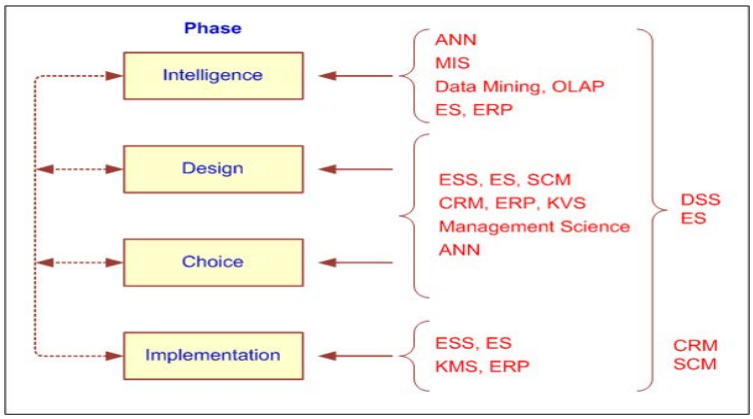

FIGURE 10- HOW DECISIONS ARE SUPPORTED IN PRACTICE

To close this section, it is useful to know a bit about the history of DSS development through time. The need of having a decision support system has raised because there was a need for having distinct data repository by organizations. The old and famous version of DSS belongs to Lyons' Tea which was built around 1951 in England. It was the first generation of DSS systems and back in that time, the name of this system was LEO 1 (Lyon Electronic Office). The role of this system was given support to the activities like overnight production requirement, assembly instructions, delivery schedule, invoices and management reports at that time.

The era of the second generation of DSS starts when data warehouses appeared to give more support in different business components like accounting and logistics. Thanks to this generation of DSS, there was an enterprise-wide data warehouse system which also has embedded different application inside, EIS and GPS to name the few. Another aspect of second-generation DSS was the usage of OLAP (Online Analytical Processing) systems alongside dashboards and scorecards applications.
By penetration of Internet usage in the industry and enterprises, we are facing the last industrial revolution which called industry 4.0 and one of the latest buzz words is IOT or internet of things. Thanks to the internet in this latest evolution we now have the third generation of DSS and one the famous characteristics of this generation is real-time or live data warehouses. The components of the third generation DSS are getting smaller and faster day by day and we can see DSS, embedded in more different systems. In today's world of business, enterprises need technologies to access integrated data to store, to analyze and to make better decisions.

3.3. BI

Business Intelligence or BI is one the latest buzz words in the world of business and we started to hear BI more and more these days. Although BI is almost part of every big company among 500 fortunes nowadays, still there are SMEs which don't have any idea about this term.
Like any other new buzz word, which is also a content-free term, in the world of business, there are different definitions for the BI available on the internet;

Below is the definition of BI by Data Warehousing Institute:

> The processes, technologies, and tools needed to turn data into information, information into knowledge, and knowledge into plans that drive profitable business action.

And here, Hitachi Solutions (Hitachi Solutions Canada n.d.) explains the term BI in a really clear way:

> BI is about delivering relevant and reliable information to the right people at the right time with the goal of achieving better decisions faster.

For this to happen, BI platform must gather unstructured data from different components of the business, then transform it into meaningful information and present it to executives to make the enterprise decisions better and more professional. BI introduces a vast amount of raw data in a meaningful actionable way which is crucial in this fast-paced digital world.

While these are simple concepts, BI is a large and complex field including:

- Performance Management,
- Analytics,
- Predictive Modeling,
- Data and Text Mining and a lot more…

In the BI definition by Hitachi Solutions (Hitachi Solutions Canada n.d.), it intelligently compares the BI with the grocery store or a hypermarket. As in a hypermarket, you can find whatever you want by its organized aisles and specific signs that help you, similarly, in an enterprise which fully leverages the BI system, its executives can access to their attentive information at a glance of the eye. Thanks to the BI platform, executives don't need experts to find the relative information for them and then have this information compiled and transformed into the meaningful and readable way.

Instead of analyzing spreadsheets manually and making ad-hoc reports by employees of enterprises, organizations can use BI platforms to do so and make a strategic decision very fast based on reliable and accurate information made by BI systems.
One of the competitive advantages of BI systems is that thanks to providing anytime access to the organized and tidy data, executives will be able to figure out inefficient business processes and their hidden patterns, also strengths and weaknesses of the organizations will be clearer and consequently opportunities will be more visible and these all together will lead the executives to have a better understanding of the organizations' operations and challenges.
BI gives a unique opportunity to organizations to understand their potential or even existing customers better, because of predictive modeling in customers' needs segmentation and anticipating new opportunities to sell and even targeted marketing campaigns; since in this fast-paced digital planet, understanding customers' behavior thanks to their historical transactions and behavior

provided by BI, is a huge plus for the organizations and will increase their sales and also will help them to differentiate their brand more intelligently.

In a nutshell, Business Intelligence is a combination of different tools, methods, and technologies that gather raw data from different business components, having them organized and analyzed and finally presents them in a meaningful actionable way. In this way, organizations will have the opportunity of accessing accurate and understandable data which is on demand to find the appropriate solutions for their various challenges.

Despite the fact that there are some similarities between DSS and Business Intelligence systems, they are different in some aspect. Here are differences of two based on Business Intelligence course of coursera.org ("Coursera | Online Courses From Top Universities. Join for Free" n.d.):

- BI mainly uses integrated data from data warehouses with many possible data sources and formats, while DSS can use any data-source including a data warehouse.
- BI systems provide information that leads to better decisions, but DSS supports individual and institutional decision-making directly.
- BI orients itself toward executives and strategic decision-making, while DSS is usually oriented toward end users, analysts, and middle-level managers.
- BI tends to be developed with commercially available tools, but DSS tends to use custom applications to focus on structured and unstructured decisions.
- And finally, BI came from the software industry, while DSS largely oriented in academia.

Here, in Figure 11, we have the timeline and evolution of BI systems:

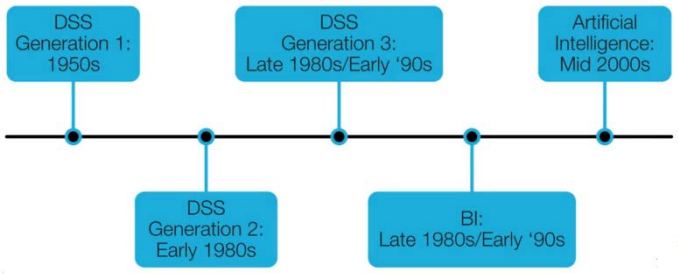

FIGURE 11- BI TIMELINE

As we can see from the timeline BI is actually the completion of the same process of DSS which also hosts EIS in the 80s and early 90s. In this part of the timeline the characteristics of dynamic multidimensional reporting, forecasting, and predictive analytics, and data mining were developing.
As we can see from the figure above, the term BI has appeared since the mid-90s, but the modern BI systems which we are familiar with today has been evolved since mid-2000s thanks to the latest technological buzzword which is AI or Artificial Intelligence.
We can say there are four major components available for BI which are…

- Data Warehouse,
- Business analytics tools to manipulate and analyze data,
- BPM system for monitoring and analyzing performance,
- A user interface which generally consists of dashboards, portals, and scorecards.

Here, in Figure 12, Turban explains deeply the capabilities and components of Business Intelligence systems:

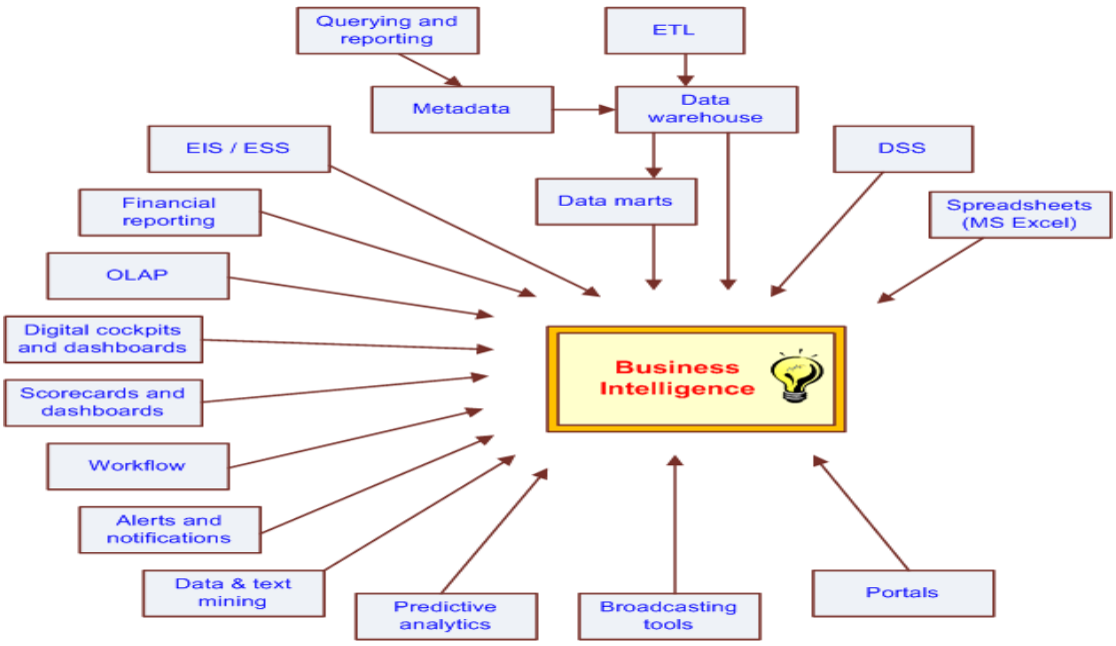

FIGURE 12- EVOLUTION OF BI CAPABILITIES

After getting know the components and capabilities of BI systems, we can focus on the general architecture of Business Intelligence systems. Here is a generic architecture in Figure 13 which is based on W. Eckerson in "Smart companies in the 21st century"(Eckerson 2003):

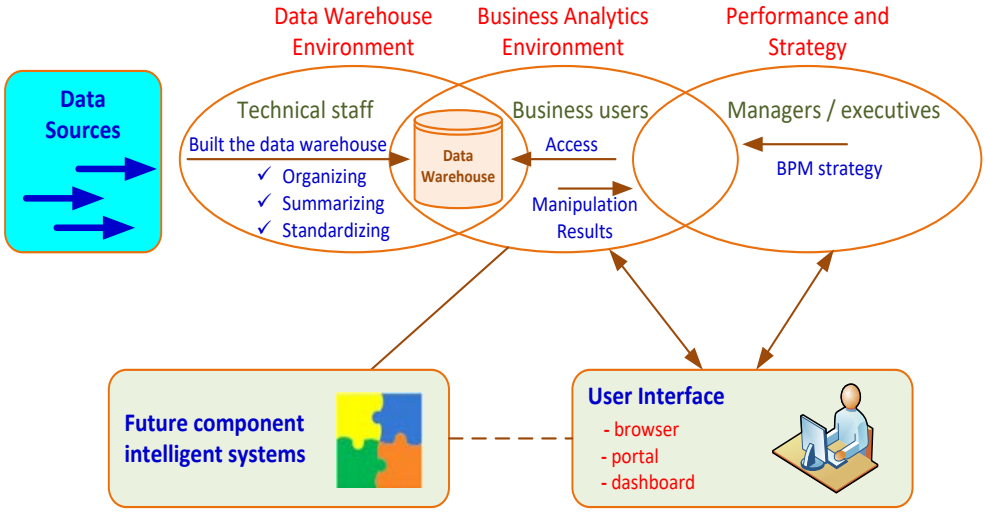

FIGURE 13- GENERIC AND HIGH-LEVEL BI ARCHITECTURE

In the detailed version of BI architecture, however, based on Pant (Deloitte Consulting LLP. 2009), BI architecture varies in each enterprise but there are some common components of BI architecture, which are found in some shape or form in all BI solutions. What is included in the BI architecture will be driven by the objectives, goals, and requirements of the enterprise.

Figure 14, depicts a comprehensive representation of the typical BI architecture. Multiple disparate Data sources, data integration services, data management services, reporting, analytical services, information delivery, and consumption services form the broad spectrum of the BI architecture.

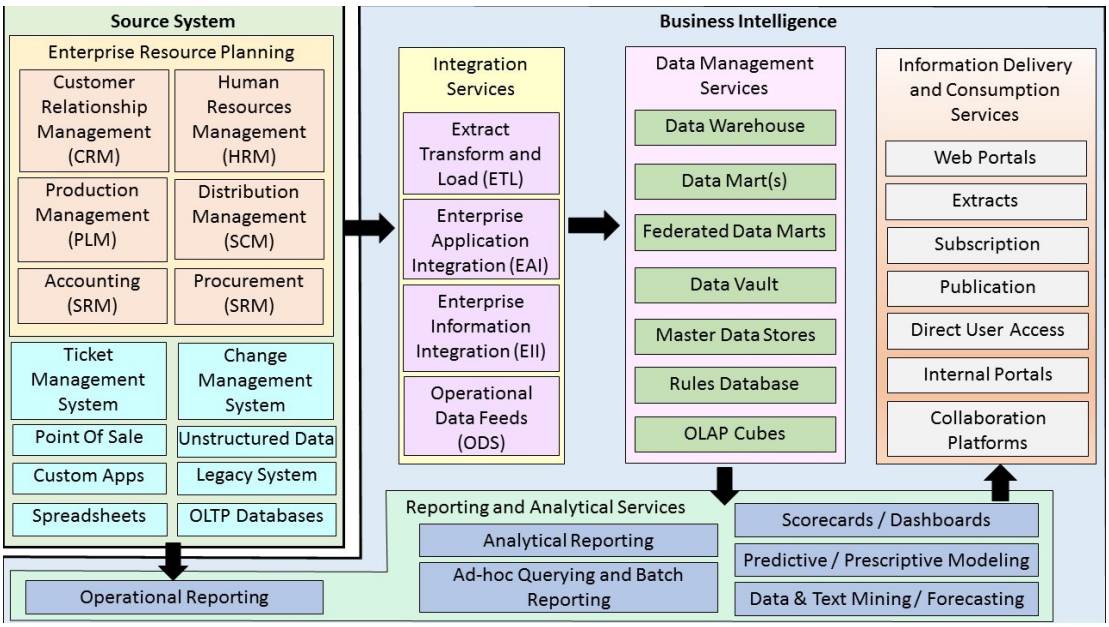

FIGURE 14- DETAILED LEVEL OF BI ARCHITECTURE

Business Intelligence falls into three different categories of applications; these three main types of application are:

- Strategic
- Tactical
- operational

Traditionally, Business Intelligence systems were used in the enterprises to achieve long-term organization-wide goals. This part falls into ***strategic*** application category of BI and examples of these applications are mostly financial like increasing revenue and market share, cost reduction and most importantly increasing profit.
But as time passes, enterprises understand in order to survive in the dynamic market, they must use the information more effectively and in this way, they can execute numerous decisions, better. ***Tactical*** applications like helping a sales manager optimize the region-wide sales campaign and other short-term initiatives are the examples of this case.
The last category is the ***operational*** applications of BI which help enterprises to identify process-centric solutions. This type of BI is usually used at a departmental level of organizations where operations take place and progress can be monitored thanks to the real-time charts and reports.

According to White, Critical Agility: Operational BI Generates Faster and Smarter Decisions TeraData Magazine Volume 9, No. 1, March 2009, the business value of business intelligence lies in its ability to improve the effectiveness of the core business processes that drive business performance. In the private sector, business performance ultimately means revenue generation and profit delivery. In the public sector, it means accomplishing a mission with an affordable balance between service level and productivity.

According to Business School of Colorado, Denver, BI's value proposition in spread all around the enterprise and have the answer to these following questions:

CUSTOMER SEGMENTATION

- What market segments do my customers fall into, and what are their characteristics?

PROPENSITY TO BUY

- Which customers are most likely to respond to my promotion?

CUSTOMER PROFITABILITY

- What is the lifetime profitability of my customer?

FRAUD DETECTION

- How can I tell which transactions are likely to be fraudulent?

CUSTOMER ATTRITION

- Which customer is at risk of leaving?

CHANNEL OPTIMIZATION

- What is the best channel to reach my customer in each segment?

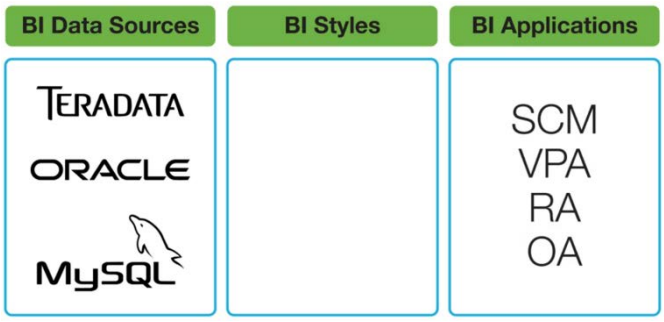

FIGURE 15- LAYERS OF BI

There are three different layers in the BI platform; Data sources are the first layer of this platform and they can be in terms of different kind of databases like relational, multidimensional, columnar or other types of databases.
The second layer is composed of a different type of applications to support companies to create reports, dashboards, and other analytic workflows. Customer Analysis, Supply Chain Management, Financial Reporting Analysis, Product Management, Vendor Performance Analysis, Risk Analysis and Operation Analysis are the examples of these applications.
The third layer which is responsible for providing a user interface to communicate with organization's data in various ways called different styles of Business Intelligence.

Based on MicroStrategy, we can categories these styles in 7 different parts which depicted in Figure 16. (“Data Analytics Trends - Blog - Stay Informed” n.d.)

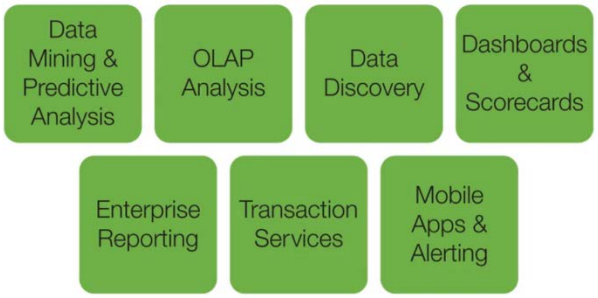

FIGURE 16- 7 STYLES OF BI

Nowadays, the usage of smartphones, tablets, and other technological gadgets are disrupted at almost all levels of our life and enterprise-grade BI platform must function across devices accordingly. This will give an opportunity to organizations to leverage the advantages of more pervasive BI.
There is a shift in the usage of BI platforms within last decade like the market disruption changes in a smartphone or other technological markets. During last years, BI platforms were considered to give support to IT departments and standardization projects, but today thanks to latest version of BI platforms wide range of business users from different departments and different levels of enterprises are demanding access to interactive styles of analysis without having specific knowledge in the technical fields or data science skills.

According to Gartner's 2015 report, "*traditional BI market share leaders are being disrupted by platforms that expand access to analytics and deliver higher business value. The BI and analytics platform market are undergoing a fundamental shift. During the past ten years, BI platform investments have largely been in IT-led consolidation and standardization projects for large-scale systems-of-record reporting. These have tended to be highly governed and centralized, where IT-authored production reports were pushed out to inform a broad array of information consumers and analysts. Now, a wider range of business users is demanding access to interactive styles of analysis and insights from advanced analytics, without requiring them to have IT or data science skills. As demand from business users for pervasive access to data discovery capabilities grows, IT wants to deliver on this requirement without sacrificing governance. This is important for companies as they invest in BI and Analytics platforms. BI leaders should track how traditionalists translate their forward-looking product investments into renewed momentum and an improved customer experience*." (Sallam et al. 2015)

FIGURE 17- MAGIC QUADRANT FOR BUSINESS INTELLIGENCE PLATFORMS, GARTNER (23 FEBRUARY 2015)

Based on Gartner (Sallam et al. 2018), the disruption of BI market began from 2004 and from that time, the system of records (SOR) platforms in enterprises started to shift from IT-Centric to Business-Centric agile analytics embedded with self-service capabilities. Recently, there is a new wave of disruption which is starting in the field of Business Intelligence's latest version by bringing augmented analytics as a differentiated option in the BI market.
Accordingly, from 2016, the Gartner group changed its criteria for the assessment of BI and analytics vendors in its famous Magic Quadrant Report. Gartner used five main use cases in the Magic Quadrant report which are around *Agile Centralized BI Provisioning*, *Decentralized Analytics*, *Governed Data Discovery*, *OEM or Embedded BI*, and *Extranet Deployment*.
Gartner also used 15 critical capabilities for assessing the selected BI vendors which all these capabilities are fallen into one of five different categories which are: *Infrastructure*, *Data Management*, *Analyses and Content Creation*, *Sharing of Findings*, and *Overall Platform Capabilities*.

There are two different evaluation criteria in the Gartner's Magic Quadrant which are two axes of the model.
The vertical axis is the criteria in which the execution ability of vendors' BI and Analytics platform is assessed. There are numerous factors are involved in the assessment of Gartner's group; like the positive experience of their customers such as sales, support, product quality, user enablement, availability of skills and ease of upgrade/migration.
On the horizontal axis, however, the evaluation criterion is based on completeness of vendors' vision which has the same factors as the vertical axis and mostly is around the assessment of vendors' understanding of how market forces can be exploited to create value for customers and an opportunity for the vendors.
Finally, the vendors are fallen into one of four different quadrants of Gartner's model based on their characteristics and specifications. Following are the short definition of each quadrant that adopted from Gartner's report of February 2018 (Sallam et al. 2018):

LEADERS

"Leaders are vendors that demonstrate a solid understanding of the product capabilities and commitment to customer success that buyers demand in the current market. This is coupled with an easily understandable and attractive pricing model that supports proof of value, incremental purchases and enterprise scale."

CHALLENGERS

"Challengers are well-positioned to succeed in the market. However, they may be limited to specific use cases, technical environments or application domains. Their vision may be hampered by the lack of a coordinated strategy across the various products in their platform portfolios."

VISIONERS

"Visionaries have a strong and unique vision for delivering a modern analytics and BI platform. They offer depth of functionality in the areas they address; however, they may have gaps relating to broader functionality requirements or lower scores on customer experiences, operations, and sales execution."

NICHE PLAYERS

"Niche Players do well in a specific segment of the analytics and BI market — such as cloud BI, customer-facing analytics, agile reporting, and dashboarding, embeddability or big data analytics — or have a limited capability to out-innovate or outperform other vendors. They may focus on a specific domain or aspect of BI, but are likely to lack the depth of functionality elsewhere."

Figure 18 is illustrating the Magic Quadrant for Analytics and BI Platforms as February 2018 and adopted from Gartner's report (Sallam et al. 2018).
In comparison with 2015, Microsoft made a considerable shift among leaders of the market and prized the Number 1 vendor in the market. The explanation behind this shift could lie behind the fact that, from 2015, Microsoft introduced its new BI platform, called Microsoft Power BI. One of the most noteworthy characteristics of Power BI is its ability of integration with Microsoft Office applications like Excel and Access which is of extreme importance for enterprises. Another reason could be the pricing strategy of Power BI that makes it easy for SMEs to adopt and implement this analytics platform based on their specific needs.

FIGURE 18- MAGIC QUADRANT FOR ANALYTICS AND BUSINESS INTELLIGENCE PLATFORMS, GARTNER (FEBRUARY 2018)

3.3.1. OLAP

One of the most effective styles of BI platforms is OLAP which stands for "Online Analytical Processing".
There are a variety of different aspects in which OLAP can be helpful for the organizations. Based on Business School of University of Colorado Denver, here is the list of different capabilities of OLAP applications in enterprises ("Coursera | Online Courses From Top Universities. Join for Free" n.d.):

- Marketing and Sales Analysis
  - Consumer Goods Industries, Retailers
  - Financial Services (Banks, Insurance etc.)
- Clickstream Analysis and Web Analysis
  - Pure Play E-commerce Sites
  - Click-n-Mortar Organizations
- Database marketing and CRM
  - Customer Segmentation
  - Customer Value Analysis
- Budgeting and Financial Reporting
  - Requires multiple dimensions such as Time, Account, Organization, Product segment etc.
- EIS, Balanced Scorecards
  - Management Reporting based on P&L Ratios
  - KPIs, CSFs
- Other Applications
  - Profitability Analysis
  - Defect Analysis
  - Quality Analysis

OLAP itself categorized into four different types or styles. Based on Turban's book (Turban, Sharda, and Delen 2014), these styles are listed below:

- **ROLAP** – Relational OLAP (using relational databases; a star schema used)
  - Relational Databases
  - SQL Queries
- **MOLAP** – Multidimensional OLAP (using multidimensional databases)
  - Multidimensional array requiring preprocessing
  - Ability to pivot, slice & dice data
- **HOLAP** – Hybrid OLAP
  - Combination of ROLAP and MOLAP
- **DOLAP** – Desktop OLAP

OLAP famous cubes are part of MOLAP styles because of multidimensional structure of this style. In this style, data should be preprocessed in order to fit into the specifically predefined cubes which makes data analysis way faster than traditional OLAP or ROLAP.

Here is the good example, adopted from TERADATA University network which shows how data cubes could be useful for different people in the organizations.

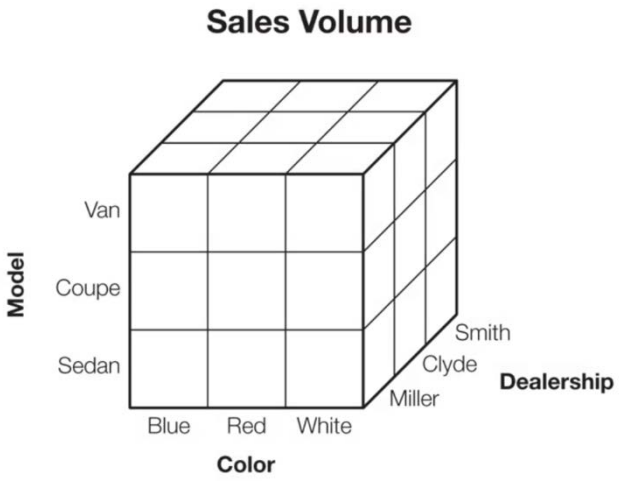

FIGURE 19- MULTIDIMENSIONAL VIEW OF DATA

Imagine an automobile marketer who needs sales figure to analyze them from different perspectives. Thanks to the multidimensional type of database marketer can analyze these data from different angels like sales by model, by the dealership, the color of the car or even in a certain period of the time.

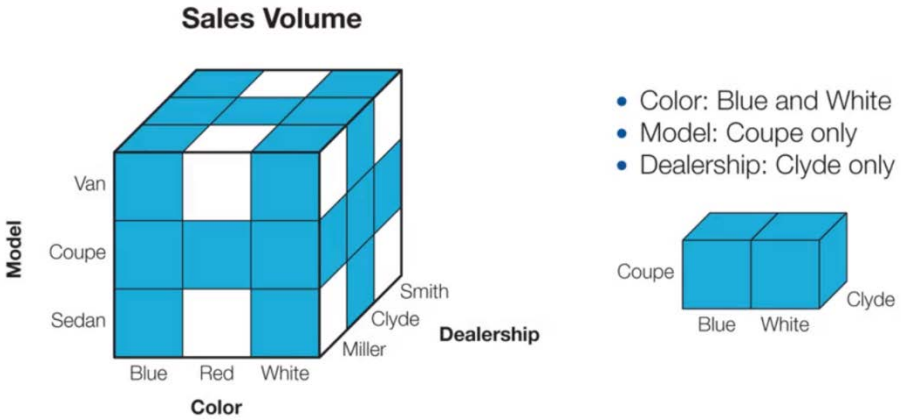

FIGURE 20- CUBE STORAGE

In order to analyze the number of blue and white Coupes which sold at Clyde dealership, the marketer can use this cube storage and have all he wants at a glance and really fast. On the other hand, an account manager may want to check the sales based on a different model in different dealerships; he can easily use the pivoting function of MOLAP style of BI and rotate the cube as he wants, like Figure 21…

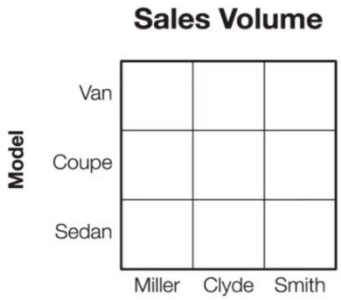

FIGURE 21- DIFFERENT DIMENSIONS OF A CUBE

OLAP completely differs from OLTP which stands for Online Transaction Processing. OLTP usually deals with functions like online bill payment which is classified as a day-to-day function, but OLAP hires more broad view and helps enterprises to make long-term decisions better and more effectively.
The following is the table which shows the differences between two in detail which is adopted from TERADATA University Network presentation on OLAP…

TABLE 1- OLTP VS OLAP

	OLTP	OLAP
USER	Clerk, IT Professional	Knowledge Worker
FUNCTION	Day-to-day Operations	Decision Support
DATABASE DESIGN	Application-oriented (E-R based)	Subject-oriented (Star, Snowflake)
DATA	Current, Isolated	Historical, Consolidated
VIEW	Detailed, Flat Relational	Summarized, Multidimensional
USAGE	Structured, Repetitive	Ad-Hoc
UNIT OF WORK	Short, Simple Transaction	Complex Query
ACCESS	Read / Write	Read Mostly
OPERATIONS	Index/Hash on Prim. Key	Lots of Scans
# RECORDS ACCESSED	Tens	Millions
# USERS	Thousands	Hundreds
DATABASE SIZE	100s MB-GB	100s GB-TB
PERFORMANCE METRIC	Transaction Throughput	Query Throughput, Response

3.4. Business Performance Management Systems (BPM)

Among last two decades, managers and executives understand the importance of BPM systems and its vital role inside enterprises to support them to reach the strategic goals of organizations. In comparison with traditional BI, business performance management gives more opportunities to executives in the critical functions like monitoring, measuring and managing the business performance of the enterprises.
As time passes, more organizations are implementing BPM frameworks like Balanced Scorecard (S. Williams and Williams 2007). The root of BPM is back to 80s, but companies started to leverage the true potential of this management system after BI revolution. One of the key factors of BPM is that the way it uses the bundle of management systems applications which are integrated and mix them with frameworks like BSC and dashboards.
BPM systems got different names within organizations like Corporate Performance Management or CPM which is used by Gartner Group, Enterprise Performance Management or EPM which is used by Oracle and Strategic Enterprise Management which used by SAP, but all of these terms refer to the same processes and tools which are designed to measure, monitor and manage business performance.
But because of some reasons, some enterprises cannot fully leverage the true potential of BPM systems. One of the main reasons is the complexity of the process in which BPM systems gather data from different departments and components of enterprises. The other reason is the dependence of BPM systems on BI platforms and the data warehouses which is hard for organizations to fully optimize their performances. And the last reason could be the lack of incentives and compensation plans for the users of this system. Even though the technical aspects work properly, managers should have cultural changes in order to fully leverage the BPM systems.

According to AMR Research (John Hagerty and Verma 2007), there are five different product categories for BPM systems. They are…

- **Planning, budgeting, and forecasting (PBF)** - Contribution, aggregation, manipulation, and approval of the financial plan on a periodic or continual basis
- **Financial consolidations and reporting** - Legal and statutory consolidation sys-tems along with more generalized financial statement generation capabilities
- **Financial analytics and dashboards** - Profitability applications, role-specific dash-boards, metrics, and specific financial analytics for detailed financial processes
- **Financial governance, risk management, and compliance (GRC)** - Governance and control requirements that include national and/or international regulations, such as SOX or International Financial Reporting Standards (IFRS)
- **Scorecards and strategies** - Methodology-based scorecards (such as The Balanced Scorecard) and strategy management applications

Based on Turban (Turban, Sharda, and Delen 2014), the BPM cycle contains four main phases which the Figure 22 from his book illustrates them clearly.

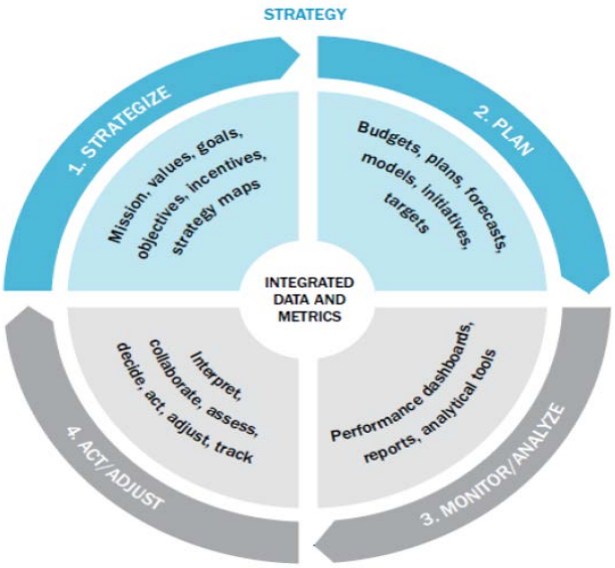

FIGURE 22- BPM CYCLE

This BPM cycle is somehow like the famous PDCA(Plan-Do-Check-Act) cycle of management, but slight difference is, here Do as Strategize is before Plan phase of the cycle. Based on this cycle the major role of BPM is the optimization of business performance by connecting the strategy phase to execution phase and regularly checking this process in order to have corrective actions and by continues improvement be even more efficient.

Based on TDWI (http://www.dw-institute.com/) and AMR research report (John Hagerty and Verma 2007), there are three approaches to deploy BPM in the enterprises. The Figure 23 from this research depicts these ways clearly…

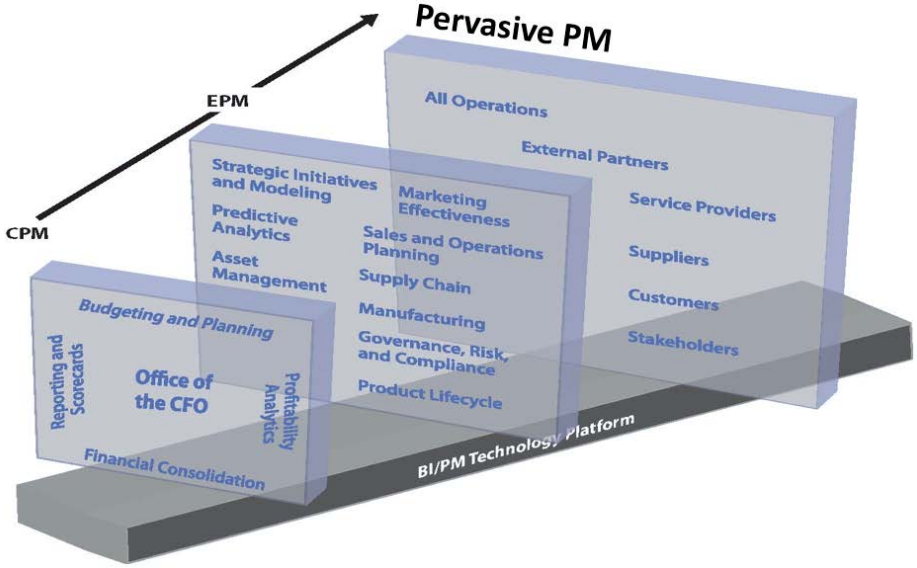

FIGURE 23- PERFORMANCE MANAGEMENT CONTINUUM

Corporate Performance Management has its roots in the functional approach of BPM which oversaw budgeting and planning. The problem of this inside-out approach is its limitation of groups vision inside the whole organization.
Through the passage of time and by gaining more experience, enterprises stated to employ an outside-in approach which connects operational and financial performance in the organizations. This perspective was part of the cross-functional approach to BMP systems which also requires strategic initiatives and modeling, also called Enterprise Performance Management or EPM.
In the latest approach of BMP which is called big-bang approach, enterprises change their view in a top-down manner and they implement a pervasive strategy that widespread along the entire company.
And the way executives should get started is to start small by quick implementations then in the next step they have to think globally. On the third step they have to engage incremental deployment and right after moving to the final step which is called “prioritize by source”, they can leverage the true potential of frameworks like Balanced Scorecard and Key Performance Indicators.

From BPM cycle which is depicted above, we can see the first two components of the cycle are related to the strategy part and on the other side component three which is monitoring and analyzing beside part a fourth of the cycle which is acting and adjusting are related to the Performance Measuring systems or PMS. In the Performance Measurement part of the cycle, executives of enterprises use BI platforms as a support the functions of evaluating business strategy. So, PMS play a critical role in the enterprises since thanks to this system, managers will be notified if anything goes wrong in the organization.
In the book of Business intelligence and Analytics by Turban (Turban, Sharda, and Delen 2014), there are two different measurement models apply. The first model is DMAIC and the latest model with two slight changes is DMADV…

Define the goals
Measure existing systems
Analyze the system
Improve the system
Control by adjusting management systems

Define the goals
Measure existing systems
Analyze the system
Design the system
Verify by adjusting management systems

In order for the PMS to be effective, it should blend historical performance of the enterprise with future expectations and at the same time, it should keep eye on the key factors of performance measurement.
One of the major factors of measurement systems is KPIs or Key Performance Indicators which give a general view to executives about enterprise generic condition. Thanks to the KPIs, companies will make sure about how they are doing in the business by checking both strategic and objective metrics of performance. We can compare these KPIs with the gauges of automobiles dashboards which give very useful and critical information about car’s performance to the driver.
In order to survive in the challenging situations of these days business markets, enterprises should be at their best possible condition in order to achieve strategic goals like producing no waste, zero defects in their product lines or getting full 5-star satisfaction from their customers. These strategic goals will not happen but with making progress toward a strategic goal and repeated periodic achievement of some levels of operational goals.

Based on Turban's explanations (Turban, Sharda, and Delen 2014), there are four common KPIs which are…

There are three different ways that KPIs can use in order to show to the managers, range of acceptable level of performance. These could be "***Thresholds***" which are indicators of upper and lower level of acceptable performance. Another way of indicating performance is using "***Targets***"; The major characteristic of the targets is that they defined desired end-state at a specific point in time. And finally, the last type of indicators is "***Benchmarks***" which compare the performance of the enterprise with an external standard; like comparing car sales with the dealership of next town or using a statistical method like Six Sigma accuracy level (Turban, Sharda, and Delen 2014).

The criticality here is choosing the right number of KPIs for the enterprise since too many KPIs will use more resources of the company which will lead to inefficient performance measurement system and sometime KPIs themselves may have some conflicts with each other which will be confusing. Enterprises should choose the best minimum amount of KPIs which drives strategic value and proactive action.

One of the problems with KPIs is that they could grow through an organization in an uncontrolled way since each department of the enterprise has its own KPIs which means a huge number of indicators that should be handled. Organizations are using Balanced Scorecards as a remedy to this obstacle since the role of BSC is to group KPIs based on prioritization of enterprises.
Although, both Balanced Scorecards and Dashboards are some sort of visualizations we cannot use them interchangeably since dashboards are usually used in the operational part of enterprises whether in hourly or weekly bases but BSCs are mostly used achieving strategic and tactical goals of the organizations and are mostly used by executives.

Figure 24 is adopted from “dssresources.com” (Vasiliu 2006), and explains the difference between dashboards and KPIs…

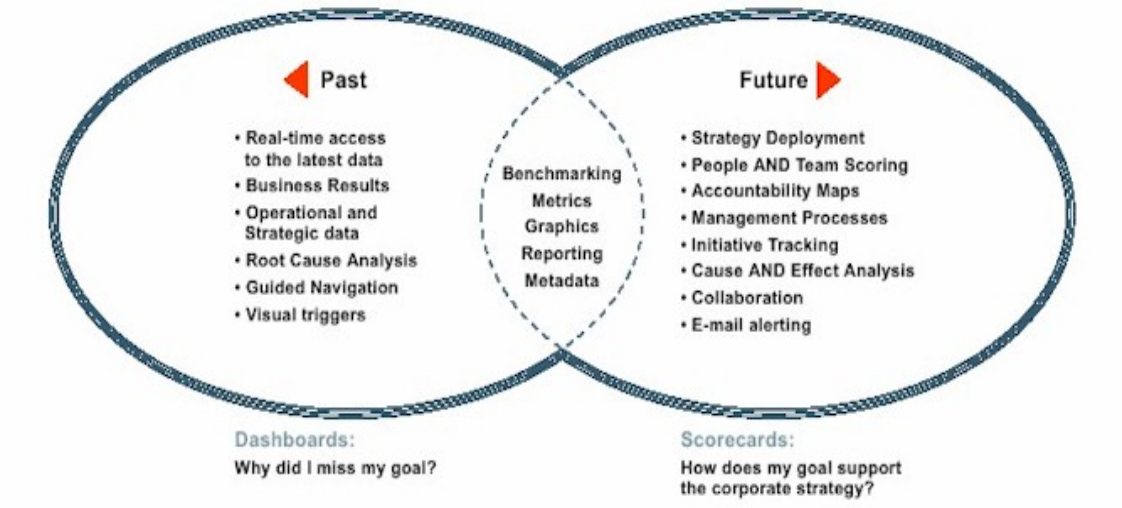

FIGURE 24- DASHBOARDS AND SCORECARDS OVERVIEW

Based on Turban (Turban, Sharda, and Delen 2014), there are four perspectives available for Balanced Scorecards which is depicted in Figure 25…

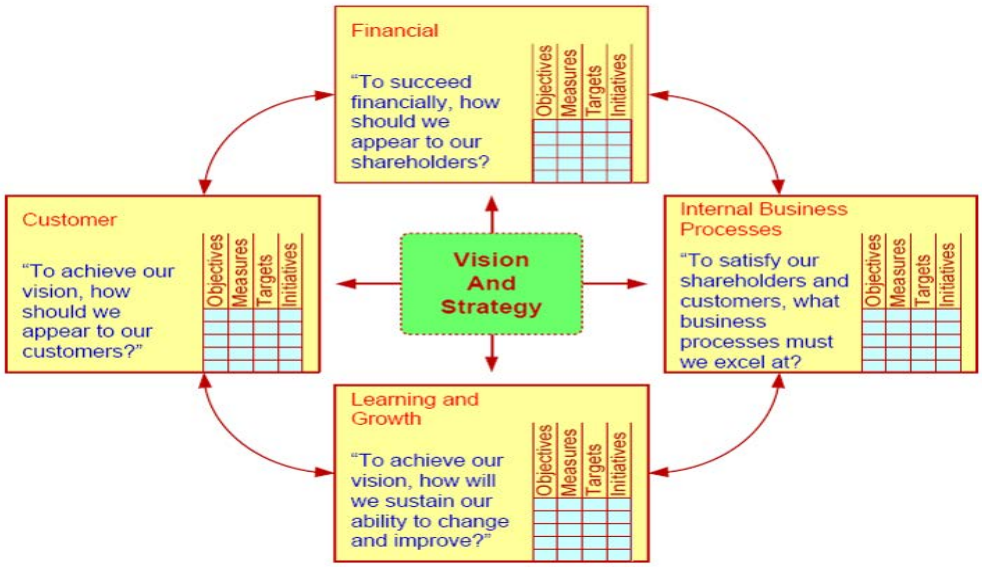

FIGURE 25- BALANCED SCORECARDS PERSPECTIVES

Based on this model, Turban believes that the definition of the “Balanced” in the term BSC comes from this overview that there should be a balance between financial and non-financial indicators and also among indicators which are internal and external or qualitative and quantitative etc. (Turban, Sharda, and Delen 2014)

Since the process of collecting, reporting and distributing of BSC is labor intensive by its nature, although seems straightforward process, enterprises use software tools to enable these functions. One of the reasons which explain why companies tend to use software packages is, delegating these tasks to someone else which is doing this process by normal office software and sending reports by email may trigger email errors and also since it is done by hand, there is not any connection to the other corporate systems like accounting systems.

Turban (Turban, Sharda, and Delen 2014) believes there are several benefits of using BSC in enterprises; which are:

- Providing executives with a consolidated and strategic view of plans, budgets, and forecasts
- Alerting executives when initial performance signs reveal problems.
- Aligning the organization towards a common strategy
- Isolating and reducing inefficiencies in customer and product strategies
- Tying performance measures and non-financial targets
- Increasing buy-in from decision makers
- In-depth insight into real-time financial and operational results

There is one more item in the bundle of performance management tools besides BSCs and KPIs, which is called Six Sigma (6σ). Based on the Business University of Colorado Denver ("Coursera | Online Courses From Top Universities. Join for Free" n.d.), this tool is developed by Motorola in the 80s with the aim of projecting the number of possible defects in a company. One of the terms which are related to Six Sigma is DPMO that stands for "Defects Per Million Opportunities", and by this method, enterprises can start continues improvement process and by measuring, controlling and taking corrective actions, they can reduce their defects of any kind to near zero. Following is the cycle of six sigma which is adopted from Gupta's book (Gupta 2007).

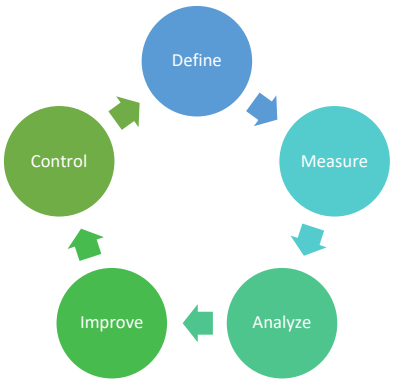

FIGURE 26- SIX SIGMA CYCLE

Here in Table 2, which is adopted from Six Sigma Business Scorecard book (Gupta 2007), there are differences between Balanced Scorecards and Six Sigma methodology…

TABLE 2- COMPARISON OF BALANCES SCORECARD AND SIX SIGMA

BALANCED SCORECARD	SIX SIGMA
Strategic management system	Performance measurement system
Relates to the longer-term view of the business	Provides snapshots of business's performance and identifies measures that drive performance toward profitability
Designed to develop a balanced set of measures	Designed to identify a set of measurements that impact profitability
Identifies measurements around vision and values	Establishes accountability for leadership for wellness and profitability
Critical management processes are to clarify vision/strategy, communicate, plan, set targets, align strategic initiatives, and enhance feedback	Includes all business process-management and operational
Balances customer and internal operations without a clearly defined leadership role	Balances management and employees' roles, balance costs and revenue of heavy processes

Each of these tools is supporting the enterprise in some way but the only way for these methods to be effective and efficient enough for the organizations is to bundle them all in one unique platform and leverage the full potential of them. This is when Corporate Performance Measurement platform plays a vital role in the business role by combining KPIs, BSCs and Six Sigma methodology in one place and helps executives to reduce defect and refine KPIs.

Since till now we understood the power of integration in the field of Management Support Systems, we shouldn't forget one of the buzz words of today's' business world in the field of integration, which is Visual Analytics. Here is the role of this integration phenomena…

As Turban stated in his book (Turban, Sharda, and Delen 2014), Information Visualization's target is to answer questions like "what happened" and "what is happening" and is closely associated with Business Intelligence (routine reports, scorecards, and dashboards).
On the other hand, Predictive Analytics is used to answer questions like "why is happening", "What is more likely to happen" and is usually associated with business analytics (forecasting, segmentation, correlation analysis).

Figure 27 from Business Intelligence and Analytics (Turban, Sharda, and Delen 2014) is illustrating different phases of business analytics better than sentences; These phases are Descriptive, Predictive and Prescriptive…

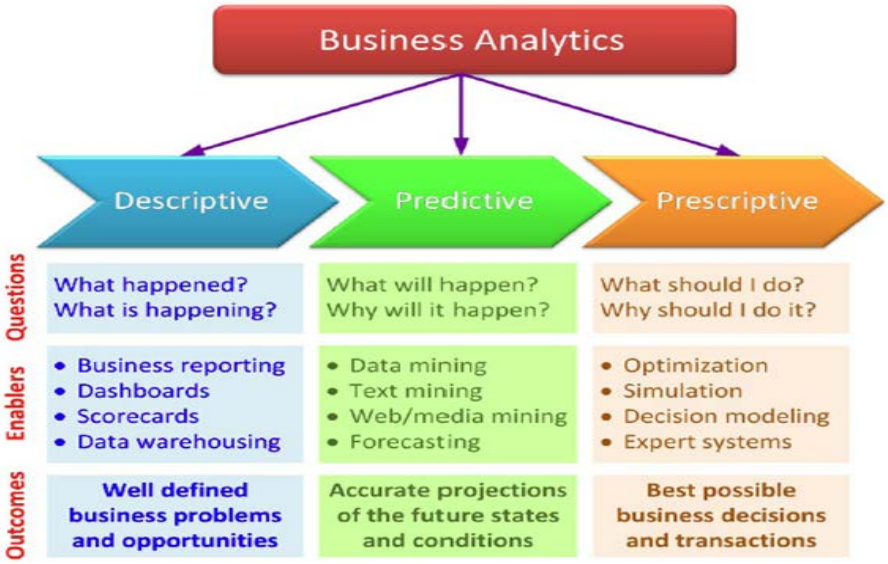

FIGURE 27- BUSINESS ANALYTICS OVERVIEW

All these said it should mention that the Business Analytics could not be possible without this massive advancement in terms of storing, processing or analyzing Big Data.
Big Data is refers to data that cannot be stored in a single storage unit, the type data which is arriving in many different forms like structured, unstructured or in form of stream and finally the data which is in the shape of clickstreams from websites, posting on social media sites like Twitter, Instagram and Facebook, or data from traffic or weather sensors (Turban, Sharda, and Delen 2014).

Big Data analytics gave birth to the new paradigm called MapReduce programming paradigm that instead of pushing data to a computing node, solution pushes computation to the data. MapReduce is first developed by Google then used by Apache project called Hadoop MapReduce (Turban, Sharda, and Delen 2014).

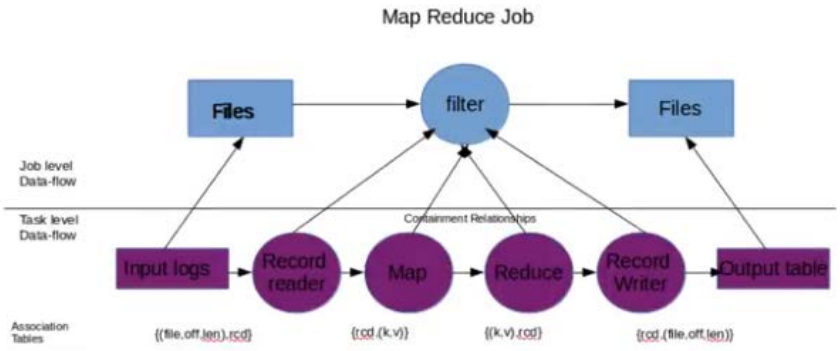

FIGURE 28- MAPREDUCE ALGORITHM

These days BI analytics became a competitive advantage for more and more companies and is not a plus anymore. Vendors of Business Analytics understood that there is a growing demand in the market of visualizations with following the trend of being descriptive, predictive and prescriptive; Microsoft Azure Visual Insight and SAS Visual Analytics are good examples of this move.
Figure 29 from Harvard Business Press (Davenport and Harris 2007) is showing the tendency of organization which leverages Business Analytics as their competitive advantage…

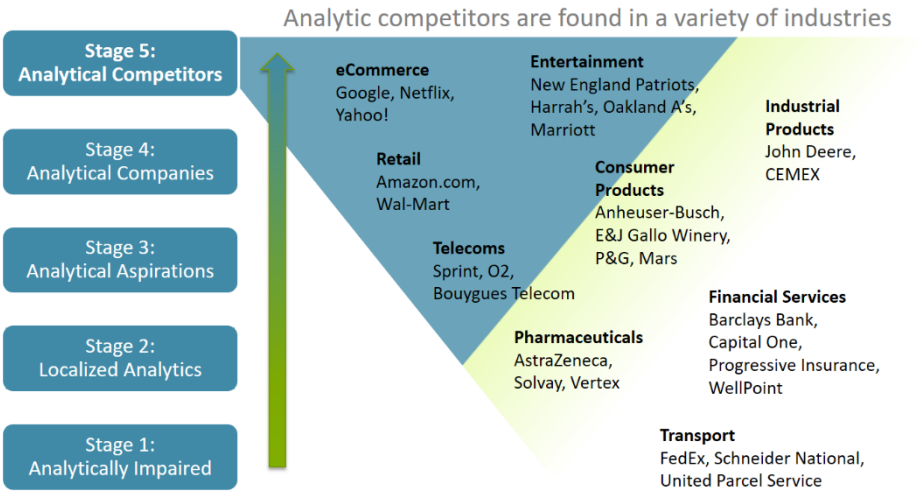

FIGURE 29- ORGANIZATIONS ARE BUILDING THEIR COMPETITIVE STRATEGIES AROUND ANALYTICS

More BI and analytics vendors are becoming aware that their customers require quick and preferably interactive visualizations, not just for their normal reporting systems, but also to illustrate predictive and prescriptive decision-making information. Due to the increasing demand for visual analytics coupled with fast-growing data volumes, there is an ever-growing need to invest in highly efficient Visual Analytics Platforms (Turban, Sharda, and Delen 2014).

Figure 30 which is adopted from Harvard Business Press (Davenport and Harris 2007), is illustrating the type of questions that waiting to solve by BI…

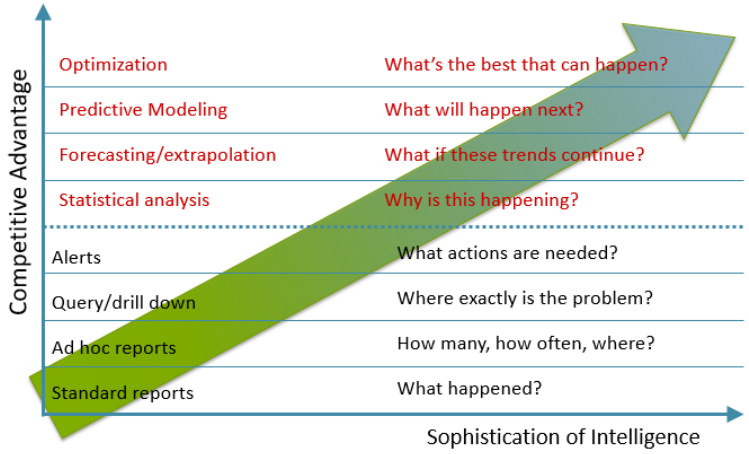

FIGURE 30- COMPANIES ARE USING BI AND BA BASED STRATEGIES TO ACHIEVE BUSINESS EXCELLENCE

As Business School of Colorado Denver believes ("Coursera | Online Courses From Top Universities. Join for Free" n.d.), There are two emerging strategies which will dominate BI tools and applications within next ten years;

- First, the explosion of the information captured across the larger social network and social media sites.
- Second, the ability to capture massive new datasets from mobile devices.

Enterprises will understand the power of these sources to improve to the pervasive phase of Business Intelligence maturity and they know that they must implement the long-term BI strategy in order to survive.

I want to finish this chapter with the thoughtful quote written by Bill Schmarzo, CTO, DELL EMC GLOBAL SERVICES, which says…

> "Organizations do not need a **BIG DATA Strategy;** they need a **Business Strategy** that incorporates Big Data."
>
> - *Bill Schmarzo*

4. Case Study Analyses

This chapter of the thesis consists of excerptions of the selected academic article which are the case studies in the field of BI implementation and its critical success factors in the context of SMEs. Some of these case studies are also composed of survey-based research which is conducted in different countries and among different business sectors.
The criterion of case selection was searching academic literature based on keyword-search technic. The keywords were "BI + SME", "Business Intelligence + SME" and "Business Intelligence Implementation + SME".
One of the challenges of finding proper cases among academic literature was the fact that, BI and its technologies are relatively new, even for large enterprises; thus, it was a quite challenging task to find cases which were conducted in the context of SMEs.

4.1. Business Intelligence (BI)

After searching the academic literature via Google Scholar and Politecnico digital library, the number 80 cases were founded in the first step. During the next step, after analyzing all 80 cases, 9 cases were sifted out from them, which carries the appropriate relevance to the main objective of this dissertation.
Followings are the excerpts of those 9 selected case studies about BI technologies, which conducted in different countries in the SMEs' context.

4.1.1. Case of Morocco

A MATURITY MODEL FOR BUSINESS INTELLIGENCE SYSTEM PROJECT IN SMALL AND MEDIUM-SIZED ENTERPRISES: AN EMPIRICAL INVESTIGATION

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SETTAT, 577, ROUTE DE CASABLANCA, MOROCCO

CHAFIK OKAR
SCHOOL OF TECHNOLOGY, UNIVERSITY HASSAN 1ER,
BERRECHID, 218 QUARTIER TAQADOM PASSAGE D'ALGER, MOROCCO

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SETTAT, 577, ROUTE DE CASABLANCA, MOROCCO

This study describes a maturity model for the project of designing and implementing BI System in SMEs. The concept of Critical Success Factors (CFSs) is used to develop the maturity model and it will be validated through a pilot test and empirical investigation in Moroccan SMEs.(Fedouaki, Okar, and El Alami 2012)

4.1.1.1. Methodology

The first part of this study is conducted by the pilot test in Moroccan SMEs to evaluate maturity level of BI and analyzing the possibility of any improvement.
The second part of the study is done by sending surveys to different industries among Moroccan SMEs and analyzing the maturity level of BI systems by empirical investigation.(Fedouaki, Okar, and El Alami 2012)

The proposed model has two objectives:

- **First,** provides a framework to assess maturity level of BI System project in SMEs
- **Second**, offers a support for SMEs to develop an improvement roadmap to its BI System.

4.1.1.2. Findings/Results

Maturity model of BI system implementing in SMEs

Based on the literature, they claim that there are six different steps in almost every engineering project which starts from inception and goes through implementation.
They state, based on Moss's descriptions, after analyzing empirical data and other BI system projects, there are six dimensions for BI projects in enterprises which are depicted in Figure 31 (Fedouaki, Okar, and El Alami 2012):

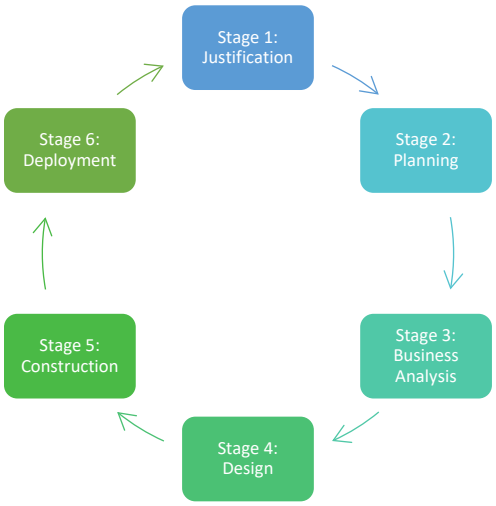

FIGURE 31- ENGINEERING PROJECT STEPS

They use three different perspectives of Critical Success Factors in assessing the implementation projects of BI systems, which is adopted by leading companies in the field of business intelligence; These categories are:

- Organization
- Process
- Technology

They declare that, in order for SMEs to be able to fully leverage the potential of BI systems in their enterprises, these SMEs should meet the following CSFs; from an organizational point of view the followings are the most important ones:

- Adequate budget
- Well defined business problem and processes
- Well defined users' expectations
- Adjusting the BI solution to users' business expectations
- Support from senior management
- Competent BI project manager/leadership
- Skilled/qualified sufficient staff and clear business vision
- Integration between the BI system and other systems
- Subsequently were listed data quality
- Flexibility and responsiveness of BI on users' requirements

There are also other factors which considered as minor factors by the authors of this study; These factors are listed as below:

- Effective change management
- Appropriate technology and tools
- “User-friendly”/Usability of BI systems

The authors of this article chose Critical Success Factors by Olszak (Ziemba and Olszak 2012) among other available maturity models in the literature, like Gartner's Maturity Model. The followings are three dimensions of maturity model which is introduced by Olszak and used by authors of this article:

- **Level 1 (initial):** There is no process area and the process is chaotic;
- **Level 2 (defined):** Is the level where SMEs BI System implementation processes are documented, standardized, and integrated into a standard implementation process for the organization;
- **Level 3 (managed):** SMEs BI process and activities are controlled and managed based on quantitative models and tools

The authors simplified the 6 levels of Engineering Project steps because of the nature of SMEs which are less complex in comparison with big enterprises, and use them as a staged representation of Olszak's maturity model. These levels are mixed and combined into three major stages, as follows:

I. Justification and Planning
II. Business analysis and Design
III. Construction and Deployment

Table 3 is showing the detail of this maturity model which is used by authors for implementing BI systems at the level of SMEs (Fedouaki, Okar, and El Alami 2012).

In this model, the maturity level is analyzed at each stage of Critical Success Factors. In this process, evidence should be collected and documented by SMEs for all CSFs. And at each stage, the overall level of maturity is the minimum of all CSFs level of the stage. Thanks to this maturity model, SMEs will understand their position in BI systems and the possible opportunities for improvement which is now shown clearly. Because of the model's methodology, organizations will be informed about their maturity level and also, they know the steps which should undertake to improve to the next level of maturity. The goal is to reach the last level of maturity and keeping their position at this level by periodic monitoring and assessment.

TABLE 3 -MATURITY MODEL FOR A PROJECT OF IMPLEMENTING BI SYSTEM IN SME

BI Project life cycle	*CSFs of BI System project in SMEs*	*Maturity level 1 (initial)*	*Maturity level 2 (defined)*	*Maturity level 3 (Managed)*
Justification and Planning	**Competent BI project manager (leadership)**	The manager has no experience in the BI project	BI project manager has a slight knowledge in this area with a short experience	Competent BI project manager with a long experience in this area
	Well defined a business problem and processes	Business problems and processes are not defined	Some Business problems and processes are defined	Business problems and processes are clearly defined
	Clear business vision and plan	Business vision and plan of the BI project is not specified and not clear	Business vision and plan of the BI project is fairly clear	Business vision and plan of the BI project is clear, transparent strategy and, importantly, good communication
	Adequate budget	No studies on the budget of the BI project	A preliminary study on the budget of the BI project is done	A global study on the budget and the economic efficiency of the BI project is done

	Effective change management (e.g. willingness to accept a change of processes).	The BI project does not include an effective change management	The BI project includes a change management program	The BI project includes an effective change management
	Support from senior management.	They aren't any support for the BI project by senior management.	Some senior managers support the BI project.	All senior managers support the BI project.
Business analysis and Design	**Skilled (qualified) sufficient staff/ team/ managers.**	The BI project doesn't include awareness and training programs for staff/ team/ managers.	Preliminary awareness and training programs are provided to staff/ team/ managers at some stages of the BI project.	Good awareness and training programs are provided to staff/ team/ managers at each stage of the BI project.
	Well defined users' expectation (information requirements)	Users' expectations are not defined	Some users' expectations are defined	Users' expectations are well defined
	Adjusting the BI solution to users' business expectation (requirements)	The BI solution is not adjusted to the users' business expectations	The users' business expectations are partially adjusted by the BI solution	All users' business expectations are entirely adjusted by the BI solution
Construction and Deployment	**Data quality**	Low data quality	Medium data quality	High data quality
	BI flexibility and responsiveness on users' requirements	BI is inflexible and cannot response on users' requirements	BI is partially flexible and responsive on some users' requirements	BI is completely flexible and responsive on users' requirements
	Appropriate technology and tools	Use of inappropriate technology and tools	Some appropriate technologies and tools are used	Use of appropriate technology and tools
	"User-friendly" (usability) BI system	The BI system isn't "User-friendly"	The BI system is partial "User-friendly"	The BI system is "User-friendly"
	Integration between BI system and other systems (e.g. ERP)	No integration between BI system and other systems	There is integration between the BI system and some other systems	A good integration between the BI system and other systems

The Pilot Test

The authors had a chance to apply this maturity model alongside with its improvement roadmap in a Moroccan SME which they give a nickname of "EXPERT" to this enterprise for the confidential reasons. This company is busy with importing and distributing some sort of technical materials among different parts of the country and is the owner of several warehouses located nationwide. In the time of this study, 2012, the number of employees was 210.

The important fact about this SME is the attitude of the CEO who believes that market is growing and there are new opportunities in the way and in order to make most of these opportunities he needs a system to support his decisions in the volatile market of business. Thus, he decided to implement the BI system to empower the enterprise, which is a perfect sign of manager's awareness of market change. The CEO of company analyzed the maturity level of his company based on this study's suggested model and the details are available in Table 4 (Fedouaki, Okar, and El Alami 2012):

TABLE 4 - THE MATURITY LEVEL OF EXPERT'S BI SYSTEM PROJECT

BI Project life cycle	CFSs of BI System project in SMEs	Maturity Level of EXPERT's CSFs of BI System project	Maturity Level of EXPERT's stages of BI System project
Justification and Planning	Competent BI project manager.	Level 2	Level 2
	Well defined a business problem and processes	Level 2	
	Clear business vision and plan	Level 2	
	Adequate budget	Level 3	
	Effective change management	Level 2	
	Support from senior management	Level 2	
Business analysis and Design	Skilled sufficient staff/ team/ managers	Level 2	Level 2
	Well defined users' expectation	Level 2	
	Adjusting the BI solution to users' business expectation	Level 2	
Construction and Deployment	Data quality	Level 3	Level 3
	BI flexibility and responsiveness on users' requirements	Level 3	
	Appropriate technology and tools	Level 3	
	"User-friendly" BI system	Level 3	
	Integration between BI system and other systems	Level 3	

On the other hand, after analyzing the criticalities, Table 5 shows the improvement roadmap which generated by the authors of this article and gives the improvement possibility of BI system to the EXPERT company.(Fedouaki, Okar, and El Alami 2012)

TABLE 5 - THE IMPROVEMENT ROADMAP FOR EXPERT COMPANY'S BI SYSTEM PROJECT

BI Project life cycle	CFSs of BI System project in SMEs	Improvement roadmap for EXPERT Company's BI System project
Justification and Planning	Competent BI project manager	Provide an awareness and training programs to BI project manager and all stakeholders at each stage of the project
	Well defined a business problem and processes	The definition of business problems and processes must be clearer
	Clear business vision and plan	Business vision and plan of the BI project must be clearer. (Transparent strategy and good communication).
	Adequate budget	Maintain a global study on budget of the project
	Effective change management	The BI project must include an effective change management
	Support from senior management	Maintain the support of all senior managers for the project
Business analysis and Design	Skilled sufficient staff/ team/ managers	Provide a good awareness and training programs to staff/ team/ managers at each stage of the BI project
	Well defined users' expectation	Users' expectations must be well defined.
	Adjusting the BI solution to users' business expectation	Adjust entirely the BI solution to all users' business expectation
Construction and Deployment	Data quality	Maintain a high data quality
	BI flexibility and responsiveness on users' requirements	Maintain a complete flexibility and responsiveness of BI on users' requirements
	Appropriate technology and tools	Maintain the use of appropriate technology and tools
	"User-friendly" BI system	Maintain the friendly use of BI System
	Integration between BI system and other systems	Maintain a good integration between the BI system and the other existing systems

The Imperial Investigation

In this level of study, the number of **65 Moroccan SMEs** which had BI systems implemented in their enterprises and with less than 250 employees which also generate less than 10 million USD turnover are selected. These SMEs are from different business sectors which are Manufacturing, Information Technology, Insurance, Sales, and distribution. The aim of this empirical investigation was to figure out the maturity level of BI systems in their enterprises and the authors employed the survey method of research and the hypothesis of the authors of this article was:

> *"A company could be very advanced regarding one stage of BI System project life cycle while being rather antiquated regarding another."*

Table 6, illustrates the results of the survey which confirm the hypothesis of the research. Based on results companies performed independently in different life cycle stages of BI system maturity and they could be advanced and mature enough in one stage and perform very weak on other stage or stages of the model.

Based on this assessment, the authors calmed that the average maturity level of SMEs of this research is around level 2 (the "defined" level of maturity).
Based on the results, the authors claimed that the focus of these Moroccan SMEs were on the technical aspects of stage three of the life cycle which is "Construction and Deployment" and also there was an improvement opportunity for SMEs at second level of BI maturity model, "defined", about the field performance management BI.

TABLE 6 - MATURITY LEVEL FOR EACH STAGE OF LIFE CYCLE BI SYSTEM PROJECT

Maturity level	Justification and Planning	Business analysis and Design	Construction and Deployment	
Level 1 "initial"	23.53%	17.65%	11.76%	17.65%
Level 2 "defined"	47.06%	52.95%	35.29%	45.10%
Level 3 "managed"	29.41%	29.40%	52.95%	37.25%
Total	100%	100%	100%	100%

4.1.1.3. Concluding Remark

The authors utilized the maturity model of Olszak in this research which contains three different levels of maturity and various amount of Critical Success Factors. Then they apply this model on a Moroccan SME as a pilot test and to consolidate the results which are outcomes of this test, they perform an empirical investigation based on survey method within several SMEs from different economic sectors in Morocco.

The authors of this article claimed that this model could help SMEs to analyze their BI systems maturity level and get to know how to improve them and continue their journey of development to the last level of maturity in their composed model.

Based on the outcome of both pilot test and empirical investigation, there was some evidence available which showed that the average maturity level of BI systems within the researchers' sample group was near the second level on maturity model ("defined"), out of three level.

Also, the conducted survey confirmed their research hypothesis which was about independence within different stages of BI lifecycle and shows that an SME could be very advanced in one stage rather inadequate on the other stages.

Based on the author's opinion, generally, SMEs are more competent and advanced regarding technical aspects than the parts which are related to business process and people-oriented tasks.

Finally, the research demonstrated that the majority of these SMEs were in the basic level of the final stage of BI life cycle and there was absolutely a room for improvement of their Business Intelligence systems.(Fedouaki, Okar, and El Alami 2012)

4.1.2. Case of France

AN EXAMINATION OF THE IMPACT OF BUSINESS INTELLIGENCE SYSTEMS ON ORGANIZATIONAL DECISION MAKING AND PERFORMANCE: THE CASE OF FRANCE

SOPHIAN GAUZELIN & HUGO BENTZ

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This study examined the impact of business intelligence systems on organizational decision-making and performance. The study consists of an empirical qualitative research that was carried out with interviews of 200 members of 10 selected SMEs. The study found out that when BI systems are deployed in SMEs, they facilitate timely decision making, improves organizational efficiency, enable a company to meet client's needs appropriately and lead to more satisfied employees.(Gauzelin and Bentz 2017)

4.1.2.1. Methodology

The researchers used semi-structured interviews among 10 French SMEs which located inside of France. From each SME, the number of 5 Managers and 15 Junior Managers were selected randomly which makes 50 managers and 150 junior managers in total.
The interviews were designed to cover BI from different points of view with the qualitative descriptive approach. After gathering all the answers from 200 participants of the study, results were analyzed and coded and finally ended with the discussion about dominant themes.(Gauzelin and Bentz 2017)

4.1.2.2. Findings/Results

Within Figure 32, we have results of interviews related to the Managers of the SMEs which is related to different angles of Business Intelligence.

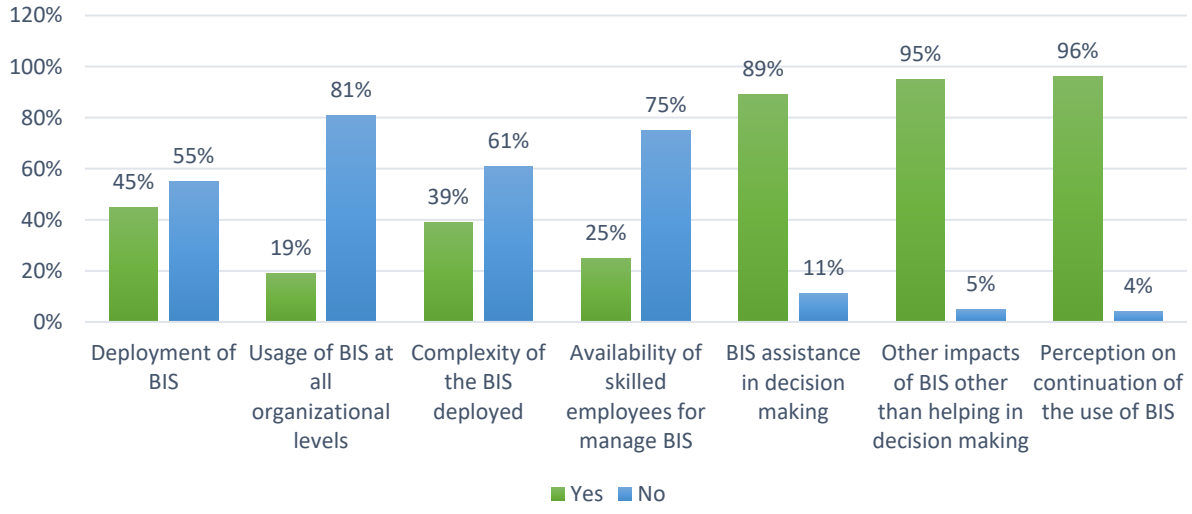

FIGURE 32 - GRAPH SHOWING THE RESPONSES OF SME MANAGERS TO THE VARIOUS ASPECTS OF BI SYSTEMS

And Figure 33 is illustrating the attitudes of junior managers towards different aspects of business intelligence systems within SMEs.

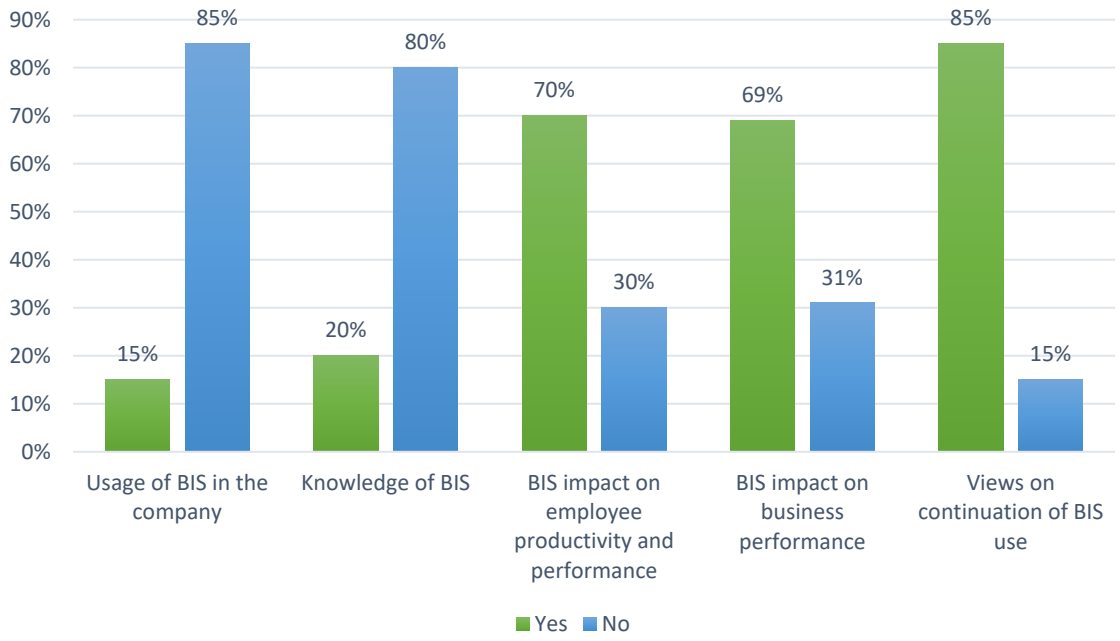

FIGURE 33 - GRAPH SHOWING THE RESPONSES OF SMES JUNIOR EMPLOYEES ON THE VARIOUS ASPECTS OF BI SYSTEMS

Analysis of BIS Deployment and Usage

Based on the outcome of these interviews, the authors of this study show that generally, the condition of Business Intelligence deployment within SMEs was in low level; since, based on the results, only 45% of Managers believed that they have deployed and were using BI systems but more importantly only 15% of junior employees believed that they were using BI systems in their enterprises.
Another considerable issue which rises from the results is that only 19% of managers accepted the fact that they were using BI systems at the organizational level of their enterprises. This is the sign of the fact that, Business Intelligence systems are not fully leveraged and used in an enterprise-wide level among these SMEs.

Based on interviews, the authors of this research demonstrate some reasons as an obstacle for SMEs to fully deploy and leverage the BI systems in their enterprises; the followings are some of these reasons:

- High adoption and implementation costs of Business Intelligence systems is one of the most important barriers to entry, which managers of SMEs are facing
- The next reason is the lack of appropriate IT systems within SMEs
- One the latest reasons which stop some of SMEs' managers to implement the latest version of BI systems is **cybersecurity**. Since there is some sort of upgraded BI systems which are available and functioning as a cloud-based service, there are issues of trust and security rises accordingly.

This latter factor, by the authors of this study, considered as a major factor of a setback for SMEs in the adoption and implementation of BI systems in their enterprises. Since we are living in the information age and one of the major concerns of organizations in this new age is the security of the most valuable asset of enterprises which is nothing but **data**.

Analysis of BIS Complexity and Availability of Skilled BI Maintenance Personnel

As it is illustrated in the figures above, most of the managers believed that the BI systems which implemented in their companies are complex in their nature and these managers are 61% of the samples population.
Interestingly, both managers and junior employees are agreed about the scarcity of skilled work-force in order to handle Business Intelligence systems; since only 20% of junior employees alongside with just 25% of managers believed that there were enough skilled work-force available in their enterprises which are dominant users of BI systems with appropriate knowledge.

So, another barrier which is mentioned by enterprises to BI system implementation is the factor of complexity. Because, based on interviews, the majority of employees were not competent with their IT skills in these issue causes another problem which is lack of appropriate knowledge in order to communicate with Business Intelligence systems. Another reason for this problem considered as the deficiency of companies' resources which holds enterprises from having quality personnel in the management tasks of BI systems.

Analysis of Impact of BIS on SMEs

Based on the information form this research, one positive point about the implementation of BI systems in SMEs is the awareness of managers about different benefits and strong potential of these management support systems. This awareness of managers led to willingness about the continuation of the existence of BI systems and the rate of 96% about the perception of managers on the continuation of BI systems usage in their SMEs could use as a firm support for this analysis.
These managers also believed that Business Intelligence plays a crucial role in the decision-making process of organizations and 89% of managers agreed with this. Beside the decision-making support functionality of BI systems there are also other popular functions of BI systems among managers; Like business analytics and predictive functions, which help organizations to adapt themselves to the trends and challenges of this fast-paced digitally connected world and also undeniable benefits of BI systems in making long-term strategic decision by executives of the enterprises.
Figure 32 also illustrates that 95% of executives accepted the fact that thanks to the BI systems, their enterprises could perform more efficient and productive than before.
As a support for this part of the analysis, we can look at 70% rate of acceptance by junior employees which believe that thanks to the BI systems the performance and productivity level of them have been boosted, and accordingly, this leads to enhancement of organization's performance.
Another important point which is worth to mention here is, the authors of this article claimed that based the outcome of this research, since BI systems offer more economic methodology in the field of information gathering, it causes a rise in the ROI (Return on Investment) of the enterprise.

4.1.2.3. Concluding Remark

The authors employed the qualitative approach in order to assess the impact of BI systems in the French SMEs which are located inside of France. To do so, they conduct the semi-structured interviews among 200 interviewees which 25% of them were managers and other 75% were junior employees. Based on the outcome of this research, the acceptance rate of BI systems in these organizations was genuinely high and the interviewees believe the BI systems have a considerable positive impact on their organizations; since 96% of the managers and 85% of the junior employees were agreed to continue BI systems usage in their enterprises.

Based on the outcome of these research, the authors mentioned the enterprise-wide footprint of BI systems on the operational functions of the enterprises. Followings are some instances of this result:

- Providing support to the decision-making process at the executive level of organizations by providing quality, timely and accurate data.
- Based on analytics and predictive functions of BI systems, managers can predict the future trend thanks to the past and present information analysis, and make informed decisions accordingly.
- BI systems have a truly positive impact on influencing employees and this leads to having a better enterprise-wide performance and accordingly more satisfied and loyal customers.
- This improved performance can use as a measurement indicator of BI systems in the SMEs, since assessing the real impact of BI systems on the organization was one the challenges of enterprises.

4.1.3. Case of Thailand

EXPLORING BUSINESS INTELLIGENCE AND ITS DEPTH OF MATURITY IN THAI SMES

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This study proposes a BI maturity model for SMEs that distinguishes different levels of BI maturity and identifies the factors that currently impact their levels of BI adoption. The proposed model is empirically tested using survey data from 427 SMEs and analyzed using multinomial logistic regression. Results indicate that BI adoption in Thai SMEs is still at an initial stage, with the majority being classified in the lowest level of BI maturity. Significant factors that impact the levels of BI adoption are a *relative advantage*, *complexity*, *organizational resource availability*, *competitive pressure, vendor selection* and *owner-managers' innovativeness*.(Boonsiritomachai et al. 2016)

4.1.3.1. Methodology

The intention of the researchers of this study is divided into two different parts; Primarily, they wanted to find out that to which BI maturity level these SMEs belong and at the next round, analyzing the factors which lead SMEs to belong to that specific maturity level of BI systems.
The selected SMEs are belonging to following sectors of the market:

- Manufacturing
- Service
- Wholesale
- Retail

The authors of this article proposed a 5-level maturity model for the BI systems which consists of 5 different dimensions that are depicted in Figure 34.

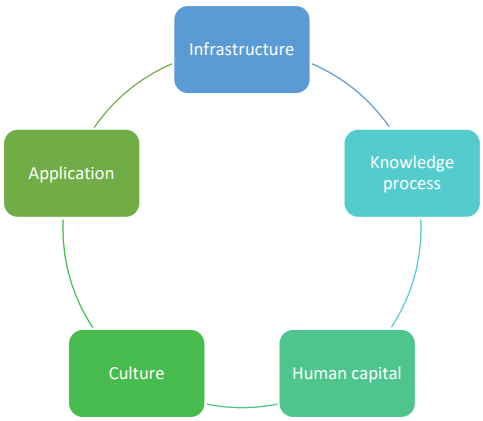

FIGURE 34 - FIVE DIMENSIONS IN BI MATURITY MODEL

The authors of this study claimed that the competitive advantage of their proposed model is the way it recognizes the relationships between mentioned five different maturity levels. Thanks to this model, we can categorize the enterprises into five different levels of BI systems adoption which starts from a low level and continue to a high level of adoption. Figure 35 illustrates the five levels of BI maturity model which enterprises belong to one of them based on their situation in five different dimensions, mentioned above.

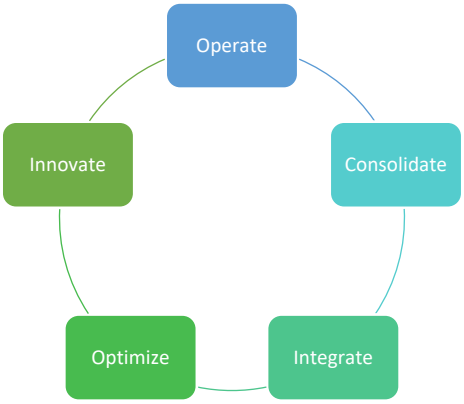

FIGURE 35 -FIVE LEVELS IN THE BI MATURITY MODEL

In the next level, researchers submitted their conceptual model which is depicted in Figure 36, based on different dimensions and levels of proposed maturity model alongside three other theoretical frameworks.

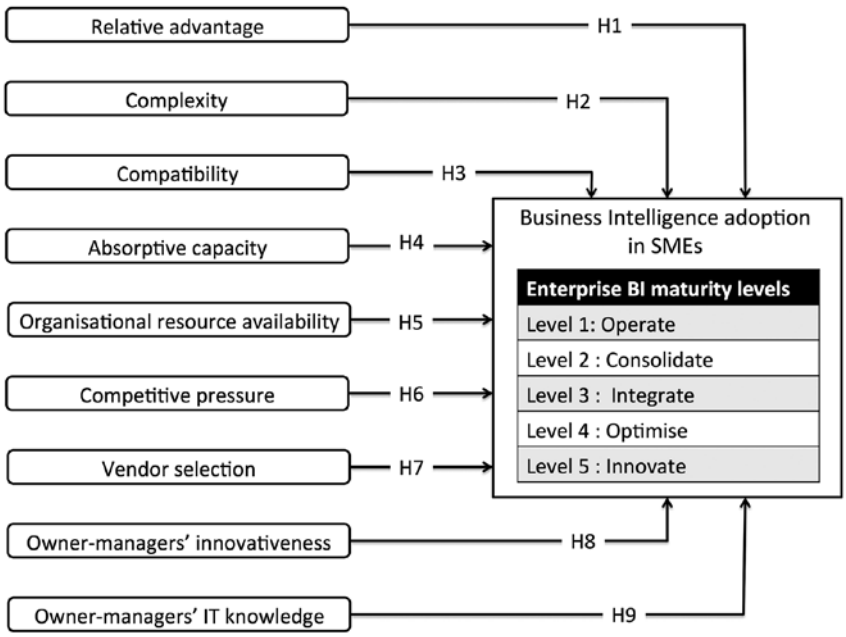

FIGURE 36 – RESEARCH MODEL AND HYPOTHESES

H1: the Relative advantage of BI significantly impacts on BI adoption levels among SMEs.
H2: Complexity of BI significantly impacts on BI adoption levels among SMEs.
H3: Compatibility of BI significantly impacts on BI adoption levels among SMEs.
H4: Absorptive capacity significantly impacts on BI adoption levels among SMEs.
H5: Organizational resource availability significantly impacts on BI adoption levels among SMEs.
H6: Competitive pressure significantly impacts on BI adoption levels among SMEs.
H7: Vendor selection significantly impacts on BI adoption levels among SMEs.
H8: Owner-managers' innovativeness significantly impacts on BI adoption levels among SMEs.
H9: Owner-managers' IT knowledge significantly impacts on BI adoption levels among SMEs.

Data collection

The researchers employed a quantitative approach which based on survey questionnaire in order to assess the maturity level of BI systems within selected SMEs. The number of 485 SMEs responded to the survey's questionnaire among the sample group which consisted of 2000 SMEs from four different sectors, mentioned earlier. After analyzing these 485 responses, the amount of 32 surveys because of incomplete answers and the amount of 26 SMEs because of the number of their employees which was more than 200, were dropped from the research sample group. Table 7 illustrates the demographic of this survey-based research which was related to 427 SMEs located in Thailand.

TABLE 7 -DEMOGRAPHIC OF THE RESPONDENTS

Demographics	Categorizes	n = 427	(%)
Gender	Male	257	60.2
	Female	170	39.8
Age	18–20	18	4.2
	21–30	90	21.1
	31–40	142	33.3
	41–50	117	27.4
	More than 50 years old	59	13.8
Education level	High school or equivalent	54	12.6
	Vocational or diploma	111	26.0
	Bachelor degree	160	37.5
	Master degree or higher	102	23.9
Position	Owner-manager	272	63.7
	Manager	146	34.2
	Other	9	2.1
Industry type	Manufacturing	88	20.6
	Service	100	23.4
	Wholesale	79	18.5
	Retail	160	37.5
Number of employees	Sole proprietor	12	2.8
	2–9 persons	119	27.9
	10–50 persons	142	33.3
	51–100 persons	100	23.4
	101–200 persons	54	12.6
Number of years in business	Less than 1 year	59	13.8
	1–5 years	139	32.6
	6–10 years	109	25.5
	More than 10 years	120	28.1

This research model consists of two different types of variables; The dependent variables are the ones which are related to five levels of BI maturity model that mentioned above. And the second type of variables which considered as independent ones, are the variables related to the factors which affected enterprises to adopt that specific level of BI systems maturity.
In order to test the accuracy and validation of the test's results, the authors of this article employed Spearman correlation within classifying of SMEs into different BI maturity levels, which were based on five different dimensions mentioned earlier.

4.1.3.2. Findings/Results

Data analyses and hypothesis testing

Based on descriptive statistics, Figure 37 shows the dominant level of BI maturity among selected SMEs in Thailand.

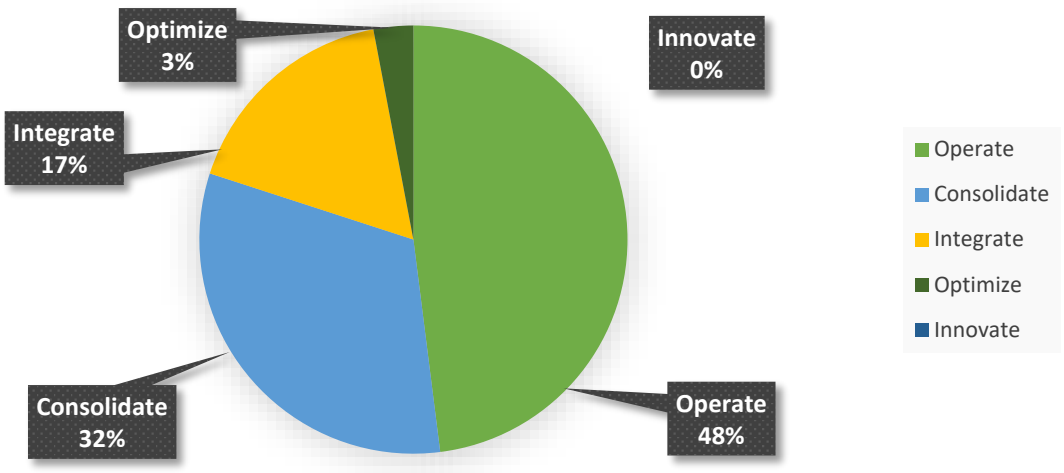

FIGURE 37- PERCENTAGE OF BI ADOPTION LEVEL WITHIN THAI SMES

Based on the results, about 80% of the SMEs falls into first and second levels of maturity model, which are very basic levels of BI adoption within SMEs. Within other 20% left, 17% falls into the third level of maturity model which is integration level. And surprisingly, none of the SMEs have the honor of belonging to the fifth level of maturity model which is the level of innovation.
The hypotheses of the researchers were tested based on Multinomial Logistic Regression model and six out of nine factors turned out to have a remarkable relationship with BI adoption levels. These hypotheses are listed below:

- H1- Relative advantage
- H2- Complexity
- H5- Organizational resource availability
- H6- Competitive pressure
- H7- Vendor Selection
- H8- Owner-managers' innovativeness

Discussion and Findings

The results show that the majority of SMEs fall into the first level of maturity model which is “Operate” level; based on the author's opinion, the reason for this lies behind the fact that, Business Intelligence applications and functions are not complicated in this level. On the other hand, in this low operating level of maturity, there is no need for high IT infrastructure and no specific knowledge required for implementing the BI systems.
The problem which arises here is, in this level of maturity, BI systems are not capable of fully transform the raw data into meaningful information which leads to making better strategic decisions by executives.
Based on this research model in analyzing the factors which affect BI systems adoption, SMEs are seeking for the higher perception of relative advantage and lower levels of complexity in the Business Intelligence systems, in order to implement them.
On the other hand, unexpectedly, turns out that the factor of compatibility is not playing the outstanding role in the adoption of BI systems and the explanation for this, based on authors opinion, is that in order to implement BI systems there is no need to have radical changes in routines of the organizations.
The other factor which analyzed by researchers was the organizational resource availability that plays a consequential role in the implementation decision made by SMEs. The issues like a lake of financial and technological resources alongside with capital expenditures are the reasons which make this factor more understandable. They also claimed that absorption capacity is not a critical factor for the SMEs to implement BI systems.
The other outstanding factors in the adoption of BI systems by SMEs are competitive pressure and vendor selection. Authors of this study claimed that, as enterprises identify competitive pressure, their willingness to adopt higher levels of BI systems increase accordingly.

Based on the results, even though owner-managers’ IT knowledge has no remarkable effect on enterprises in the process of BI systems adoption, the factor of owner-managers’ innovativeness plays an important role in this process. The more innovative is the owner of SME, the more willingness to improve to the fifth level of maturity model which is “innovate” level of this model.

4.1.3.3. Concluding Remark

This study explored the current BI adoption situation of Thai SMEs. The results showed that the majority of Thai SMEs were classified at the lowest level, suggesting that they are still at an early stage of BI technology adoption. This leaves ample scope for Thai SMEs to be elevated into higher levels by focusing on understanding the enabling factors of BI as a strategy. In identifying the factors that elevate BI levels in Thai SMEs, results found that high relative advantage, high organizational resource availability, high competitive pressure, high vendor selection, high owner-managers’ innovativeness and low levels of complexity were all important.(Boonsiritomachai et al. 2016)

By acknowledging the current stage of BI adoption and understanding the enabling factors that encourage Thai SMEs to move to higher levels, government agencies and technology suppliers can develop strategies to advance BI adoption. Initiatives that could support the use of more advanced BI could be through marketing and advertising campaigns that persuade SME owner-managers on the perceived potential advantage of using BI technologies, as well as to provide financial support and educational seminars to increase their innovativeness. IT vendors can also help advance SMEs to higher BI levels by providing their expertise for customized solutions relevant to the particular SME. Interactions between the SME and IT vendor can further benefit them in navigating the complexities of BI technology choice and implementation.(Boonsiritomachai et al. 2016)

4.1.4. Case of Sweden

IMPLEMENTATION OF BUSINESS INTELLIGENCE SYSTEMS, A STUDY OF POSSIBILITIES AND DIFFICULTIES IN SMALL IT-ENTERPRISES

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A qualitative study was performed, at four different IT-enterprises, to gather the empirical material. Interviews were performed with CEOs and additional employees at the enterprises. After the empirical material has gathered an analysis was performed to draw a conclusion regarding the research topic. The study has concluded that there are differences in possibilities and difficulties of implementing BI-systems among small IT-enterprises. A difference among the enterprises is the perceived ability to finance an implementation. Another difference is in the managerial and organizational support of an implementation, but also in the business need of using a BI system in decision-making. There are also differences in how the enterprises use a DW (Data Warehouse). Not all enterprises benefit from the ability of a DW to manage complex and large amounts of data, neither from the advanced analysis performed by OLAP. The enterprises thus need to examine further if the use of a BI-system is beneficial and would be used successfully in their company.(Westerlund and Persson 2015)

4.1.4.1. Methodology

The authors of this research study used a qualitative approach in order to assess the data which collected based on interviews. They use academic literature as a backbone and guideline for the research methodology and designing of the questionnaire. In order to figure out disparities between opportunities and challenges offered by Business Intelligence systems, the researchers chose 4 SMEs from the sector of Information Technology which are located in Sweden. Table 8 demonstrates the details about these Swedish SMEs.

TABLE 8 - THE PARTICIPATING ENTERPRISES

Company	Location	Independence	Type of Company	Turnover	Number of Employees
A	Uppsala, Sweden	Independent in a bigger concern	IT-solutions	30 MSEK (2014)	20
B	Uppsala, Sweden	Independent	IT-solutions and IT-consultants	20 MSEK (2013)	40
C	Uppsala, Sweden	Independent in a bigger concern	IT-consultants	30 MSEK (2013)	25
D	Uppsala, Sweden	Independent	Programming	20 MSEK (2014)	20

Table 9 shows the details about interviewees from these four SMEs mentioned above. From each organization, one the employees alongside with the CEO of each company were selected. The objective of the interviews was to fathom the structure of enterprises and the way in which they use data in their decision-making process.
The interviews questions employed three different aspects, as listed below, in order to bring ease to the process of assessing the questionnaires;

- The first aspect is about understanding the way in which enterprises store and organize their data in the concept of Data Warehouse theories.
- The second aspect is how the enterprises use and value analytical functionalities, which is related to OLAP theories.
- The last aspect was of a more general nature, regarding their use and plans of using analytical tools in decision-making.

Table 9 is demonstrating the details of interview sessions alongside with the position of the interviewees in each enterprise.

TABLE 9 - THE PARTICIPATING RESPONDENTS

Name	Position	Enterprise	Interview	Length	Date
A1	CEO	A	Face to face	75 min	04/10/2015
A2	Financial manager	A	Face to face	45 min	03/30/2015
B1	CEO	B	Face to face	60 min	03/30/2015
B2	Controller	B	Face to face	30 min	04/23/2015
C1	CEO	C	Face to face	30 min	05/07/2015
C2	Consulting manager	C	Face to face	55 min	04/09/2015
D1	CEO	D	Face to face	55 min	04/10/2015

4.1.4.2. Findings/Results

Organizational factors determining BI implementation outcome

Figure 38 is illustrating the four different factors that, based on the research, are the drivers of BI implementation in SMEs.

FIGURE 38 - ORGANIZATIONAL FACTORS DETERMINING BI IMPLEMENTATION OUTCOME

RESOURCES

After analyzing the attitude of these four enterprises regarding the factor of *resources*, it turned out that Enterprise C believes the implementation of Business Intelligence systems could be exorbitant and this enterprise doesn't see that BI systems worth this amount of cost. They claimed that they don't see that much opportunity in this system to invest the number of needed resources. On the contrary, enterprise A and enterprise B claimed that thanks to Business Intelligence systems they could save money in the long-run, although the implementation expenses of BI systems could be costly for them. And finally, in the assessing of enterprise D, it turned out that there is BI system already implemented in the organization, and this organization alongside with enterprise A and enterprise B didn't look at financial aspects of implementation as a stumbling block.

COMMITMENT

Despite the fact that, enterprise A didn't consider financial aspects of BI system implementation as an obstacle, this enterprise alongside with enterprise C, didn't see any need to implement BI system in their organizations. Based on interviews, they claimed that, since their enterprises are small regarding enterprise-size and also, they don't have to deal with lots of information, they don't see any future in the implementation of BI systems in their companies.
On the other part of the story, enterprise B look at BI systems as an opportunity and they believe that they can use BI systems as a supporting device in the process of decision-making. Enterprise D, which already have BI system implemented in their organization has a positive attitude towards BI systems and mentioned their complete satisfaction. Based on the assessments, the authors believed that regarding the *commitment* factor, there is a different point of views among organizations.

WILLINGNESS

In the willingness aspect, however, based on interview results, the viewpoint of enterprises A, C, and D toward using data and data analysis in the decision-making process is positive. On the other hand, in their opinion, just data and data analysis are not enough for them and they need to add other spices to the soup of decision-making; gut feelings, previous experiences, intuitions and good marketing, just to name a few.
On the other side, based on the interview results, enterprise B is looking to data analysis as an essential factor in the journey of decision-making.
Likewise, all companies to some extent want a business culture where data and data analysis is an aspect to be considered in the decision-making.(Westerlund and Persson 2015)

NEED

Based on the results of interviews, enterprises A and D mentioned that the operational market in which they are active, is highly dynamic and volatile; If we consider the defection of BI systems, these systems could be a potential remedy for these companies' challenges. Enterprise D state that, thanks to the BI tools, their organizational needs are fully satisfied and decision-making process couldn't be easier.
Enterprise B on the other hand, got another logic for their need of BI systems; They claim that in the way of growth in the market and to enjoy bigger pie of market share, they need the handle the vast amount of data which created in this growth process and they state that there is an absolute need for the BI system implementation to face the challenge of data managing and decision-making.
On the contrary, based on imperial material gathered from the interviews, enterprise C stated that they don't see any need for BI systems in their organization since they see themselves completely competent in the data managing tasks in order to make accurate and reliable decisions.

Use of Data Warehouse

Table 10 demonstrates the different states of Data Warehouse which these enterprises are using. The integrated state of Data Warehouse is the most mature and complete state of the DW that just enterprise D was fully leveraged this state; and the reason for this is, their DW collects data from different components of the organization and connected to the BI system of the company.

On the other hand, we can see the names of enterprises A and D in the state of subject-oriented DW and the reason is, since the systems of company A are connected and enterprise D employ integrated DW, they can focus on the specific part of data in their DW.

Based on the definition of DW, all the stored data in the DW does not change and there is a timestamp for each record of historical data. Since all four enterprises are storing their historical data in their DW and this data is not changed in the passage of time, all enterprises implemented and satisfied the states of non-volatile and time-variant of the Data Warehouse.

TABLE 10 - THE ENTERPRISES' USE OF A DW

DW-definitions	Enterprise A	Enterprise B	Enterprise C	Enterprise D
Integrated	NO	NO	NO	YES
Subject-oriented	YES	NO	NO	YES
Non-volatile	YES	YES	YES	YES
Time-variant	YES	YES	YES	YES

Benefits and Drawbacks of using a Data Warehouse

At the time of the interview, enterprises B and C claimed that they waste lots of time for the data extraction task from different components of their organizations since in that time they were using simple databases, not Data Warehouses. The possible remedy for this problem is definitely the DW; since it connects and integrates data flow from different departments and make analysis easier within an integrated platform.
In the case of Enterprise-A, the CEO of the company stated that they were using DSS and all of the organizations' systems were connected. Likewise, company B stated that integrated DW was extremely beneficial for them since they are operating in the context of global market and have to handle the vast amount of data from different parts of the world in a controlled way.
Based on this data, we can come to the conclusion that, the DW system is beneficial for enterprise B, C, and D, since support them to handle and manage the massive amount of raw data which are also complex in nature. But regarding company A, it seems that they don't need to use DW in their system since everything is connected to their organization.
But on the other hand, another aspect regarding company A is, they were complaining about data-overload in their databases; since they have to deal with the gigantic amount of data from different components of the enterprise.
Enterprise B however, stated that they prefer to process their raw data manually and the reason is they believe that manual processing gives them in-depth comprehension of their organization's situation.

Benefits of using OLAP

Based on the nature of the organizations, they need to assess their complex data from different points of view, in order to make timely and accurate decisions. So, if we use this fact as a reference, we can come to the conclusion that, all four companies somehow agree with the importance of the OLAP functions in the process of decision-making, predictive analytics and forecasting, multi-dimensional analytics, just to name a few.
Company D, which already implemented BI systems, is using benefits of OLAP analyzing style from different angles. Likewise, company A expressed its satisfaction with their implemented system. Company B, which already believes in the massive potential of BI systems, stated, despite the fact that their data analyzing process was not unsatisfying, they definitely see the improvement space in this critical process in order to make data analysis faster and more accurate and having better presentable information.
On the other hand, although company C expressed its satisfaction about their data analyzing processes, they confirm that functionalities of OLAP system are absolutely beneficial.
We should take to the consideration that, companies A and D claims that they are operating in a dynamic business market on the contrast with company C and D which stated that their activities are not in a dynamic environment.
In a nutshell, all four companies, found the functions of OLAP extremely useful for them, since it provides a competitive advantage in the field of instance decision making and lives data analysis.

4.1.4.3. Concluding Remark

The financial aspect is not an obstacle for enterprise A, B, and D, but for enterprise C. The organizational factor, *commitment*, is a barrier for enterprise A and C, but not for enterprise B and D. None of the enterprises perceive the factor, *willingness*, as an obstacle. The factor, *need*, is an obstacle for enterprise C, but not for the other enterprises.(Westerlund and Persson 2015)
In the aspect of DW, the first criterion, *integrated*, is fulfilled by enterprise D. The following criterion, *subject-oriented*, is fulfilled by enterprise A and D. The criteria *non-volatile* and *time-variant* are fulfilled by the enterprises. Enterprise D has fulfilled the four criteria of the definition and therefore, uses a DW.(Westerlund and Persson 2015)
In regarding OLAP, it has been demonstrated that the enterprises perceive the details, overviews, critical aspects and different perspectives as important in decision-making.
A DW can manage and organize the complex and large amount of data and is in this aspect advantageous for enterprise B, C and D. It would thus be disadvantageous for enterprise A. A DW provides timely access to historical data, but this would be disadvantageous for the enterprises. The advanced analysis performed with OLAP is advantageous for enterprise B, C, and D but disadvantageous for enterprise A. The rapid reports and analyses that OLAP provides are important in all the enterprises in decision-making and are thus advantageous for them.(Westerlund and Persson 2015)

4.1.5. Case of North Africa

BUSINESS INTELLIGENCE VERSUS ENTREPRENEURIAL COMPETITIVE INTELLIGENCE AND INTERNATIONAL COMPETITIVENESS OF NORTH AFRICAN SMES

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This study aims to analyze the effects of different devices of business intelligence and entrepreneurial competitive intelligence on the international competitiveness of 300 North African SMEs. Furthermore, through this study, the authors will try to examine the mechanical role of the internal audit of entrepreneurial competitive intelligence in the packaging of such effects. The originality of this research lies in the attempt to better understand theoretically and empirically the particularities of each of the concepts related to entrepreneurial competitive intelligence and its internal audit on one side and its effects on the international competitiveness based on export intensity on the other side. Our results show that the competitive position of North African SMEs is strongly dependent on the entrepreneurial competitive intelligence approach because it includes essential additional actions which refer not only to a defensive attitude but also and potentially to entrepreneurial orientation.(Tarek and Adel 2016)

4.1.5.1. Methodology

The intention of authors was to evaluate whether the competitive advantages and international competitiveness of North African SMEs are affected by different devices of business intelligence and entrepreneurial competitive intelligence of the organization or not. On the other hand, the other aspect of this research was to analyze the impact of an internal audit of entrepreneurial competitive intelligence on the benefits of the bundle mentioned above.
In order to shed light on this issue, the authors of this research study chose non-price indicators for the competitive advantage of North African SMEs, such as product differentiation and product's range alongside with selecting an indicator for the international competitiveness of these SMEs, which is export intensities.

The authors of this study employed a statistical quantitative approach in order to assess the research hypotheses, which are listed below, form the data gathered thanks to the survey questionnaires.
There are three hypotheses, mentioned by the authors:

H1: Business intelligence is an effective but insufficient process for achieving international competitiveness of SMEs;
H2: Entrepreneurial competitive intelligence as a more globalizing system than business intelligence positively and significantly affects the international competitiveness of SMEs.
H3: an Internal audit of entrepreneurial competitive intelligence has a positive effect on the international competitiveness of SMEs and determines the effectiveness of business intelligence devices.

At the first stage of the research, authors' aim was to map out the relative subjects of business intelligence, entrepreneurial competitive intelligence, and internal audit of entrepreneurial competitive intelligence.
Table 11 is demonstrating the base of empirical analysis which was undergone by researchers of this study that are related to devices of entrepreneurial competitive intelligence and internal audit of it.

TABLE 11 - ACTIONS AND ITEMS OF ENTREPRENEURIAL COMPETITIVE INTELLIGENCE AND INTERNAL AUDIT OF ENTREPRENEURIAL COMPETITIVE INTELLIGENCE

Actions			Items
Devices of entrepreneurial competitive intelligence	Devices of business intelligence	Collection of strategic information	Fixing of a research plan and the group of experts
			Identification of sources of information and field activities
			Determination of the sensors of information
		Information processing and analysis	Fixing of processing grids
			Mobilization of internal skills
			Use of external expertise networks
		Dissemination and sharing of information	Use of tacit knowledge
			Knowledge codification
		Memorizing the previous business intelligence processes	The conjunction of components of the targeted project
			Choice of the mode of archiving of documents
	Other devices of entrepreneurial competitive intelligence	Protection of information assets	Choice of technical protection procedures
			Sensitizing of personnel for the need to protect
		Entrepreneurial orientation	Innovation
			Risk-taking
			Proactivity
An internal audit of entrepreneurial competitive intelligence	*There is no specific categorization*		Verification of collective action in the the process of entrepreneurial competitive intelligence
	There is no specific categorization		Evaluation of the performance of the devices related to entrepreneurial competitive intelligence
	There is no specific categorization		Diagnosis of the operating expertise of the team to achieve the project objectives

Table 12 is exposing different variables of competitive advantages, which are related to North African SMEs. The authors of this study, considered the product differentiation and the products range as the inexorable, non-price variables of competitive advantages of these SMEs.

TABLE 12 - ITEMS RELATED TO THE PRODUCT DIFFERENTIATION AND THE RANGE OF PRODUCT

Competitive advantages	Items
Product differentiation	The orientation of the consumer demand for the company's products by refining its brand or its specific characteristics
	Encouraging consumers to purchase goods by offering specific attractions compared to its competitors
	The decrease of competitive pressures once the specifics are met by the product against the various products on the market
Range of product	Deepening the range of products
	Extension of the range of products
	Contraction of the range of products
	Diversification of the range of products

The methodology of this research is based on survey questionnaires. The number of six countries have chosen by authors which are listed in Table 13. Then the amount of 300 questionnaires were sent to the SMEs located in these six North African countries. After gathering the answers and analyzing the results, authors grouped these SMEs based on three different classifications, which are, SMEs that only applied BI devices, SMEs that applied entrepreneurial competitive intelligence totally or partially and SMEs that internal audit devices of entrepreneurial competitive intelligence in the form of total or partial.

Table 13 demonstrates that from these 300 SMEs, the number of 190 stated they only implement the business intelligence devices, 110 of these SMEs claimed that they employed entrepreneurial competitive intelligence either totally or partially. And finally, the amount of 50 enterprises in the selected sample adopted the internal audit devices of entrepreneurial competitive intelligence in the form total or partial adoption.

TABLE 13 - DISTRIBUTION OF NORTH AFRICAN SMES OF OUR SAMPLE THAT HAS IMPLEMENTED DEVICES OF BUSINESS INTELLIGENCE (BI), ENTREPRENEURIAL COMPETITIVE INTELLIGENCE (ECI), AND INTERNAL AUDIT OF ECI

Country of origin	Total SMEs by country of origin	Total SMEs that applied only BI devices	Total SMEs that applied totally or partially devices of ECI	Total SMEs that applied totally or partially internal audit devices of ECI
Algeria	60	40	20	7
Egypt	50	30	20	5
Libya	30	10	20	5
Morocco	70	50	20	13
Mauritania	20	10	10	5
Tunisia	70	50	20	15
Total	**300**	**190**	**110**	**50**

4.1.5.2. Findings/Results

After analyzing the data and validating the results by authors of this study, all three hypotheses are proved successfully. Based on this confirmation, the authors mentioned that BI is the appropriate choice for the cases in which SMEs need immediately some sort of information. On the other hand, entrepreneurial competitive intelligence is used to support strategic and long-term decisions. Based on authors opinion, this kind of information is related to the detailed and in-depth assessment of gathered data, continues use of internal and external resources of the company and processes like securing and protecting valuable information.
In other words, the process of entrepreneurial competitive intelligence is a longer, more globalizing, more focused, and especially more economically efficient process in comparison with business intelligence.
Additionally, the authors claimed that, in order to mechanically make sure that different devices of entrepreneurial competitive intelligence which are the promises of successful and effective use of business intelligence are appropriately functioning, SMEs should rely on the internal audit of entrepreneurial competitive intelligence.(Tarek and Adel 2016)

The major issue raised by this paper lies mainly in the development of the role assigned to the internal audit of ECI in the success of the internationalization process of SMEs by strengthening their international competitiveness. Furthermore, the question related to the contribution of the entrepreneurial orientation in the development of international competitiveness of SMEs, which remains an action inseparable from the approach of ECI, is crucial and essential.(Tarek and Adel 2016)

4.1.5.3. Concluding Remark

The results of this paper have shown the crucial role of the internal audit and the devices of entrepreneurial competitive intelligence in strengthening the competitive advantages of the North African SMEs whether in terms of product differentiation and range of product. To this end, facing the stressed and instantaneous changes of the signals of competitiveness in the national and international environment of SMEs, business intelligence as a response to a need of information, or the emergence of need is insufficient. Indeed, the competitive position of companies is strongly dependent on the entrepreneurial competitive intelligence approach because it includes essential additional actions which refer not only to a defensive attitude but also, and potentially, an offensive attitude that is planned and materialized by a given entrepreneurial orientation. In other words, the competitiveness of SMEs requires not only the reaction to an information need but also the implementation of a real decisive approach that integrates both the security component through a strong protection of information assets and decision component by following an adequate entrepreneurial orientation.(Tarek and Adel 2016)
In a broader perspective, the results of this paper can be translated into strategic orientation to all SMEs in developing countries. Those latter have not yet assigned the information from their international environment the value that it deserves. In addition, the management of information and its transformation into strategic decisions to preserve or enhance, internationally, a better competitive position must be part of a longer, more calculated, and more oriented approach than to use only a traditional BI system. In other words, it is essential to highlight other additional and specific variables related to information systems, particularly the protection of strategic information and the entrepreneurial orientation. To this end, the results of this study show that ECI is an effective approach for achieving a competitive advantage based on product differentiation and range of product and international competitiveness based on export intensity. Finally, SMEs in developing countries are required to highlight the importance of the internal audit of ECI, which is a guarantor of the success of ECI and BI at the same time.(Tarek and Adel 2016)

4.1.6. Case of Poland

CRITICAL SUCCESS FACTORS FOR IMPLEMENTING BUSINESS INTELLIGENCE SYSTEMS IN SMALL AND MEDIUM ENTERPRISES ON THE EXAMPLE OF UPPER SILESIA, POLAND

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The main objective of this study is to identify the critical success factors (CSFs) for Business Intelligence (BI) systems implementation in small and medium enterprises (SMEs). The structure of the study is subordinated to this objective. The study identifies the term Business Intelligence, characteristics of Business Intelligence systems, and various perspectives of their development. Then, the existing CSFs of IT projects and BI projects proposed by various authors in literature are reviewed. Next, based on statistical data and literature, the role of SMEs in the economy and the barriers to their development are assessed. The obtained results allowed us to determine that one of the barriers to the SMEs development is the implementation and use of IT. Subsequently, using in-depth interviews with SMEs, the SMEs need for BI systems as well as the determinants and barriers to their implementation are recognized. Based on the findings, using critical thinking and inductive reasoning, the authors of the article along with the researched enterprises have defined CSFs that are crucial for implementing BI systems in SMEs. The results obtained may be useful for managers, policymakers, business analysts, and IT specialists in dealing with planning and implementation of BI systems in SMEs.(Ziemba and Olszak 2012)

4.1.6.1. Methodology

The aim of the authors of this research study is distinguishing the critical success factors of Business Intelligence Systems implementation, particularly within SMEs. In order to be able to make this happen, the authors recognized partial implementation of the following goals, which are listed below (Ziemba and Olszak 2012):

- determining the demand for BI systems in SMEs;
- identifying the determinants and barriers to the implementation of BI system in SMEs; and
- identifying the CSFs for the BI system implementation in SMEs.

The research method of this study is well-explained in Table 14. The authors have used qualitative research approach by analyzing empirical data gathered from interviews alongside with literature review. On the other hand, other research methods like critical thinking and inductive inference have been employed by authors, as well.

TABLE 14 - THE RESEARCH METHODS USED IN THE STUDIES

Purpose of Research	Research Methods	Interview's Questions	Research Group
Determining the demand for BI systems in SMEs	In-depth interview	List the most requirements for BI systems	20 SMEs from Upper Silesia, Poland: - which have implemented or are in the process of implementation of BI systems; and - which were represented by IT professionals, business analysts, and owner-managers
Identifying the determinants and barriers to BI system implementation of SMEs	In-depth interview	- List the determinants of BI systems implementation - List the barriers to BI systems implementation	20 SMEs from Upper Silesia, Poland: - which have implemented or are in the process of implementation of BI systems; and - which were represented by IT professionals, business analysts, and owner-managers
Identifying CSFs for BI system implementation in SMEs	Critical thinking, inductive reasoning, in-depth interview	Choose the most significant CSFs for BI systems implementation	20 SMEs from Upper Silesia, Poland: - which have implemented or are in the process of implementation of BI systems; and - which were represented by IT professionals, business analysts, and owner-managers

As authors mentioned and based on the demonstration of study's research method, the research was performed through different categories which are classified based on mentioned goals. The first stage was the in-depth interviews which are done in a bundle of 20 Polish SMEs which are located in Upper Silesia. Then the authors used these generated data from interviews, and by cooperation with enterprises, Critical Success Factors of Business Intelligence systems' implementation were clearly defined based on critical thinking and inductive reasoning.

This research study was performed in 2010 in the region of Upper Silesia in Poland. The authors of this article have sent invitations to 200 organizations in order to invite them to participate in their research program; surprisingly almost 10% of these organizations had a positive point of view regarding this research, accordingly just 20 out of 200 accepted to participate in the research program. These organizations were selected from different segments of the market as listed below:

- 10 SMEs from the ***commerce*** sector
- 7 SMES from the ***service*** sector
- 3 SMEs from the ***consulting*** sector

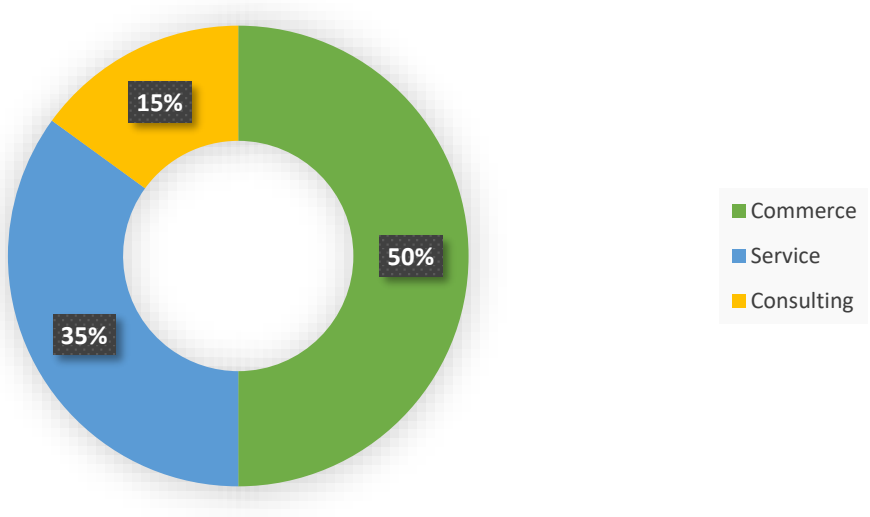

FIGURE 39- DISTRIBUTIONS OF PARTICIPATED SMES BASED ON THEIR MARKET SEGMENT

The interviewees of this research were mainly owner-managers, business analysts, and IT professionals which were related to BI implementation projects in mentioned enterprises.

4.1.6.2. Findings/Results

The demand for BI systems in SMEs and the diagnosis of BI systems market for SMEs

Interestingly, all of the SMEs that participated in the research, which are 20 enterprises, intrigued to know more about supporting the role of BI systems, and authors claimed that BI systems play a vital role in the competitiveness of enterprises in the market alongside with improved information resources management. The authors of this study mentioned that owner-managers and business analysts interviewed SMEs proved these results. Based on these interviewees' opinion, thanks to the data analysis function of BI systems, enterprises gained more support in the field of competitive advantage.

In the last decade, only large organizations and big companies were interested in BI systems implantation and were enjoying the latest technologies offered by BI, like Data Warehouses, OLAP and data mining. By contrast, lately, vendors of BI systems are more interested in SMEs market and day by day, are adapting themselves to solve these small enterprises' challenges and needs. As mentioned in this article, both domestic and international vendors of BI system are giving service to the SMEs which are in Poland.

Determinants and Barriers to the BI implementation in SMEs

The interviews with the owner-managers, business analysts, and IT specialists from 20 enterprises in the SME sector that have implemented or are in the process of implementing BI systems have allowed the authors to identify the determinants and barriers to BI systems implementation. The determinant that plays the largest role in the BI system implementation in SMEs is the price of the BI system and its implementation. This was confirmed by 18 surveyed enterprises. Additional determinates mentioned were the suitability of BI for users' business needs (17 enterprises), integration of the operational systems with BI systems (17 enterprises), well-defined business problem and processes (15 enterprises), as well as changeability and development of the BI system (14 enterprises). Other important determinants of BI effective implementation mentioned by the surveyed enterprises are "user-friendly" BI system, the reference lists of a BI supplier, past cooperation with a BI supplier, as well as the kind of BI technology and tools. The detailed results of the determinants governing the implementation of BI in SMEs are presented in Figure 40.(Ziemba and Olszak 2012)

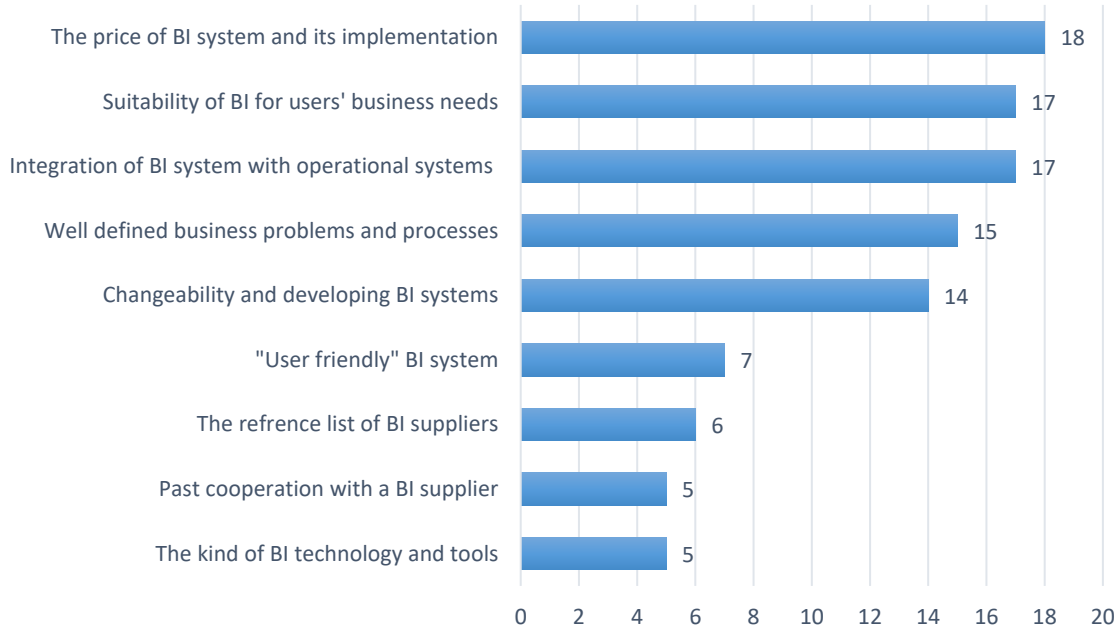

FIGURE 40 - THE DETERMINANTS OF BI SYSTEM IMPLEMENTATION IN SMES IN UPPER SILESIA

The biggest barriers that the respondents encountered during the implementation of BI systems have a business and organizational character. Among the business barriers, the most frequently mentioned were the lack of well-defined business problems (18 enterprises), not determining the expectation of BI (15 enterprises), and the lack of relations between business and BI vision system (9 enterprises). Whereas as the key organizational barriers the studied enterprises enumerated were the lack of manager's support (17 enterprises), the lack of knowledge about the BI system and its capabilities (16 enterprises), exceeding the BI implementation budget (15 companies), ineffective BI project management (14 firms) and complicated BI project (13 enterprises), the lack of user training and support (12 enterprises), and the resistance of the "human factor" (11 enterprises). During the implementation of BI systems, the enterprises had to overcome technological barriers, such as the lack of appropriate data for the BI system (13 enterprises) and the lack of BI system flexibility (9 enterprises). The detailed results of the barriers to BI systems implementation in SMEs are presented in Figure 41.(Ziemba and Olszak 2012)

FIGURE 41 - BI SYSTEM IMPLEMENTATION BARRIERS IN SMES IN UPPER SILESIA

Critical Success Factors for BI system implementation in SMEs

The authors of this research study, introduced three different classifications for BI systems' Critical Success Factors, thanks to the critical thinking and inductive reasoning methodologies; which are listed below:

- Organization
- Process
- Technology

These perspectives result from the nature and determinants of barriers to the BI systems implementation. Within the frame of an individual perspective, the critical success factors have been identified, accounting for the different determinants and barriers. The details of these three perspectives are illustrated in Figure 42. (Ziemba and Olszak 2012)

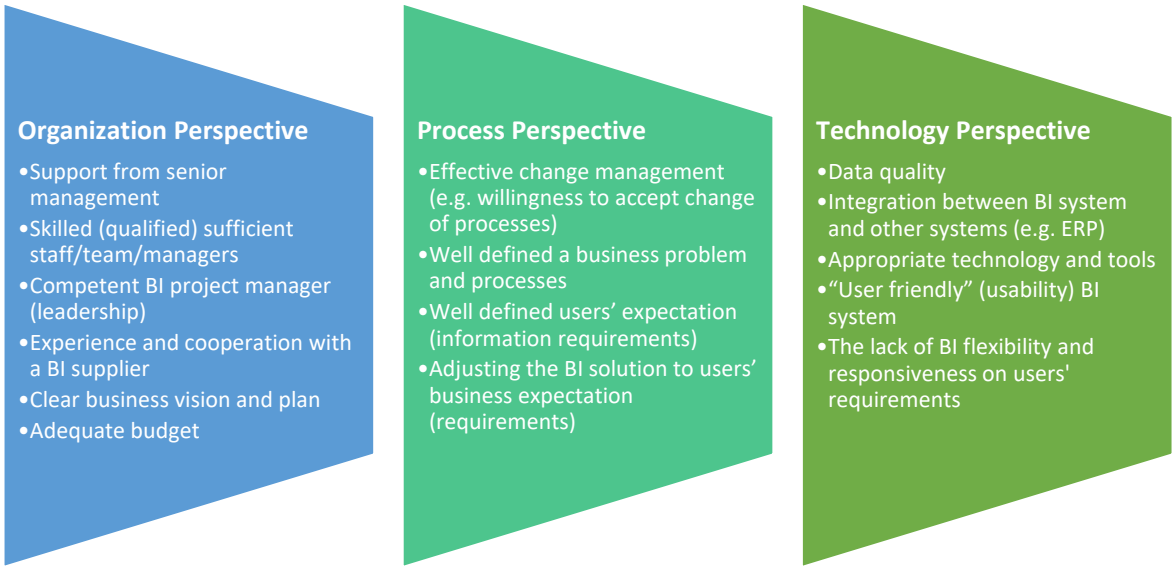

FIGURE 42 - CSFS OF BI SYSTEMS IMPLEMENTATION IN SMES IN UPPER SILESIA

From surveyed enterprises, owner-managers, business analysts and IT professional were re-assessed and re-examined these classifications of Critical Success Factors alongside with CSFs themselves in order to identify in-depth, the impact of these factors on their SMEs. Table 15 demonstrates the detailed version of these Critical Success Factors within Polish SMEs.(Ziemba and Olszak 2012)

TABLE 15 - IMPACT CSFS ON THE SUCCESS OF THE BI PROJECT IN SMES IN UPPER SILESIA

Critical Success Factor		Impact on the success of the BI project (number of enterprises)
Organization perspective	Adequate budget	20
	Support from senior management	18
	Competent BI project manager (leadership)	18
	Skilled (qualified) sufficient staff/team/managers	17
	Clear business vision and plan	17
	Experience and cooperation with a BI supplier	10
Process perspective	Well defined a business problem and processes	20
	Well defined users' expectation (information requirements)	20
	Adjusting the BI solution to users' business expectation (requirements)	18
	Effective change management (e.g. willingness to accept a change of processes)	16
Technology perspective	Integration between BI system and other systems (e.g. ERP)	20
	Data quality	18
	BI flexibility and responsiveness on users' requirements	17
	Appropriate technology and tools	15
	"User-friendly" (usability) BI system	13

4.1.6.3. Concluding Remark

The research results indicate that the use of a BI system will result in a business success only if the BI users, on a regular basis, develop business and decision-making processes, recognize their needs, assist their modelling and oversee the completion of a project as well as actively participate in the implementation of new BI components. The knowledge and skills of a project team and BI systems users are of primary importance.(Ziemba and Olszak 2012)
In summary, for a BI project's implementation to be successful and to bring tangible business benefits to SMEs in the future, it is necessary to meet some basic conditions(Ziemba and Olszak 2012):

- BI system must be a part of the company's business strategy.
- Managing the BI system implementation ought to be centralized, but all its prospective users should be involved in the implementation.
- The implementation of the BI system requires appropriate knowledge and skills for the BI implementation.
- BI system implementation project must have a sponsor who is positioned in the organizational hierarchy as high as possible.
- BI system requires permanent development and adaptation to new challenges and expectations of an enterprise.
- It is necessary for users to be able to use the BI system.
- The cost of BI implementation must cover the costs of technology but also account for measures to establish a project team, technical support, substantive support, change management, employees training as well as maintaining and developing the BI system in the future. Otherwise, the enterprise receives a powerful tool that no one will use.

4.1.7. Case of UK

IMPLEMENTING A BUSINESS INTELLIGENCE SYSTEM FOR SMALL AND MEDIUM-SIZED ENTERPRISES

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The study elaborates the considerations for implementing BI systems for SMEs. The study provides the implementation of Business Intelligence system for an SME and the purpose and constraints of the system are detailed.(Sang, Xu, and De Vrieze 2016)

4.1.7.1. Methodology

The authors of this research study have selected two companies which are active in the insurance sector of the market and performing as a one-unit insurance group. Then, the authors have implemented a case study approach in order to evaluate the different aspects of BI systems implementation which was deployed partially at the time that case study was performing.

Two different insurance companies, which in this study called company A and Company B, have started their partnership in the insurance sector of household gadgets and appliances and by this way, Insurance Group Z was created by joining of these two companies.
In this insurance group which is based in the UK, company A is responsible for insuring the household appliances, but on the other hand, responsible of company B was insurance of both household appliances alongside with household gadgets. One of the competitive advantages of these insurance companies, based on information of the research study, is their affordable and competitive pricing strategy. At the time of performing this research study, based on historical data of Insurance Group Z, there were 68’000 customers insured by this group.
Both company A and B currently have two types of insurance policies, which are:

- Single product insurance policy
- Multi-product insurance policy

Both types of the insurance policies currently cover accidental, electronic and mechanical damages, loss and theft cover for over 50 products of appliances and gadgets. The current maximum number of covered product on a policy is 18 products.(Sang, Xu, and De Vrieze 2016)

Company B is solely online-oriented; the website where the customer can set up the policy and can make payment, and the online customer portal where customers can make claims, buy additional items, and download related policy documents. On the other hand, the sales of insurance product for Company A is internal-oriented where the sales and retention teams dial existing and potential customers through the internal campaigns. Prospective customer leads are supplied by external parties daily or in real time.(Sang, Xu, and De Vrieze 2016)

Insurance Group Z primarily uses over six SQL Server 2008 R databases storing for the customer, policy, claim, payment and marketing data. Each database has APIs consumed by the company's systems such as CRM, Sales, Claims, Reports, etc. In addition, MySQL database is used for campaign dialer and call recording. However, these databases are not designed or optimized for BI, reports or related ad-hoc queries. Thus, this makes it difficult for business users to gain insights of business performance, customers, and growth in efficient ways.(Sang, Xu, and De Vrieze 2016)

4.1.7.2. Findings/Results

After the assessment of Business Intelligence systems which were implemented in the Insurance Group Z, the authors of this study explained the available BI application that two companies were using at the time of case study. Following are the list of these applications with a brief explanation of their usage and functions in the BI system.

BI Application

MANAGEMENT SUPPORTED SYSTEM

A management focused reporting system is designed and built, enabling the provision of information for business users and the addition of new reports as needed. A reporting database is used for storing raw and fact data as required. The primary purpose is for fast implementation and cost-saving due to no data warehouse.(Sang, Xu, and De Vrieze 2016)

VICIDIAL

Vicidial (Open Source Dialer) is used for most of the sales campaigns. It has various reports including real-time capabilities, which allow the analysis of the performance of each campaign, sales agents, monitoring, disposition, etc.(Sang, Xu, and De Vrieze 2016)

QLICKVIEW

QlikView enables the Data Analyst to analyze data in different ways which cannot be easily and quickly implemented in the business. Key information of sales data with suppliers is analyzed and learned. For example, analysis of sales data enables the analyst to see what kind of data from a specific provider is generating more sales than another provider.(Sang, Xu, and De Vrieze 2016)

RSTUDIO WITH R

R programming with *Apriori* and *RStudio* is used for analyzing claim data and patterns. This gains a better understanding of customer claim data, claim patterns, and enables the provision of valuable insights to the insurance group Z, supporting the decision-making process. Findings are converted into interactive web pages which can be easily accessible by business users.(Sang, Xu, and De Vrieze 2016)

Based on the extracted information of this article, implementing Business Intelligence systems in an enterprise has several pros which some of them are listed below:

- Optimizing the business
- Creating new opportunities
- Quick and more effective response to the market demands

In addition, managers and business users have access to information of profit and cost drivers that directly impacts the business.(Sang, Xu, and De Vrieze 2016)
The authors of this research study claimed that because of Business Intelligence systems' implementation in the mentioned Insurance group, and the way this BI system supported the following business operations efficiently, companies were enjoying increased revenue by 30%(Sang, Xu, and De Vrieze 2016):

- Lead Data Trend Analysis - planning and determining new lead strategies
- Campaign Dialer and Agent Analysis
- Estimating and forecasting sales
- Claim Analysis – Claim data, claimed customers and products
- Monitoring and compliance with internal and external rules

After assessing all of the existed and implemented BI systems in the Insurance Group Z by the authors of this study, they found some weaknesses in the business strategy of the companies. First one is the lack of a Data Warehouse in their BI systems. The authors believe that, if the companies implement a data warehouse in their enterprise they could substitute their inadequate reporting database used by the management supported system for advanced integrated DW technology of BI systems in order to have more effective management and organization.
The other issue that was found by the authors was the fact that, since company B is an internet-based organization and all of its services are based on the web, implementing a cloud-based BI solution could be a huge plus and competitive advantage for this company.
After all, BI is essential and a key enabler to increase business value and growth. And the insurance group Z can leverage and unleash the complete value by implementing the BI-enabled business strategy.(Sang, Xu, and De Vrieze 2016)

4.1.7.3. Concluding Remark

BI is not just an IT system, but a corporate asset which enables organizations to manage insights of their data, businesses, strategies, profits (past, present, and forecast) and performance. Thus, it helps to make better decisions.(Sang, Xu, and De Vrieze 2016)
Business IT Alignment plays an important role in an organization by enabling the business and IT management to work cohesively to support the organization's goals and objectives by implementing technology solutions such as BI-enabled business strategy.(Sang, Xu, and De Vrieze 2016)
SMEs requires a new approach to manage their insights of the businesses by implementing a BI solution, as various reasons discovered in the paper such as vendors targeted large enterprises, the capability of complex resources and finance. Hence some technology solutions were overviewed, and solutions such as cloud-based or SQL Server BI solution is most promising to meet SMEs' requirements.(Sang, Xu, and De Vrieze 2016)
Overall, it is the challenge for organizations, SME or Large, to discover new ideas and processes, define strategy and implement the findings into BI capability as the competition grows, and market and customer demands increase. Most of all, BI is the ultimate asset and tool, which will enable organizations to manage insights of their business and make better decisions.(Sang, Xu, and De Vrieze 2016)

4.1.8. Case of Greece

BUSINESS INTELLIGENCE DURING TIMES OF CRISIS: ADOPTION AND USAGE OF ERP SYSTEMS BY SMES

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This research study composed of assessing the adoption and implementation processes of ERP and BI platforms in the sphere of Western Macedonia. The focus of the study is mostly on critical factors that have an impact on the adoption of these mentioned above decision-support systems in the context of SMEs and try to shed light on how these SMEs could benefit by these systems during a period of crises.

Special emphases of discerned factors were put on economic and organizational aspects of SMEs, which are participated in the research survey. Surprisingly, based on the results of this study, it turned out that, although executives of SMEs identified the value added of ERP/BI platforms, especially in the field of managing and integrating organizational data, they do not leverage the full competences of their ERP systems' BI applications, since these executives do not take advantage of the knowledge and experience gained from using implemented systems (Antoniadis, Tsiakiris, and Tsopogloy 2015).

4.1.8.1. Methodology

The main objective is to distinguish the key benefits that can affect an SME by adoptions and usage of an ERP platform, with its embedded Business Intelligence capabilities.
To measure the above mentioned, 37 firms of the region of Western Macedonia were examined, during April and May 2014. Most of the firms (56.10%) are commercial firms, with 31.71% coming from the manufacturing sector, 7.32% are services firms and only 4.88% from the tourism sector. More than one out of two firms (58.54%) employ more than 20 employees, and the clear majority of the firms (80.00%) had more than 1.5-million-euro turnover. It is worth mentioning to note that approximately all examined SMEs were using ERP systems provided by Greek software firms (such as SoftOne, Singular Logic, Entersoft, etc.) and that all firms have implemented an ERP system during the last 10 years.
Managers and users of ERP systems were personally interviewed, based on a structured questionnaire composed of 5 sections, focusing on the implementation, adoption, and usage of Business intelligence capabilities of the ERP system used by the firm. All questions were taken from relevant literature hypotheses and were presented using the Likert scale from 1 (totally disagree) to 5 (totally agree). To identify the relationship between the advantages yielded by the usage of ERP systems, business intelligence features, and firms' characteristics, various statistical tests were employed as the non-parametric test of Kruskal-Wallis, the Spearman correlation coefficient and the Kolmogorov–Smirnov non-parametric test.(Antoniadis, Tsiakiris, and Tsopogloy 2015)

4.1.8.2. Findings/Results

Among a various number of Decision Support Systems, ERP systems are the one which recently adopted by executives of SMEs. The average rate of ERP usage based on their implementation date, among surveyed SMEs, is 6 years with a minimum of 3 years and maximum of 9 years. Based on research results, the factors like "*data integration*", "*controlling activities*" and "*flexible decision making*" are mentioned as most effective characteristics of ERP platforms by the executives of surveyed SMEs. Interestingly, all mentioned advantageous factors are the attributes of Business Intelligence systems.
More surprisingly, it is worth mentioning that, the factor of "*contribution to cost reduction*" is considered the less beneficial one by executives; even if these surveyed SMEs were in the middle of economic crises epoch and cost reduction was of utmost importance for them.
On the contrary, the factors like "*cost of initial setup and support*", and "*cost and time required for training the personnel to handle the new system*" are mentioned as preventive ones to the adoption of ERP systems.

Based on the research results, the prominence of the critical factors which are having an impact on the implementation success of ERP platforms is generally accepted by participated executives as they mentioned in the relevant academic literature.

The most vital factors recognized are the support of the software provider (with the average of 4.67), the configuration/customization of the ERP system (with the average of 4.55), and the ability of communication and cooperation between all the involved departments of the firm (with the average of 4.55). Respectively the least important factor concerns the composition and the skills of the group assigned to implement the project with an average of 3.76.(Antoniadis, Tsiakiris, and Tsopogloy 2015)

The benefits of implementing and using ERP platforms were completely and carefully examined by 14 questions in section B of the questionnaire. The overall average value for all questions is 4.10 with a standard deviation of 0.47, while answers are not normally distributed.(Antoniadis, Tsiakiris, and Tsopogloy 2015)
The benefits that are most favored by respondents are the integration of data and information from different departments (with the average of 4.68), the reliability of information assembled (with the average of 4.43), and saving time (with the average of 4.40).(Antoniadis, Tsiakiris, and Tsopogloy 2015) However, saving operational resources (with the average of 3.60), cultivating a culture of responsibility (with the average of 3.68) are valued as the less important contribution of ERP systems, and effective intra-enterprise solution (3,78), raising questions concerning the strategic and organizational integration of ERP systems in the participating SMEs.(Antoniadis, Tsiakiris, and Tsopogloy 2015)

Finally, the section 4 of the questionnaire concerned about Business Intelligence by examining 23 business intelligence capabilities of ERP systems. The average value for the total of the 23 variables is 3.99 with a standard deviation of 0.508. Notably, 11 out of 23 variables take scores less than indicating that SMEs do not take full advantage of the business intelligence capabilities of ERP systems.(Antoniadis, Tsiakiris, and Tsopogloy 2015)

Cronbach value for the questions of Table 16 is 0.903 and the Kolmogorov-Smirnov test shows that answers do not follow a normal distribution.(Antoniadis, Tsiakiris, and Tsopogloy 2015)

TABLE 16 - PERCEPTIONS OF MANAGERS CONCERNING BI CAPABILITIES, OF ERP SYSTEMS

The possibility of Business Intelligence	Average	Median	S.D.	Range
Group services and tools (groupware)	3,97	4	0,706	2
Possibilities of collaborative decision making	3,68	4	0,541	2
Clustering of problems	4,03	4	0,875	3
Optimization techniques	4,45	5	0,768	3
Import/Export data from/to other systems	4,48	5	0,769	2
Simulation models	3,55	3	0,810	3
Simulation / risk assessment	3,74	4	1,094	4
Treasury management tools (capital, producers, loans)	3,90	4	1,044	4
Economic management tools (Financial Accounting)	4,42	4	0,620	2
Investment Management Tools	3,39	4	1,174	4
Cost-audit tools (profitability analysis, profit accounting centers)	4,19	5	1,138	4
Property management tools	3,35	3	1,082	4
Graphic representations	3,90	4	1,012	4
OLAP Possibilities (Multi-dimensional analysis)	4,39	5	0,715	2
Aggregated results tools	4,68	5	0,702	2
Entrepreneurial references (enterprise reporting)	4,42	5	0,848	3
Data Extraction (data mining)	4,19	4	0,873	4
Dynamic user interface (Dashboard)	4,03	4	0,836	2
Decision-making methods, using fuzzy logic	3,74	4	1,032	4
Decision-making analysis with multicriteria	3,87	4	1,056	4
Data warehouses	4,13	4	0,846	3
Applications on mobiles (mobile application), tablets	4,03	4	0,912	3
Cloud applications systems (Web-based)	3,61	4	0,989	4
Total Average:	**3,99**		**0,508**	

Business intelligence competencies that are perceived the most significant are the aggregated results tools (4.68), importing/exporting data (4.48) and economic management/accounting tools (4.42), while property management tools (3.35) and investment analysis tools (3.39) are considered less important.(Antoniadis, Tsiakiris, and Tsopogloy 2015)

Furthermore, the correlations between ERP system implementation and their Business Intelligence capabilities, with the years of ERP usage are also investigated, using the Spearman coefficient. The more years a firm utilizes an ERP the more conscious should be on the benefits and competences it offers, due to experience and economies of knowledge.(Antoniadis, Tsiakiris, and Tsopogloy 2015)
The results of the Spearman coefficient point out that years of usage have no correlation with the considered benefits of implementing and utilizing an ERP platform nor with the Business intelligence capabilities of the ERP system. That result may point out the lack of economies of knowledge, and the underutilization of the ERP platforms' capabilities, resulting to poor ROI, and less efficient management and marketing decisions, that are critical in times of crisis. However, as expected the perceptions of the benefits emanating from the implementation of ERP systems are highly and positively correlated with the perceptions of BI competencies that the system delivers.(Antoniadis, Tsiakiris, and Tsopogloy 2015)

4.1.8.3. Concluding Remark

The objective of the research was investigating the perceptions and attitudes of SMEs utilizing ERP platforms and their BI competences in the sphere of Western Macedonia in Greece. The integration of ERP systems is important for SMEs from a strategic point of view, especially due to the competition, they face in a globalized business and economic environment, where cost reduction consideration and customer needs are of utmost importance.(Antoniadis, Tsiakiris, and Tsopogloy 2015)
The sample composed of 37 firms and respondents found more vital the benefits originated from reliable data collection and consolidation, as well as saving time by automating procedures, but not saving operational resources, and cost. Similarly, the BI competencies that are considered more significant are data related, crucial for business reporting and data importing and exporting capabilities, about profit and non-profit organizations analysis.(Antoniadis, Tsiakiris, and Tsopogloy 2015)
ERP systems and their Business intelligence capabilities are not incorporated in SMEs to fully exploit the advantages that have its roots in their usage. Organizational and operational factors such as culture, strategy, leadership, learning, and quality management, as well as the strategic orientation of an enterprise are tremendously affecting the implementation and integration of sophisticated BI platforms.(Antoniadis, Tsiakiris, and Tsopogloy 2015)
SMEs, especially in times of crisis, divert resources from "expensive" tasks as training and integration of new software and its capabilities divesting themselves from potential competitive advantages and losing the chance to gain core competencies.(Antoniadis, Tsiakiris, and Tsopogloy 2015)

4.1.9. Case of Czech Republic

COOPERATION OF ACADEMIC AND COMMERCIAL SPHERE DURING THE IMPLEMENTATION OF BI BY THE MEANS OF SAAS

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The objective of this research study is the investigation of BI platforms utilization in the context of SMEs among Czech Republic enterprises which are located in Moravia-Silesia region.
Based on authors claim, there was a similar situation in Central Europe at the time of the investigation, thus they generalize the characterizes of the research in the mentioned above sphere. The main focus of the study is on the introduction of utilized Business Intelligence tools within the context of SMEs, and the suitability of SaaS also assessed in the mentioned section among enterprises. Among the conferred results of the survey, the ICT usage is also available in order to give support to the decision-making process within the context of SMEs, in the sphere of Moravian-Silesian of Czech Republic.
Following the survey, the cooperation of academic and commercial sphere during the implementation and optimization of BI application in the form of SaaS is discussed.(Rozehnal and Tvrdíková 2012)

4.1.9.1. Methodology

The survey-based study was conducted during 2011, to investigate the utilization of ICT platforms in favor of enterprise's operations at the Faculty of Economics, VŠB - Technical University of Ostrava, in cooperation with CSSI (Czech Society for Systems Integration).
In the beginning, the total number of 156 SMEs, form the region of Moravian-Silesian were invited to participate in the research. Fortunately, the 112 surveys were completed and sent back by the SMEs; these consisted of 23 micro firms, 29 small businesses, and 40 medium-sized enterprises. They were also categorized by their industrial sector, i.e. manufacturing (29 firms), retail (17 firms) and services (47 firms). Within the research survey, there was also two sections regarding exploitation and deployment of BI applications and Cloud Computing services. (Rozehnal and Tvrdíková 2012)

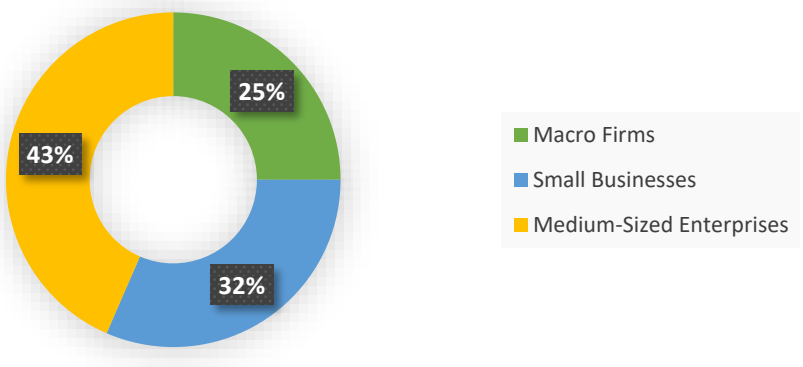


FIGURE 43- DISTRIBUTION OF RESPONDENTS' ENTERPRISES BASED ON THEIR SIZE

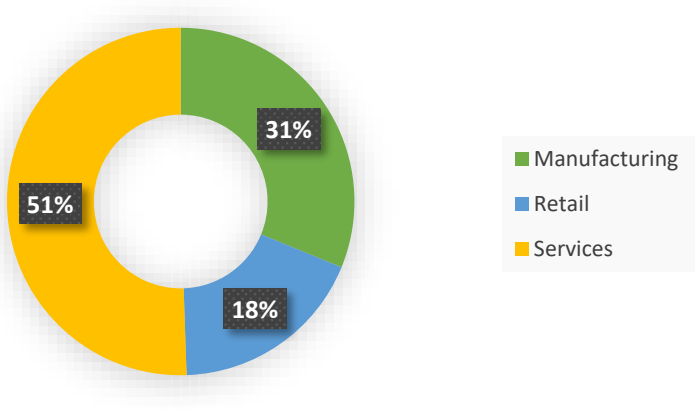


FIGURE 44- DISTRIBUTION OF RESPONDENTS' ENTERPRISES BASED ON THEIR INDUSTRIAL SECTORS

Based on research's results, it is conspicuous that, approximately, 80 percent of participated SMEs did not utilize the BI applications in a systematic way. Although, these SMEs' executives put lots of effort on the utilization of some selected applications or modules; e.g. Data Warehouse application is most frequent one among others. Based on survey's results, it is self-evident that other modules are employed within BI-BPM (Business process management), CPM (Corporate Performance Management) and CRM (Customer Relationship Management), Table 17. The authors of this research study mentioned that, one of the setbacks to have an efficient BI platform within enterprises is lies behind the fact that BI systems are not used in a pervasive manner and toward operational level; and even if companies try to integrate BI with other enterprise components, in 80 percent of the cases, they just try to integrate BI applications with their traditional ERP platforms.(Rozehnal and Tvrdíková 2012)

TABLE 17 - USE OF ICT TOOLS AMONG SELECTED CZECH SMES

Use	BI	Data Warehouse	BPM	CPM	CRM
No	90	79	88	95	79
Yes	22	33	24	17	33
Sample total	112	112	112	112	112
Expressed by the number of respondents.					

More than half of the participated SMEs, mentioned that because of absence of related knowledge about the technology of Cloud Computing they do not use these systems; also, it is worth mentioning that 15% of executives mentioned confidentiality and skepticism as a reason of not utilizing CC platforms, Table 18. (Rozehnal and Tvrdíková 2012)

TABLE 18 - USE OF CLOUD COMPUTING SERVICES AMONG SELECTED CZECH SMES

Use of Cloud Computing Services	
We use CC	8
We are interested in the issue, but we do not apply it	23
We don't have confidence in the CC use	16
We don't know CC	56
Sample total	**103**

There was a survey-based research in 2011, which conducted by Czech Statistical Office in the field of ICT utilization in the business sector, that results of which is indirectly confirmed by this research. Despite the fact that, the focus of mentioned above research was not directly on spheres that assessed in this research, the authors claimed that it is fair enough to generalize the dependence between organization's size and leveraging the ICT platforms into its operational activities. Thus, the results shed light on the fact that, the smaller the company, the lesser use of ICT, Table 19.
Among results, there was some evidence that confirms the effort of smaller enterprises on making savings by the means of ICT platforms; for instance, the deployment of open source technologies in order to benefit the utilization of freely scalable ERP/CRM platforms, Table 19. (Rozehnal and Tvrdíková 2012)

TABLE 19 - USE OF SELECTED ICT TOOLS ACCORDING TO FIRM SIZE

	Firm Size (number of employees)		
	10 - 49	50 - 249	250 +
IS Use for distribution management	21,5	46,8	68,9
ERP use for integration of business processes	17,8	50,3	79,6
CRM use	13,7	7,33	53,4
Use of freely scalable ERP or CRM	48,2	53,8	46,8
Expressed by the share of the total count in each size (in %)			

4.1.9.2. Findings/Results

The results of research shed light on the fact that, there is a conspicuous gap between availability and utilization of ICT platforms in practice. Based on evidence from literature, however, as for any other new technology, it is proper utilization of these technologies that bring competitive advantage for the enterprises. Only a combination of appropriate technology, business model and feasible methodology of implementation creates conditions for broader market penetration.
The authors of this research, at Faculty of Economics of VŠB-TUO, cooperate with Trgiman Software Solutions, a Czech software company, on the implementation of business intelligence software in the form of SaaS in economic entities.(Rozehnal and Tvrdíková 2012)
During cooperation on the project, the following requirements were most frequent(Rozehnal and Tvrdíková 2012):

- Solutions to access of users, their administration and rights management.
- Variability during work with sources of data.
- Questions linked to the security of sensitive data.
- The need for high-quality connection to the Internet, long response time while using the substandard access to the Internet.
- Economic aspects of the service.

Based on research results, it turned out that, it is indispensable to find out the proper solution to the issues like specifying communication processes with customers (users of software), alongside with possibilities of access, and the role of users within the rights and policies. Not only, no specific knowledge is expected at the beginning of the deployment and utilization process, but also, there will be a support given by an analyst to the novice user, during the beginning phase of the application and for the limited time only.(Rozehnal and Tvrdíková 2012)

Alongside with standard interfaces for data sources, e.g. JDBC or XML, etc., there were also processes which defined how to create a specific connection for the non-standard interface as well, and with the accent on the utilization of maximum variability of data sources. On the other hand, the possibility of data migration back to the software user was given to the enterprise, along with the declaration of data security and legal provision of the services.(Rozehnal and Tvrdíková 2012)

There are some other criticalities mentioned by the authors as following;

- Based on BI vendor's attitude, defining and implementing accounting metrics was of a challenge for them, especially in order to give support to the BI platform deployment.
- Another vital issue was finding the equilibrium in the matter of platform's customization with the aim of gaining economies of scale.

On the contrary, there are some beneficial factors presented by this study in the context of Software as a Service, which is listed as follows; (Rozehnal and Tvrdíková 2012)

- Update of software, upgrade
- The ability to reply to the requirements of users, gaining of experience based on good knowledge from the users' community. Comments, error reports, and questions are centrally registered, by which the process of resolution is accelerated.
- The speed of application deployment, removing barriers to implementation. Related to extend the issue of customization.
- Transfer of administration and maintenance services to the service provider (more precisely transfer of the related risks).

4.1.9.3. Concluding Remark

There is some evidence available in the academic literature regarding the deployment of cloud-based technologies in the context of Small and Medium-sized Enterprises. With the support of ideas, adopted from academic publications, the application of mentioned above technologies has been assessed among Czech SMEs with a special focus on SaaS technologies. The authors shed light on the beneficial factors of SaaS methodology and the possibility of their deployment in different economic sectors of the business, in the context of SMEs.(Rozehnal and Tvrdíková 2012)
The research study which conducted in 2011 by the authors, regarding the utilization of ICT platforms with the aim of having supportive role for the executives of the surveyed SMEs, illustrates that the penetration rate of new technological platforms, empirically is lethargic and SMEs are avoiding the investments in the field of ICT and other technologic decision support systems.(Rozehnal and Tvrdíková 2012)
The BI platform, BellaDati was chosen by the authors from a vendor called Trgiman regarding the empirical simulation study within the context of SME and the results was used as a support for the survey's results.(Rozehnal and Tvrdíková 2012)
Finally, the authors claimed that the cooperation and contribution between academia and business market are of utmost importance. One the benefits derived from this contribution is the recommendations based on testing and utilizing BI applications based on SaaS platforms in the context of SMEs alongside with its advantages, either short-term or long-term, development, customization, improved knowledge and staff training, to name a few.(Rozehnal and Tvrdíková 2012)

5. Empirical Case of SEICA

5.1. Company's Overview

Seica
The Road to Innovation

Founded in 1986, Seica S.p.A. is a global supplier of automatic test equipment and selective soldering systems, with an installed base of more than 1800 systems on 4 different continents. Seica offers a complete line of proprietary test solutions and has established strong partnerships with leaders of manufacturing and inspection systems to enlarge the portfolio of solutions across the whole production line. In a time of continuous changes, where globalization challenges competitiveness, Seica drives its strategy with a local direct presence in Italy, France, Germany, USA and China, best service and support quality with a local, strong, professional team.

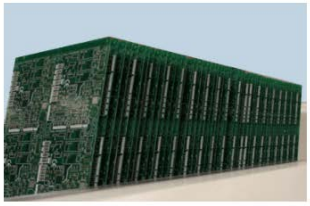
The company is divided into three different organizational parts:

SEICA TEST SOLUTIONS
This is the historic division of Seica, dealing with all test solutions, technical support and application development. It includes three areas of competences as following:

EMS
Electronic
Manufacturing
Solutions
Specializes in solutions for the electrical test of populated boards, manufacturing process verification.

MAS
Military
Aerospace
Solutions
Specializes in solutions for the defense, avionics, transportation, and energy industries.

PCB
Printed
Circuit
Boards
Specializes in solutions for the electrical test of PCBs.



SEICA PRODUCTRONICS
This division deals with Laser Selective Soldering and Optical Inspection of Seica systems, but it is also the reference for Omron, Vitronics Soltec, and Seica Automation representative.

SEICA SMART BUILDING & FACILITIES
Recently created to support the Home and Building Domotics and the industrial monitoring.

From 2014 Seica has a manufacturing department, SCM (Seica Custom Manufacturing), which adds relevant skills and know-how related to mechanical parts and specialized wirings manufacturing supporting the development of turnkey custom service offered to our customers.

For more information about the company and its products, you may visit the following link:
https://www.seica.com

5.2. Request of General Manager!

The practical journey of Seica was started with the first interview, in which the interviewers were President of the company, alongside with Production manager and R&D manager.
After being accepted for the position, there was the second interview with General manager and R&D manager about the details of the proposed project, or to put it frankly, about the existing problem(s) and its possible solution(s).

Following is the exact translation of project proposal from General Manager of the company, since the original version is written in the Italian language, and is available in
Appendix 1;

> "Development of an integrated planning model that uses information from different business areas to create a concise overview of Project Progress (orders) as a whole. This summary will be used by the General Manager for verification and control activities on various orders. The projects' data is currently present in different databases and Excel sheets managed directly by the task office of a specific part of the project. The business areas involved are Production and Logistics, the Department of Custom Manufacturing, the division that deals with Customer Services, Research and Development and the Sales office.
>
> The aim of this proposed project is the study and analysis of the available data and the definition of the method of extraction of only those data which are useful for the verification of the observance of the general planning.
>
> Particular emphasis will be given to projects aimed at the automotive sector, which are particularly articulated and require a continuous rescheduling of requirements that derive mainly from the customer."

Like many other SMEs, Seica started its journey, more than 30 years ago, in electronics sector as a family held company. Back then, the company size was microenterprise with less than 20 employees which almost all of them were engineers. These engineers had brilliant ideas in electronic sector, and from the starting day, produced machines were unique in their category. The only problem was, none of them knew anything about professional management processes. Accordingly, management of the company was like a typical garage company, which is resembling Apple Inc. at its first year of existence. Now after passing more than 30 years from company's establishing date, still executives of the company are the owners of it; despite the fact that, now, the size and scope of the company is not comparable with any kind of micro or small enterprise. Within 2017, Seica was active on different continents and had branches in various countries; US, France, Germany, China, and headquarter located in Turin, Italy, to name a few.
The number of employees was exceeding 250 personnel, and the company was experiencing the transition from medium enterprise to a large one, alongside with organizational structure changes.
With all these have been said, the owners are still holding the titles of critical positions like:

- General Manager
- HR Manager
- Strategic Manager
- Marketing Manager
- CEO (Chief Executive Officer)
- President/COO (Chief Operational Officer)

5.3. Web-based Application Solution

The size of the company alongside with the number of worldwide orders are considerably increasing day by day and make the traditional management almost impossible to hold all components of the company as a whole. In order to tackle upcoming issues, management started to use an ERP system from a local vendor, called ***ARCA***, in order to integrate different departments of the organization into one unique place.
Though, with not much surprise, like many other old-fashioned SMEs with traditional management styles, this ERP system mostly used to integrate the receiving orders from customers alongside with all the orders to suppliers of raw materials for production department. In this way, the company has a database of its customers and transactions related to its warehouse's raw material. With all these said, this ERP system is mostly useful for accounting and financing purposes since the users of this system were not fully trained to leverage all capabilities of the implemented software system.

On the other hand, logistics manager has its own Excel sheets in order to manage a part of production process. This Excel sheet was also used by production manager to partially update the different status of the production process.

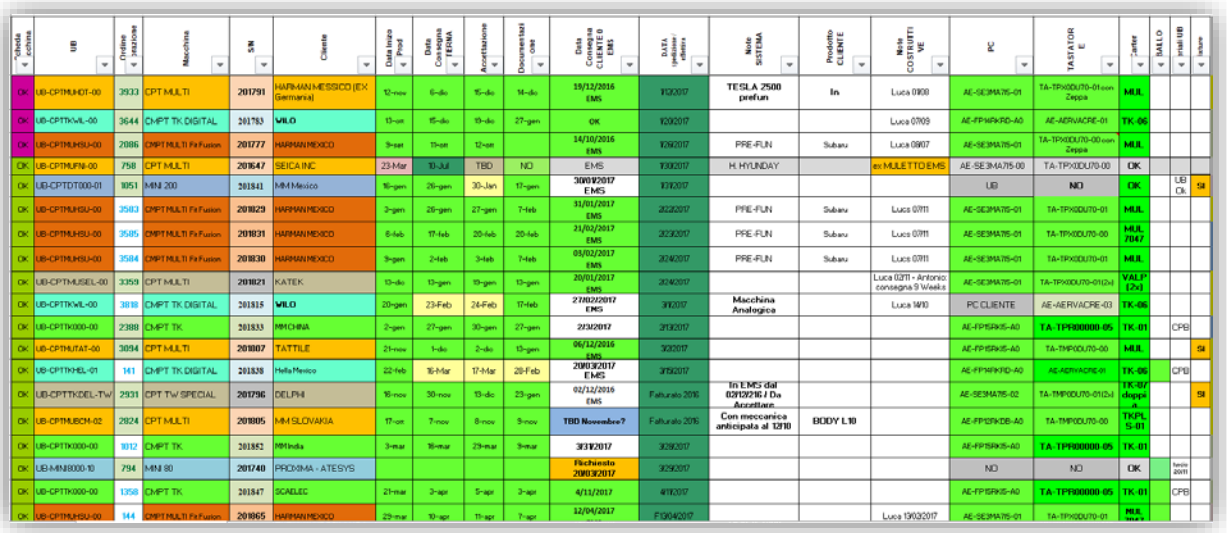


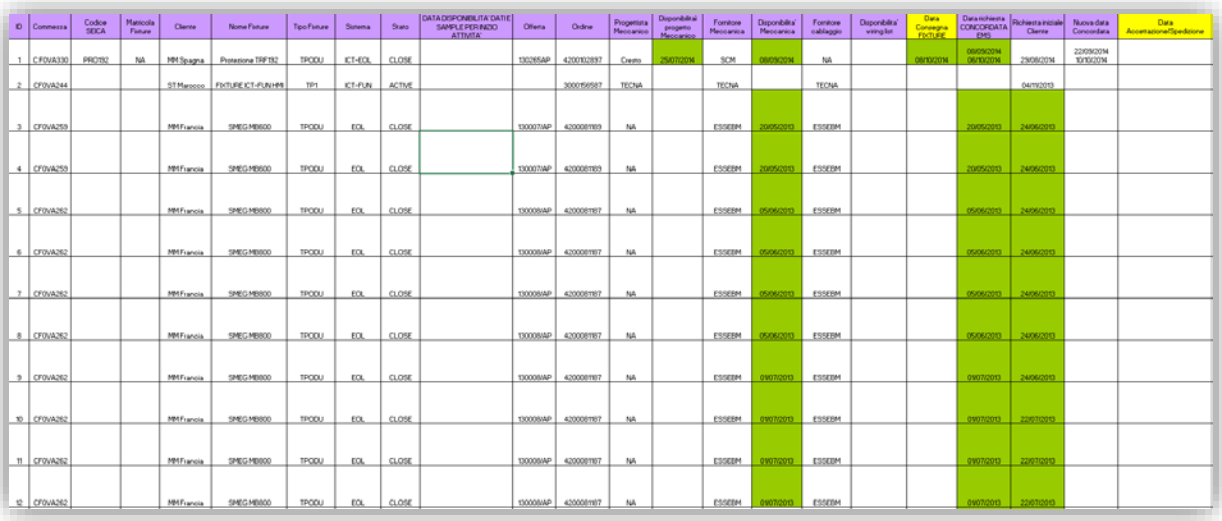
FIGURE 45- EXCEL SHEET OF LOGISTICS' MANAGER OF SEICA S.P.A.

This Excel file is located in company's database and not connected to the ERP system. All the data was entering manually and there were lots of dirty-data in this Excel sheet. Besides that, the Logistics' manager is using different colors as some kind of status indicator; each of these colors has different meaning and surprisingly nobody knows these meanings except the Logistics' manager himself. One the problems that occur in this type of stove-pipe systems is that, since there is not put any future thought into this system, the same customer has a different name in ERP system and this Excel sheet and there was not any relation between which makes lots of confusions for the management process. The Production Manager also has its own Excel sheet to schedule the actual timing of production process via Gantt-chart. This Gantt-chart is located on her computer, locally, and only she uses this file to control the production process. It is easy to understand from this evidence, that there was not any unique software for the operational department which can satisfy all the needs of managers and these issues gave birth to the existence of stove-pipe systems.

On the other side, there was another MySQL based application which is designed by the IT-Department of the company, in order to manage a part of the production process and also running the intranet of the enterprise.
There is another department in the company that, is called EMS, which is stands for Electronic Manufacturing Solution; This department is responsible for different important duties related to the production, but one the most important parts of this department is producing a complicated component, called Fixture, which is a crucial part of one of the product lines of the company, that is called Compact Series. The machines of Compact Series product line are carrying utmost importance for the managers of the company since they generate a considerable amount of company's turnover and are in demand by different industrial sectors like the Automotive sector.

FIGURE 46- COMPACT SERIES OF PRODUCTS WHICH ARE USING FIXTURES AND CANNOT OPERATE WITHOUT FIXTURES THE RIGHT-SIDE PICTURE ILLUSTRATES A COMPACT WITH FIXTURE LOADED INSIDE

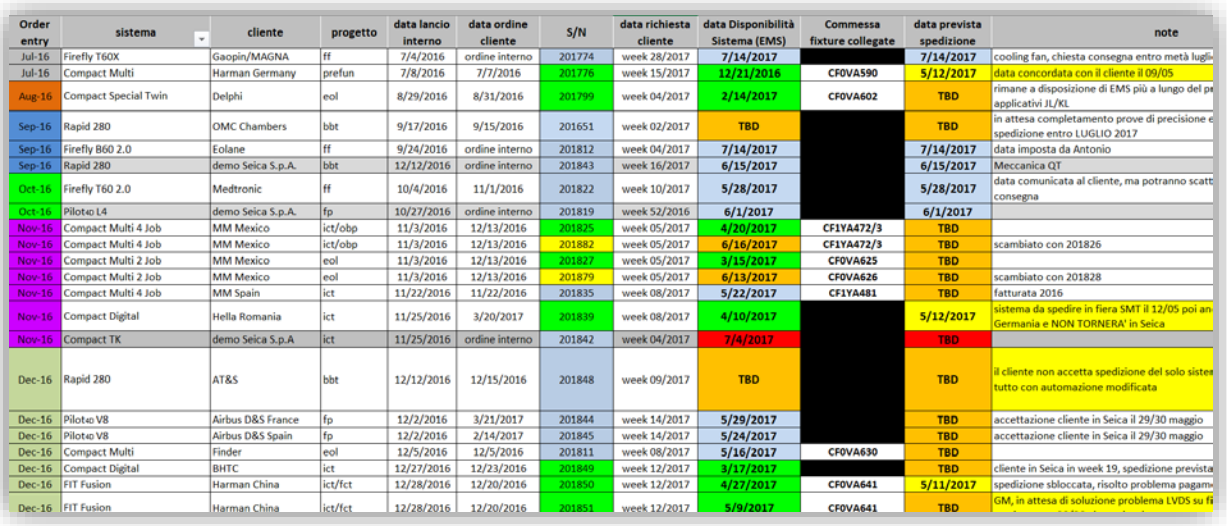
The data related to the production process of the Fixtures is directly related to the Production and Logistics departments data which are stored in local Excel sheets, even though there was not any kind of linkage between intranet of company, Production and Logistics data, and company's ERP system.



ID	Commessa	Codice SEICA	Matricola Fixture	Cliente	Nome Fixture	Tipo Fixture	Sistema	Stato	DATA DISPONIBILITA' DATI E SAMPLE PER INIZIO ATTIVITA'	Offerta	Ordine	Progettista Meccanico	Disponibilità progetto Meccanico	Fornitore Meccanica	Disponibilità Meccanica	Fornitore cablaggio	Disponibilità wiring list	Data Consegna FIXTURE	Data richiesta CONCORDATA EMS	Richiesta iniziale Cliente	Nuova data Concordata	Data Accettazione/Spedizione
1	CF0VA330	PRO192	NA	MM Spagna	Protezione TRF192	TPODU	ICT-EOL	CLOSE		130285AP	4200102897	Cresto	25/07/2014	SCM	08/09/2014	NA		08/10/2014	08/09/2014 08/10/2014	29/08/2014	22/09/2014 10/10/2014	
2	CF0VA244			ST Marocco	FIXTURE ICT-FUN-HP8	TP1	ICT-FUN	ACTIVE			3900756587	TECNA		TECNA		TECNA				04/11/2013		
3	CF0VA259			MM Francia	SMEG MB600	TPODU	EOL	CLOSE		130007IAP	4200081803	NA		ESSEBM	29/05/2013	ESSEBM			29/05/2013	24/06/2013		
4	CF0VA259			MM Francia	SMEG MB600	TPODU	EOL	CLOSE		130007IAP	4200081803	NA		ESSEBM	29/05/2013	ESSEBM			29/05/2013	24/06/2013		
5	CF0VA262			MM Francia	SMEG MB800	TPODU	EOL	CLOSE		130008IAP	4200081787	NA		ESSEBM	05/06/2013	ESSEBM			05/06/2013	24/06/2013		
6	CF0VA262			MM Francia	SMEG MB800	TPODU	EOL	CLOSE		130008IAP	4200081787	NA		ESSEBM	05/06/2013	ESSEBM			05/06/2013	24/06/2013		
7	CF0VA262			MM Francia	SMEG MB800	TPODU	EOL	CLOSE		130008IAP	4200081787	NA		ESSEBM	05/06/2013	ESSEBM			05/06/2013	24/06/2013		
8	CF0VA262			MM Francia	SMEG MB800	TPODU	EOL	CLOSE		130008IAP	4200081787	NA		ESSEBM	05/06/2013	ESSEBM			05/06/2013	24/06/2013		
9	CF0VA262			MM Francia	SMEG MB800	TPODU	EOL	CLOSE		130008IAP	4200081787	NA		ESSEBM	01/07/2013	ESSEBM			01/07/2013	24/06/2013		
10	CF0VA262			MM Francia	SMEG MB800	TPODU	EOL	CLOSE		130008IAP	4200081787	NA		ESSEBM	01/07/2013	ESSEBM			01/07/2013	22/07/2013		
11	CF0VA262			MM Francia	SMEG MB800	TPODU	EOL	CLOSE		130008IAP	4200081787	NA		ESSEBM	01/07/2013	ESSEBM			01/07/2013	22/07/2013		
12	CF0VA262			MM Francia	SMEG MB800	TPODU	EOL	CLOSE		130008IAP	4200081787	NA		ESSEBM	01/07/2013	ESSEBM			01/07/2013	22/07/2013		

FIGURE 47- PART OF COMPANY'S INTRANET DATABASE, MYSQL BASED, WHICH DEMONSTRATES THE SCHEDULING OF FIXTURES' PRODUCTION PROCESS

In the Sales department of the company, however, which is the front-end of the enterprise, companies' MySQL-based intranet is used to generate received orders and manually send them to Administration department in order to import these data into company's ERP system.
At the same time, Sales manager use another excel sheets, which is the combination of Machines and Fixtures orders, and send them to the interested employees via email. And even here, the data flow is not connected to one unique management system, and the creating and sending these Excel sheets took lots of time from the sales department.



Order entry	sistema	cliente	progetto	data lancio interno	data ordine cliente	S/N	data richiesta cliente	data Disponibilità Sistema (EMS)	Commessa fixture collegate	data prevista spedizione	note
Jul-16	Firefly T60X	Gaopin/MAGNA	ff	7/4/2016	ordine interno	201774	week 28/2017	7/14/2017		7/14/2017	cooling fan, chiesta consegna entro metà lugli
Jul-16	Compact Multi	Harman Germany	prefun	7/8/2016	7/7/2016	201776	week 15/2017	12/21/2016	CF0VA590	5/12/2017	data concordata con il cliente il 09/05
Aug-16	Compact Special Twin	Delphi	eol	8/29/2016	8/31/2016	201799	week 04/2017	2/14/2017	CF0VA602	TBD	rimane a disposizione di EMS più a lungo del pr applicativi JL/KL
Sep-16	Rapid 280	OMC Chambers	bbt	9/17/2016	9/15/2016	201651	week 02/2017	TBD		TBD	in attesa completamento prove di precisione e spedizione entro LUGLIO 2017
Sep-16	Firefly B60 2.0	Eolane	ff	9/24/2016	ordine interno	201812	week 04/2017	7/14/2017		7/14/2017	data imposta da Antonio
Sep-16	Rapid 280	demo Seica S.p.A.	bbt	12/12/2016	ordine interno	201843	week 16/2017	6/15/2017		6/15/2017	Meccanica QT
Oct-16	Firefly T60 2.0	Medtronic	ff	10/4/2016	11/1/2016	201822	week 10/2017	5/28/2017		5/28/2017	data comunicata al cliente, ma potranno scatt consegna
Oct-16	Pilot40 L4	demo Seica S.p.A.	fp	10/27/2016	ordine interno	201819	week 52/2016	6/1/2017		6/1/2017	
Nov-16	Compact Multi 4 Job	MM Mexico	ict/obp	11/3/2016	12/13/2016	201825	week 05/2017	4/20/2017	CF1YA472/3	TBD	
Nov-16	Compact Multi 4 Job	MM Mexico	ict/obp	11/3/2016	12/13/2016	201882	week 05/2017	6/16/2017	CF1YA472/3	TBD	scambiato con 201826
Nov-16	Compact Multi 2 Job	MM Mexico	eol	11/3/2016	12/13/2016	201827	week 05/2017	3/15/2017	CF0VA625	TBD	
Nov-16	Compact Multi 2 Job	MM Mexico	eol	11/3/2016	12/13/2016	201879	week 05/2017	6/13/2017	CF0VA626	TBD	scambiato con 201828
Nov-16	Compact Multi 4 Job	MM Spain	ict	11/22/2016	11/22/2016	201835	week 08/2017	5/22/2017	CF1YA481	TBD	fatturata 2016
Nov-16	Compact Digital	Hella Romania	ict	11/25/2016	3/20/2017	201839	week 08/2017	4/10/2017		5/12/2017	sistema da spedire in fiera SMT il 12/05 poi an Germania e NON TORNERA' in Seica
Nov-16	Compact TK	demo Seica S.p.A	ict	11/25/2016	ordine interno	201842	week 04/2017	7/4/2017		TBD	
Dec-16	Rapid 280	AT&S	bbt	12/12/2016	12/15/2016	201848	week 09/2017	TBD		TBD	il cliente non accetta spedizione del solo siste tutto con automazione modificata
Dec-16	Pilot40 V8	Airbus D&S France	fp	12/2/2016	3/21/2017	201844	week 14/2017	5/29/2017		TBD	accettazione cliente in Seica il 29/30 maggio
Dec-16	Pilot40 V8	Airbus D&S Spain	fp	12/2/2016	2/14/2017	201845	week 14/2017	5/24/2017		TBD	accettazione cliente in Seica il 29/30 maggio
Dec-16	Compact Multi	Finder	eol	12/5/2016	12/5/2016	201811	week 08/2017	5/16/2017	CF0VA630	TBD	
Dec-16	Compact Digital	BHTC	ict	12/27/2016	12/23/2016	201849	week 12/2017	3/17/2017		TBD	cliente in Seica in week 19, spedizione prevista
Dec-16	FIT Fusion	Harman China	ict/fct	12/28/2016	12/20/2016	201850	week 12/2017	4/27/2017	CF0VA641	5/11/2017	spedizione sbloccata, risolto problema pagam
Dec-16	FIT Fusion	Harman China	ict/fct	12/28/2016	12/20/2016	201851	week 12/2017	5/9/2017	CF0VA641	TBD	GM, in attesa di soluzione problema LVDS su fi

FIGURE 48- EXCEL SHEET OF SALES' MANAGER OF SEICA S.P.A.

The General manager of the company wants to see the overall situation of all active orders in addition to production processes related to those orders in one place, Big Picture view.
One of the straightforward solutions was changing all these Excel sheets to Microsoft Access databases application, which is the more accurate application solution for departments' needs; since they do not use any analytical function of Excel.

To this end, a data-model based on Microsoft Access, as a pilot test, was created; even though the Production and Sales managers warmly welcomed this idea, Logistics manager insists to use the Excel sheets because of the colors of each cell. Accordingly, General manager of the company did not accept the transition process from Microsoft Excel to Access and asked for another applicable solution which works well without changing these Excel sheets.

After searching the possible solutions, and consulting with experts inside and outside of the enterprise, the final proposal was using the RDBMS which is stands for Relational Data-Base Management Systems. The idea was designing a web-based application with an appropriate interface for General manager needs that work through enterprise's intranet; which finally, has been accepted by the General manager of the enterprise.

The next section of this chapter will shed light on the implementation process of RDBMS, at Seica S.p.A.

5.4. Implementation

The first step in the process of creating Relational Data-Base Management System is establishing a relationship between tables of the database, which defining Foreign-Keys and Primary-Keys will make this happen.

Before defining relational keys, the data of these tables were needed to be cleaned, since the data was entering manually by different responsible. Accordingly, the tables of Logistics-Production departments alongside with Fixtures' table, which was located on the My-SQL database was cleaned. During data-cleaning phase, tasks like changing the type of date-columns, from *general* to *date*, in order to restrict users to use only date-formats, not text, have undergone.
The other major obstacle on the road to establishing relational tables was the name of customers and the way they were codified. The problem was that the same customer was written in different ways at each of these tables. The example below illustrates the problem:

“ Magneti Marelli China, MM China, M.M. Cina ”

The solution for removing this bottleneck was making the personnel of the enterprise using the same language when they intend to point out the same customer. To this end, customers of the enterprise, all should be codified.
Within the database of company's ERP system, **ARCA**, there was a complete list of all customers with their unique customer IDs. After inspecting the existed list and cleaning some duplications (e.g. two customer ID for the same customer), this list was selected as a base for the name of customers in all databases of the company.

C002385	UNICREDIT LEASING SPA
C003023	UNICREDIT LEASING SPA

FIGURE 49- SAME CUSTOMER WITH TWO DIFFERENT CUSTOMER IDS, IN THE DATABASE OF COMPANY'S ERP SYSTEM, ARCA

Accordingly, in all tables, users were restricted to select the name of customer form predefined list of available customers. Then, in the next step, the new column of Customer's ID was added to all of these tables, which make tracking of each customer possible.

C003056	E.X.A. SRL
C003057	PINTER FA.NI. S.r.l.
C003058	DINAMICA GENERALE SPA
C003059	MAGNETI MARELLI HOLDING USA INC
C003060	AXEL S.R.L.(Scarmagno)
C003061	OMBI SRL
C003062	ROTOCOLOR SPA
C003063	TELECOM ITALIA S.p.A.

FIGURE 50- CUSTOMERS' LIST WITH A UNIQUE CUSTOMER ID

Even after adding these columns, there was still another important obstacle remaining that was preventing the satisfactory establishment of relationships among tables.

The challenge was since the company is operating worldwide, obviously, it receives orders from different parts of the world via their different sales branches, located on almost all continents.
The problem appeared when the Sales department of headquarter, located in Italy, receives an order from their sales point located in a different country (e.g. SEICA France) and wanted to register the mentioned order. Because the branches are not connected worldwide, via online service solutions, in the headquarters' database, that final customer (e.g. Cartier) did not have any customer ID, and sales department has allocated the customer ID of the sales branch to the order. So, in this specific case, at the base company, located in Italy, engineers know that the owner of the order is *Cartier*, which does not register as an independent customer in the ERP system.

AIA Amberieu (Marina Francese)	SEICA FRANCE SARL
AIRBUS FRANCIA	SEICA FRANCE SARL
AIRBUS SPAGNA	SEICA FRANCE SARL
Arvelec	SEICA FRANCE SARL
Assembly Technology USA	SEICA INC
ATS / SEICA Inc	SEICA INC
BOEING	SEICA INC
Cartier	SEICA FRANCE SARL
ENEL	SEICA SPA

FIGURE 51- RELATION BETWEEN THE ORIGIN OF ORDER (EXISTS IN THE ERP SYSTEM WITH AN UNIQUE ID) AND THE REAL OWNER OF THE PRODUCT (DESTINATION OF THE ORDER)

In order to eliminate this bottleneck, another table of relations has been created, Figure 51, which covers all of the relationships between the origin of order (usually one of the sales points) and the real owner of the product (the final destination of the order).

After establishing this relationship, users of the excel sheets and MySQL-databased intranet of the enterprise, all are restricted to use this final list of customers, with relations running behind the scene. Figure 52, illustrates these new columns and relationships in the excel sheet of Logistics' managers.
After establishing the relationships, the user just selects the intended customer, from a column of "*Destinatario"*, and the two other columns which are "*Descrizione*" and "*Cd_CF*", automatically react to the selected item, and show the allocated customer ID (*Cd_CF*) and the origin of order (*Descrizione*).

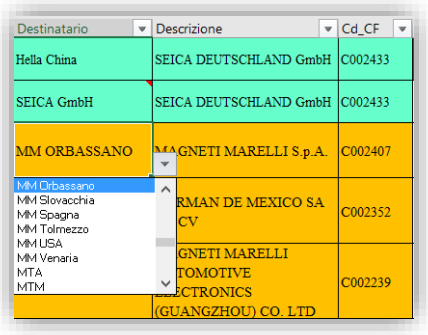


FIGURE 52- PART OF LOGISTICS' MANAGERS' EXCEL SHEET, WITH NEW COLUMNS INCLUDED

The same procedure is applied to the Intranet of the enterprise which was running on the MySQL-database structure. Figure 53, depicts the established relationship between different tables.

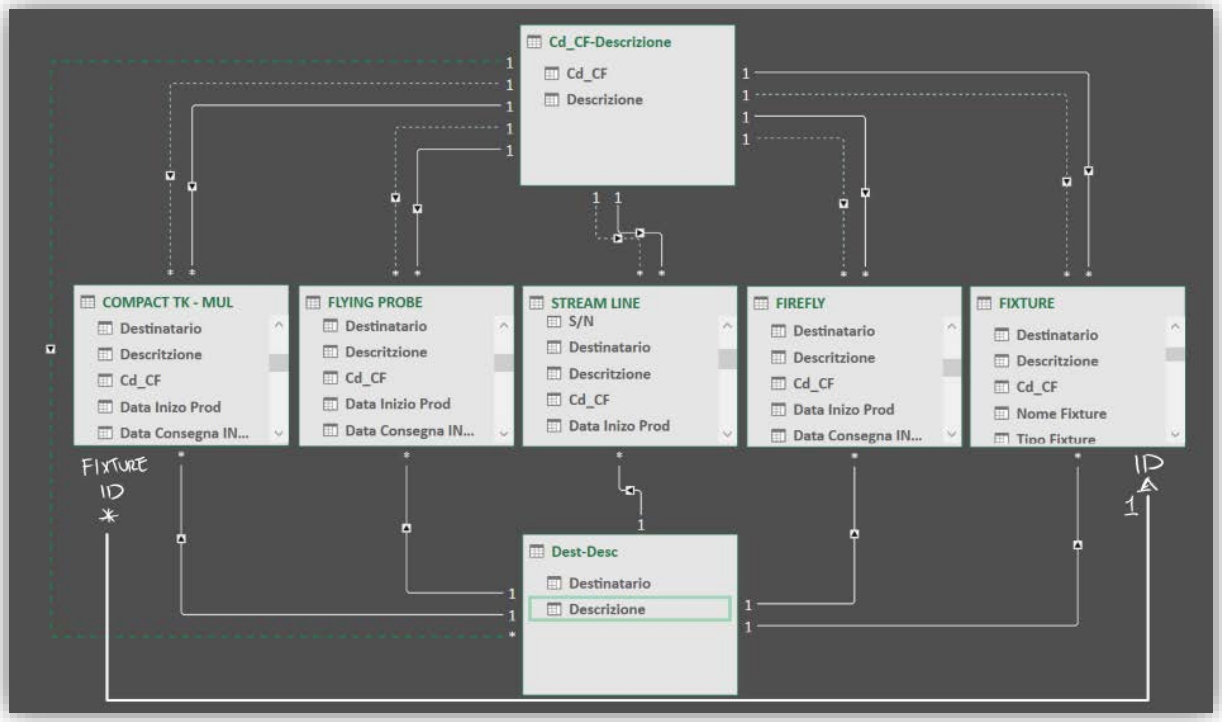


FIGURE 53- ESTABLISHED RELATIONAL MODEL BETWEEN THE TABLES FORM LOGISTICS, PRODUCTION AND EMS DEPARTMENTS

After finishing the creation and establishment of relational tables, it was time to start the basics of a relational database. To this end, with valuable contribution of enterprise's IT-Department, the Excel sheet was connected to the database of enterprise, via Java programming language.

Up to this point, the unique database composed of all needed data, for satisfying the needs of General manager, has been established and thanks to this step, Departments of Logistics and Production were connected to the database.

The next step was designing the front-end interface of the intended management's web-based application. To this end, a website was designed specifically for this project, by the author of this thesis, via HTML5/CSS3.

Before designing this web-based application, the General manager of enterprise, should print different tables from Production and EMS departments, inspect them separately and then make the intended connections among 100 rows of records, which was a significantly time-consuming task, alongside with lots of possible confusions that arose in the way of inspection task.
As company's activity scope was growing, the number of orders were increasing respectively and made the management of this huge amount of data almost impossible by manual inspection tasks.

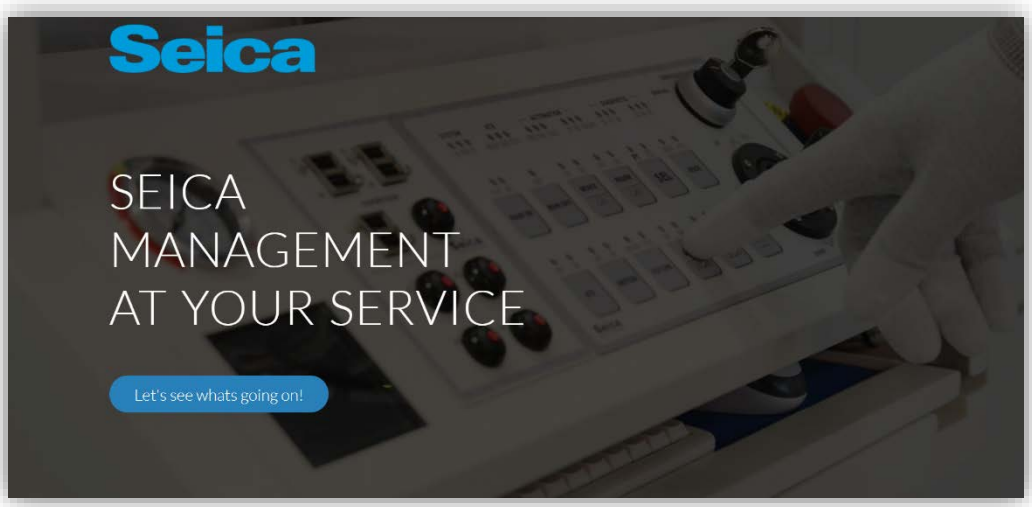


FIGURE 54- MAIN PAGE OF MANAGEMENT WEB-BASED APPLICATION, DESIGNED FOR GENERAL MANAGER

In the main page of Management's website, after analyzing General manager's needs and based on undergoing tasks, there were five different search criteria, available for the General manager. These categories are:

- Client (Order's destination)
- Customer ID / Origin of the order
- Date Interval
- Serial Number
- Fixture's Order number

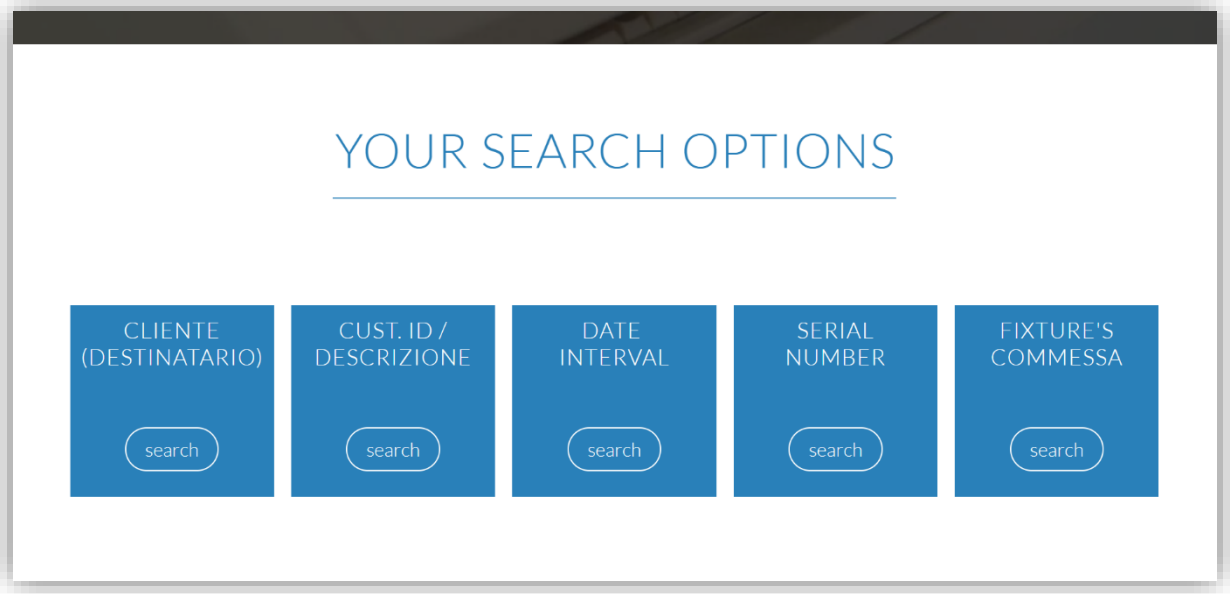


FIGURE 55- SEARCH OPTIONS FOR GENERAL MANAGER, IN THE MANAGEMENT'S WEBPAGE

After designing the interface of management's web pages, the search pages are made interactive thanks to the programming language, JavaScript. All of these 5 search criteria are capable of multiple searches at the same time (e.g. selecting more than one customer), and date filter (single or multiple date filters) is also added to the first two criteria, which are searches based on "*origin of the order/customer ID"* and *"order's destination"*.
All these search fields and date filters are connected to the MySQL database, thanks to a programming language, SQL.
The programming language, SQL, was used to write queries and connect these search criteria and time filters to the database of enterprise, which was based on MySQL.

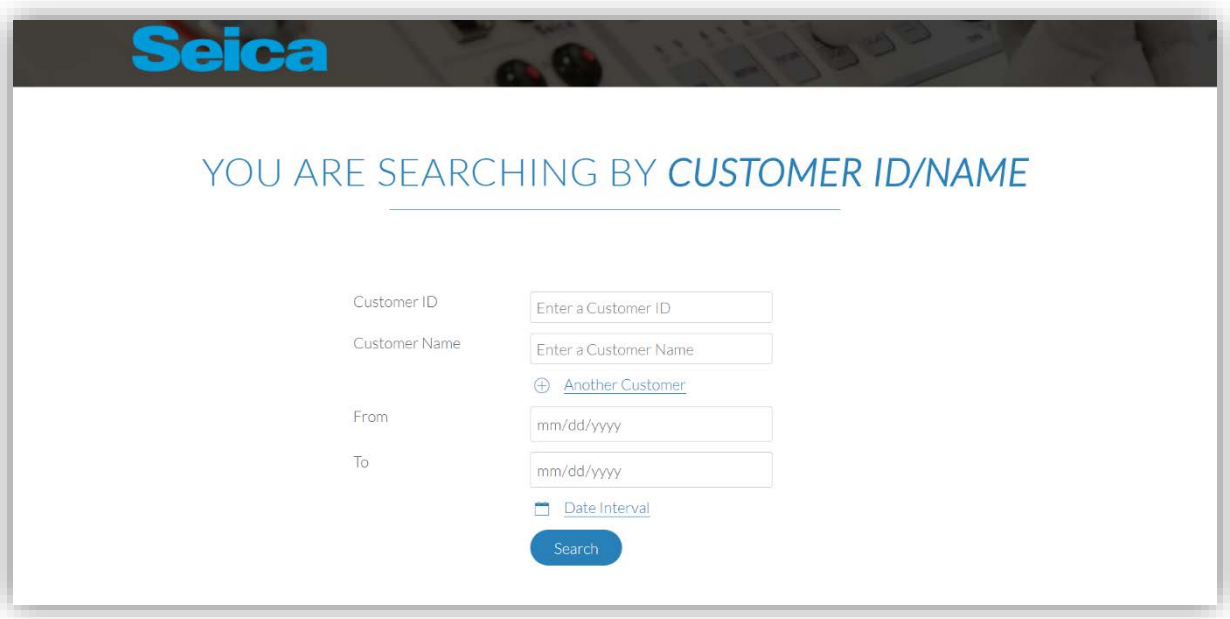


FIGURE 56- SEARCH PAGE OF MANAGEMENT'S WEBSITE, BASED ON CUSTOMER ID/NAME

After establishing all the connections to the company's database, the next step was running a pilot test on management's application in order to check the capabilities and weaknesses of the application. Then some corrective actions have applied to the application to make it more responsive and effective, based on manager's needs.

After finishing the final touches, the overall solution to the data integration problem of the enterprise, which is the RDBMS with a web-based application, presented to the General manager, alongside with Logistics and Production managers.

After having the application capabilities assessed by the General manager, she stated that it is satisfactory, although, during the passage of time, it will face series of evolution in order to fit enterprise's dynamic environment. Since the application solution was reasonable and adequate, it won a separate tab in the intranet system of the Seica S.p.A. and at the present moment is being used by different departments of the company.

In the following, there are two real examples from General Manager's search results based on "*Customer's Name"* and *"Machine's Serial" Number*.

Figure 57, illustrates the search results which made by Customer's name with all of the orders from different departments, at one place. In the systems tab, among three ordered machines from *Compact series*, just one of them have a Fixture assigned to it, in which the details of it are available in the yellow table, attached to the machine's record row.

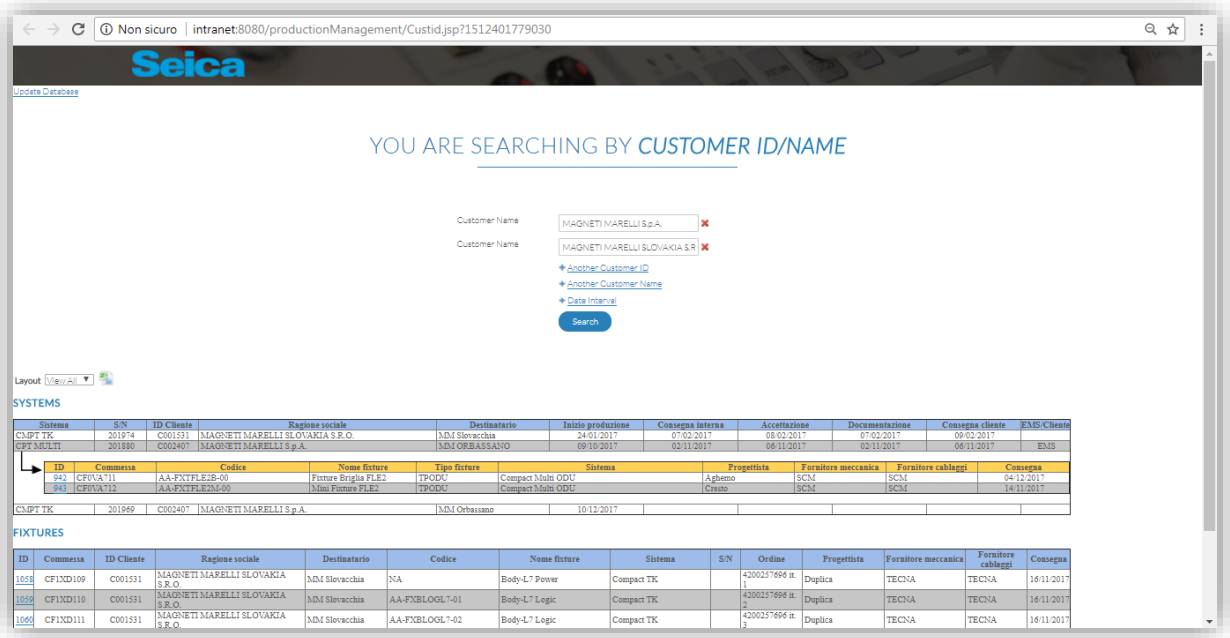


FIGURE 57- MANAGER'S SEARCH RESULTS BASED ON CUSTOMER'S NAME (SEICA S.P.A.)

And Figure 58, illustrates the search results based on machines Serial number, which is unique for each machine. Since in this case, the machine got a fixture which ordered from its customer, the details of it (yellow table) are linked to the machine's record.

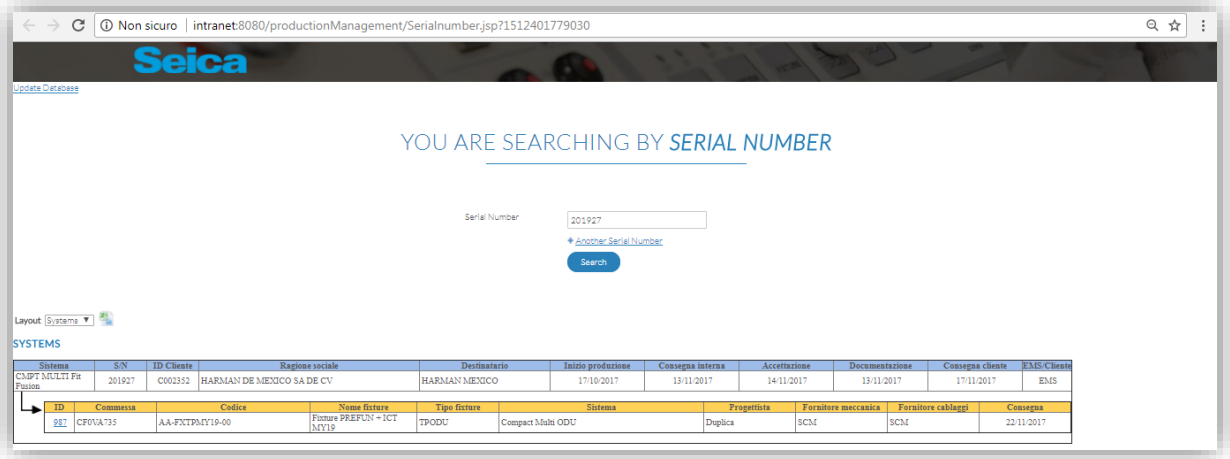


FIGURE 58- MANAGER'S SEARCH RESULTS BASED ON MACHINE'S SERIAL NUMBER (SEICA S.P.A.)

Figure 59, demonstrates the main page of enterprise's intranet with all available tabs, and the last tab which added recently, is the General Manager's tab, which is the link to the explained web-based application. This is the evidence, to illustrate the success of the project's implementation, even though, there are lots of room for improvement.

FIGURE 59- MAIN PAGE OF COMPANY'S INTRANET (SEICA S.P.A.)

5.5. Findings and Conclusion

Like any other growing SME, Seica S.p.A. is in the transition from mid-size enterprise to join the category of large organizations. Within this mentioned growth process, however, there is not just the size of the company that is expanding, but also the scale and the scope of received orders, alongside with organizational complexities in the structure of the enterprise are increasing in parallel.
To cope with these issues, the managers of enterprise, who are also the owners of it, were understood the criticality of mentioned above situation, and are searching for the appropriate application as a suitable remedy to this upraised challenge.

But the problem is, like most of other SMEs, these owner-managers want to cut the expenses in any possible way and go to the fast-paced evolving business' battlefield with attitudes and remedies that are belonging to the industrial age; regardless of being aware about the fact that, we are currently in the information age, and the ideas that belong to the industrial age will not be effective anymore!

After an in-depth analysis of General Manager's needs, based on the requested project, it turned out that there is a strong overlap between these requests and specifications of Business Intelligence systems and their capabilities to solve data integration challenges in enterprises.
Then some unstructured and casual interviews were scheduled with different managers, like Sales Manager, Logistics Manager, Marketing Manager, and other executives from a different department. And not surprisingly, none of mentioned above managers had any idea about Business Intelligence and its applications and capabilities. Right after, another meeting organized with General Manager of the enterprise, regarding existence and usage of Managerial Support Systems. It turned out that, the only management's support system was ISO 9001 series of the quality management system. There was no other metrics and applications were available in the enterprise, and following weaknesses are spotted:

- No CRM system was available,
- There was not any performance measurement metrics and accordingly no Business Performance Management system was used by managers,
- There were no Process Manager and process management policies,
- Companies warehouse is not connected directly to the ERP system and materials are not codified,
- ERP system was used mostly for covering Accounting and Administrative issues, and users were not fully trained to be able to leverage all of the capabilities of the system.

Even though, the products of Seica S.p.A. and its services are unique and their performance is in world-class category, thanks to its brilliant engineering team and the creative ideas of company's President, because of critical problems in strategic decision-making processes and process management components, company is facing major problems like six months delay in final delivery time.

Despite the fact that, the implemented web-based application partially solved the data integration problem of General Manager, but definitely is not enough for this fast-growing enterprise. The possible solution is the employing the big data and data-integration in the business strategy of the company. This will make owner-managers change their mindset and attitude from seeking short-term goals to the long-term ones.
Accordingly, they not only don't see the investment in decision support systems as an unnecessary action and expense for the enterprise but also, they will understand the real value of data as a precious asset in the information age, which we are facing phenomena like Artificial Intelligence, Block-chain and Big Data.

6. Cross-Case analyses / Findings

In this section of the dissertation, most of the case studies that have been introduced and analyzed at section 4 will be asses based on Gartner's maturity model, which is one the pioneer and advanced models in the field of Business Intelligence and Business Performance Management.
As mentioned in section 4, these business case studies were chosen from academic research articles in the field of Business intelligence and mostly were the implementation projects of BI in various SMEs from different parts of the world.
Through this section, the author tried to assess the Business Intelligence's maturity level of these mentioned cases, based on five distinctive levels of Gartner's maturity model.
To this end, followings are a brief introduction to this mentioned model of maturity, which is the foundation of this dissertation's cross-case analysis.

But before introducing the maturity model itself, it is worth mentioning, briefly, three different transition phases which presented by analysts of Gartner by which BI and analytic markets could be affected("High-Tech Tuesday Webinar: Building a Business From Analytics and BI in the Post-Big-Data World" n.d.).

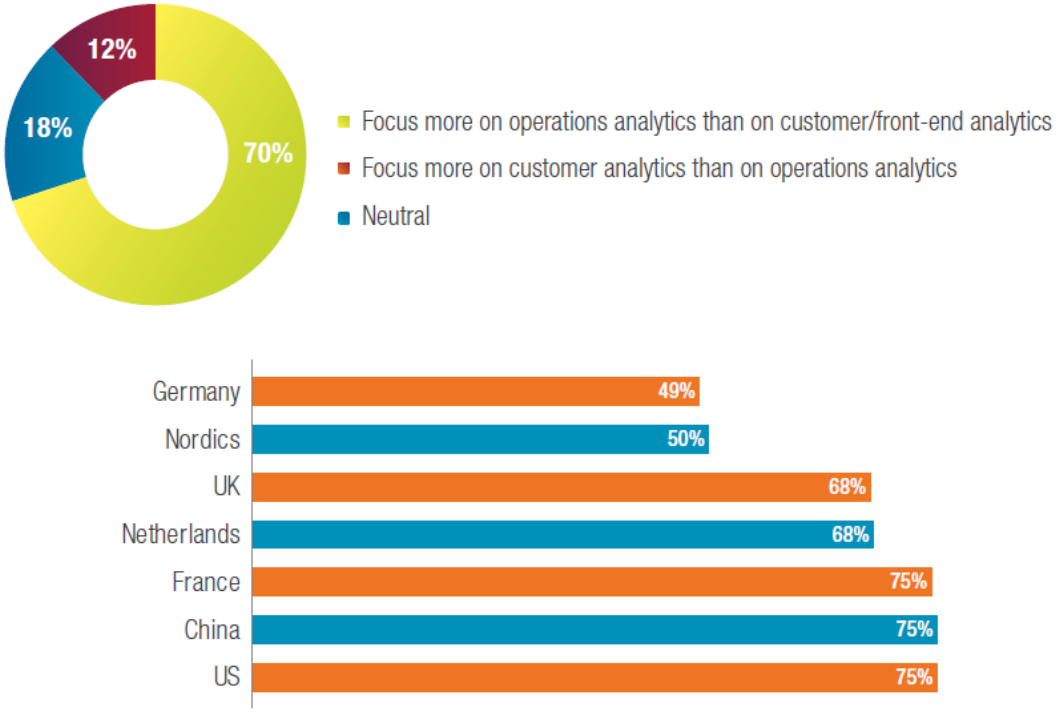
As Gartner called, at the first phase, "***BI Becoming Bimodal***". This transition has been evolved based on data-driven needs of end users. Nowadays, there is a terabyte of data generating based on different transactions within enterprises. Accordingly, the end users need to be able to access analyzed and clean data which is also presentable without relying on the IT department of the organization. Thanks to the modern BI systems this issue is solved easier than before, in comparison with traditional Business Intelligence which is getting obsolete through the passage of time with increasing rate of internet-based technology. In these modern days, enterprises are satisfying their need to have a single truth center of data with various capabilities of modern BI platforms.

As we switch to the second phase of BI transition, we face a paradigm, as Gartner called "***The rise of smart***". In this phase, Gartner explains that thanks to the new smart platforms of the modern BI systems, end users don't need to struggle with the vast amount of raw data, in order to understand their meaningful relationships, so-called information patterns. Based on powerful and smart data science and modern analytics, these patterns and insights will be automatically created and serviced to the end users, at a glance.

Gartner called the last phase of BI and analytics transition, as "***Journey into context***". There is no doubt that world getting smarter day by day, thanks to the rise of a new phenomenon like IoT (Internet of Things). Based on these technologies, different gadgets, devices and machines are getting connected with some of them having a different kind of sensors embedded within them. These sensors and gadgets are generating different types data. Some instances of these unique data are the ones that generated based on GPS systems or weather forecasting. Enterprises can start and use targeted marketing campaigns thanks to this kind of location services and the data generated by them which gives a sort of competitive advantage to the enterprises who are facing the challenges of today's dynamic world of business. Thanks to the modern BI and analytic platforms, the transactional data types, which are mentioned above, are grippingly getting value for the analytical purposes of different departments within enterprises.

An interesting research study had been undertaken by Capgemini consulting group in collaboration with MIT Sloan Management Review("Embracing Digital Technology: A New Strategic Imperative" 2013), on 2013, which explained that during that time, enterprises understood the value of these analytics platforms but the analytical focus of these organizations was on the CRM department and front-end customer relation issues. Since the significant role of customer satisfaction and data about

organization's users is undeniable. As we know CRM was one of the traditional ERP systems' crucial components, before the transition to the modern version of ERP systems.
But through the evolution of modern ERP usage, organizations are pivoting their attention from customer-driven analytics to operational analytics since enterprises are getting know the value of being smart in the production area and more companies, day by day, are joining to the increasing list of smart factories.
Based on Capgemini research("Going Big: Why Companies Need to Focus on Operational Analytics" 2016), in 2013, just 26% of enterprises had their focus on operations' analytics, in comparison with the higher rate of 40% focus on the CRM based analytics. But not surprisingly based on the latest research[1] of Capgemini consulting group, which is undertaken on 2017, the attention of enterprises to operational analytics has been risen by 44% to the total of 70% at that research was conducting. Figure 60 shows the details of this research.



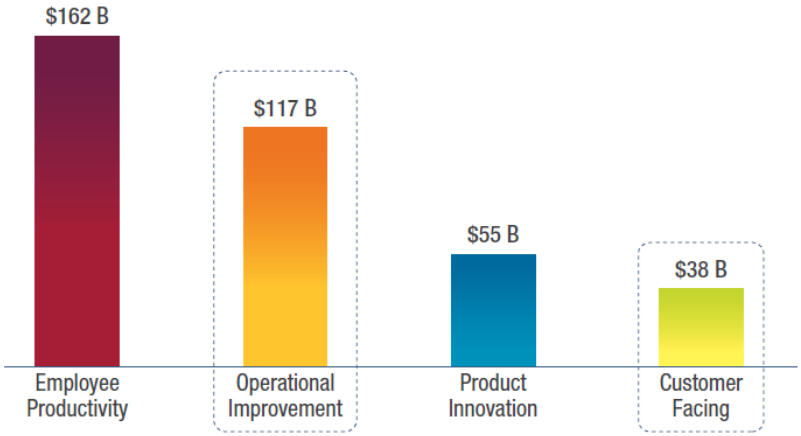
N = 608

Source: Capgemini Consulting and Capgemini Insights & Data

FIGURE 60- PERCENTAGE OF COMPANIES THAT FOCUS MORE ON OPERATIONAL ANALYTICS THAN ON CUSTOMER ANALYTICS

[1] The methodology of research was a survey-based study among 608 executives from US, Europe and China.

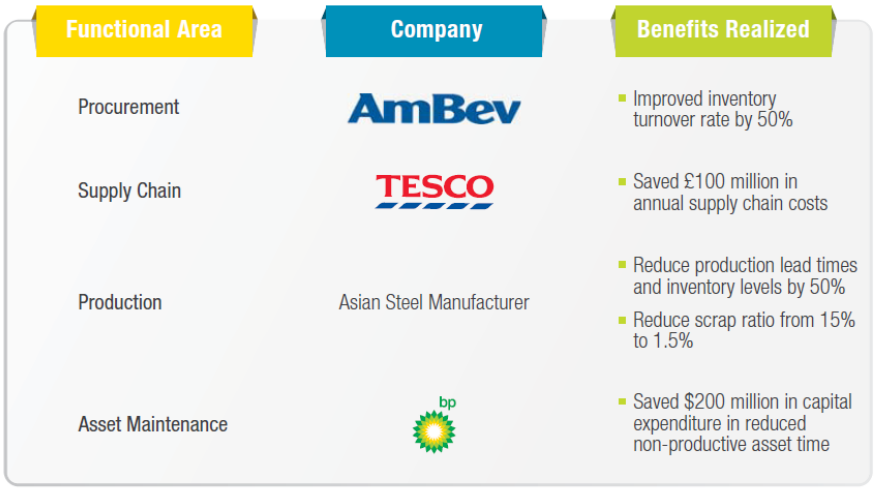
A reasonable explanation for these results is lying behind the research-based fact by Capgemini consulting group which illustrates the profit gain of manufacturing enterprises by implementing data analytics in their enterprises. Figure 61 depicts the distribution of monetary amount related to these profit-gains within different organizational segments("The $371 Billion Opportunity for 'Data Smart' Manufacturers – Vertical Industries" n.d.). From the illustrations below, we can fathom that the benefits generated by data analytics are improving the operational activities almost three times more than front-office, customer-related activities.



Source: Technet, "The $371 Billion Opportunity for "Data Smart" Manufacturers", May 2014

FIGURE 61- BENEFITS MANUFACTURING COMPANIES CAN GENERATE USING DATA ANALYSIS

Based on different reports, about various company's manufacturing process, there are significant cost-reductions regarding various aspects of operational processes.("Tesco Saves Millions with Supply Chain Analytics" 2013; "Supply-Chain Analytics: Beyond ERP & SCM: Improving Performance through Predictive, Data-Driven Insights.(Company Overview)" 2010; "Tessella Helps BP Harness Drilling Data to Save Millions" n.d.)
Figure 62, demonstrates benefit-gains of four different enterprises because of analytical application usage in their manufacturing processes.



Source: Information Age, "Tesco saves millions with supply chain analytics", April 2013; SAS, "Supply-Chain Analytics: Beyond ERP & SCM"; Tessella, "Tessella helps BP harness drilling data to save millions"

FIGURE 62- BENEFITS OF IMPLEMENTING ANALYTICS INITIATIVES IN OPERATIONS

Among these enterprises, Tesco is leveraging the power of analytic functions also in different organizational departments. Just for supply chain processes of Tesco, analytics help them to save £100 million from processes' cost("Tesco Uses Supply Chain Analytics to Save £100m a Year" n.d.).

Capgemini consulting group gives another living example of this type, which is enjoying the benefits of analytics in different organizational angles("Network Rail's Data Revolution – Information Age Exclusive" 2014).
The British enterprise, Network Rail, who is the owner, operator, and developer of Britain's railway, claimed that within time-horizon of 5 years they could save £125 million thanks to the data analytic functions. The use data-analytics to create one central place for all of the enterprise-wide data which is generated from 14 different asset information systems. Thanks to this implemented system, employees can access severe data sources, related their departments via their smartphones and tablets from any place in the world.

Since organizations are understanding the value of data and data-related analytical powers day by day, we will have an enormous explosion in the amount of data which is generated by different enterprises and smart machines. Since there are more companies that are following IoT (Internet of Things) related technologies, there are millions of data will be generated just form IoT sector. Based on Gartner's research("Industrial Analytics Revolutionizes Big Data in the Digital Business" n.d.), smart metering projects are generating 500 million meter readings in daily bases. On the other hand, EMC claimed that within the year of 2020, the amount of data generation will extremely increase by 10 times("The Digital Universe of Opportunities: Rich Data and the Increasing Value of the Internet of Things Sponsored by EMC" n.d.). Based on this research, the amount of generated data back in 2013 was 4.4 trillion gigabytes, and we are expecting to have 44 trillion gigabytes, by the year of 2020.

When for the first time we saw drones in the air, they were for nothing but just fun! Then creative companies have started using the potential of drones in their own favors, like Amazon for their prime delivery system.
Nowadays, more companies are using drones in different business aspects, like checking the condition of airplane's surface or monitoring wind-farms. Based on the research conducted by InfoQ(Sharma 2014), just 14 hours military mission can produce 70 terabytes of raw data which is waiting for analyzed!

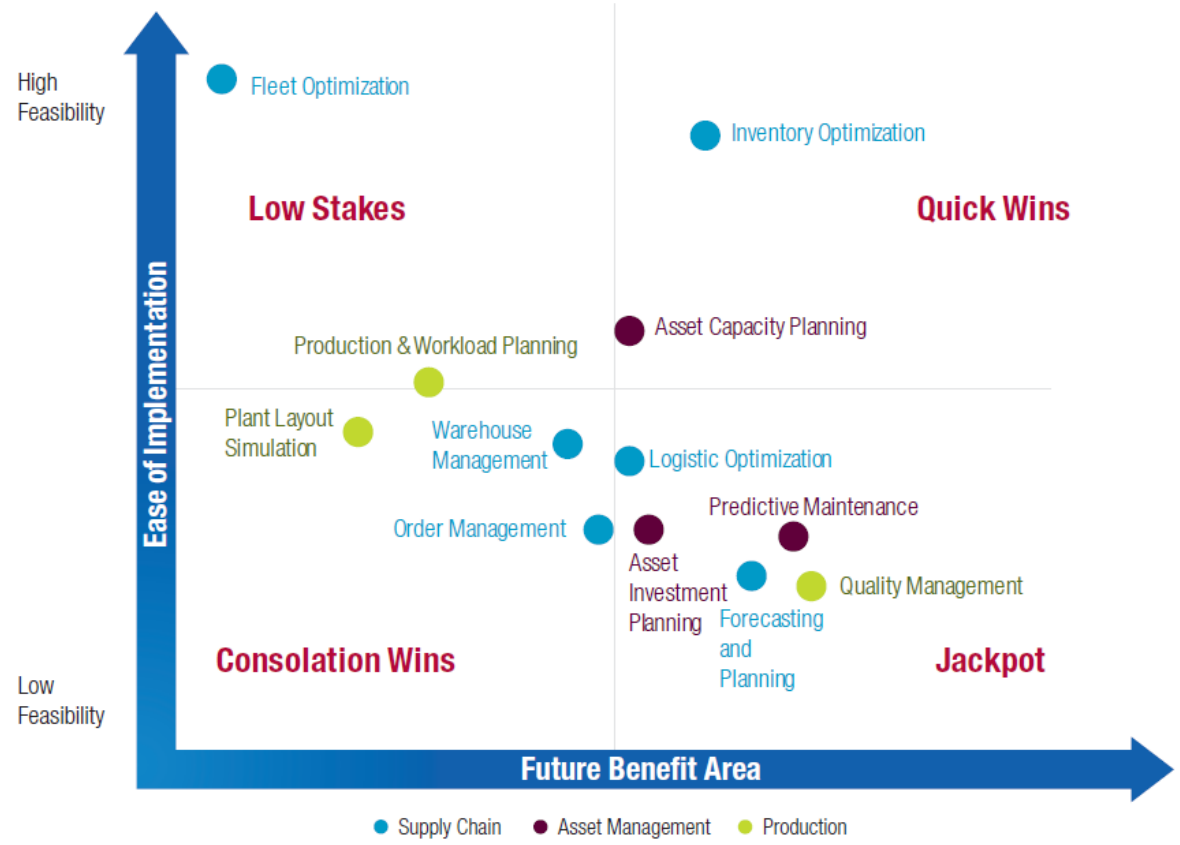
During these days, especially within last 2 years, we are hearing lots of news about autonomous vehicles and a new era of smart mobility, like ideas of Elon Musk, CEO of Tesla car maker who challenges the world of technology with his pioneer ideas in the field of smart autonomous vehicles.
Based on GeekWire research(Schlosser 2016), these autonomous vehicles, in order to be effective, needs to gather 10 gigabytes of data in each minute of driving, via different advanced sensors.
Based on the Rio Tinto reports about using automation in mining industry("Rio Tinto Limited AGM – Address by the Chief Executive" 2015; "Rio Tinto Approves US$1.9 Billion Amrun (South of Embley) Bauxite Project" 2015), the full autonomous truck fleets of this company in two of their mines which are located in Australia, are generating around one terabytes of raw data within each working day. Then these raw data need to be analyzed and handled which make this autonomous robot trucks 12% more productive than human-driven trucks.

All sort of different examples, which are mentioned above, are the witnesses to the future's challenges of enterprises regarding handling the gigantic amount of data in their everyday business life and approve the significant role of data-analytics in today's and future's companies.
Another testimony on how nations and organizations are getting affected by data-analytics' power is the report which shows the role of data-analytics as a success factor for US-bases enterprises, which are leveraging 47% of data-analytics' potential as a support for their decision-making processes("2016 Global Manufacturing Competitiveness Index - Council on Competitiveness" 2016). European organizations in comparison with their US competitors, just use 28% of data-analytics' power in the decision-making process.

Source: Compete – US Council on Competitiveness, "2016 Global Manufacturing Competitiveness Index", January 2016

FIGURE 63- GLOBAL COMPETITIVENESS RANKINGS, SELECT COUNTRIES, 2013-2021

There is no doubt about the importance of production department within smart factories, and the most of competitive advantages of manufacturing companies are usually form production department. Based on an interesting report about industry 4.0("Future Trends in Industrial Automation-IHS-AIS" 2015), the number of connected machines within production sites of smart factories will be increased by 50 times in the time horizon from 2012 to 2025.
Figure 64, by Capgemini consulting group, illustrates different functional areas of organizations which are using data-analytics' power in their favors. In this figure, functional areas are divided into three different groups, which are: Production, Supply Chain, and Asset Management.



Source: Capgemini Consulting and Capgemini Insights & Data

FIGURE 64- FUTURE BENEFITS AND EASE OF IMPLEMENTATION OF ANALYTICS INITIATIVES IN DIFFERENT FUNCTIONAL AREAS

According to the research results which was conducted in one of Intel's semiconductor fabrication facilities (De Leeuw 2015), Intel ran three different pilot case studies in the mentioned production site. The first pilot test was about reducing false rejections by their automated test equipment, which was successful because of 90% prediction in these false rejections thanks to the data-analytics. The role of the second pilot test was to reduce the wasted time because of the equipment maintenance which is the reason for machines' downtime increase. The third case was about reducing the time of image analytics which thanks to the visual analytics' competencies, reduced by the factor of 10.
Overall results of these pilot tests show that thanks to the data-analytics power, Intel could buy-back $9 million and put it into its saving accounts.

All that said, with understanding the reasons behind the widespread use of analytics and value of data for today's organizations, we better understand the importance of Business Intelligence systems within different types of enterprises. As implementing Business Intelligence systems in a way that companies can leverage the full potential of it, could be a core competitive advantage of enterprises in this data-driven world, we can now, briefly analyze the available maturity models for Business Intelligence.

Table 20 demonstrates six different maturity models for Business Intelligence systems which are available in the business market (Chuah and Wong 2011).

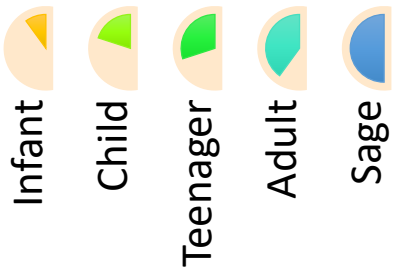
TABLE 20- VARIOUS MATURITY MODELS FOR BUSINESS INTELLIGENCE

MATURITY MODEL	DESCRIPTION
TDWI's maturity model ("TDWI Analytics Maturity Model Guide" n.d.)	The maturity assessment tool is available on the web to evaluate BI's maturity level as documentation
	Concentrates on the technical aspects, especially on Data Warehouse
	Can be improved on business aspects, especially from cultural and organizational views
Business intelligence maturity hierarchy (Deng 2007)	Applied the knowledge management field
	Author constructed maturity levels from a technical point of view but can consider as incomplete
	The documentation of this model in the form of one paper and is not enough for maturity level assessments
Hewlett Packard business intelligence hierarchy ("The HP Business Intelligence Maturity Model: Describing the BI Journey" 2007)	Depicts the maturity levels from the business technical aspect
	This model is new and needs to improve to add more technical aspects such as Data Warehousing and analytical aspects
Gartner's maturity model (Howson 2016)	***Uses to evaluate the business maturity levels and maturity of individual departments***
	Provides more non-technical view and concentrates on the business technical aspects
	Well documented and can search easily on the web
	The assessment offers the series of questionnaires in the form of spreadsheets
Business information maturity model (S. Williams and Williams 2007)	Well documented with the series of questionnaires to assist the users to perform self-evaluation
	However, criteria to evaluate the maturity are not well defined
AMR research's business intelligence/performance management maturity model (Hribar Rajterič 2010)	Concentrates on the performance management and balanced scorecards rather than business intelligence
	Not well documented and criteria to evaluate the maturity level are not well defined
	No questionnaire to evaluate the maturity levels and is very hard to analyze the model
Infrastructure optimization maturity model (Kašnik 2008)	Focuses on the measurement of the efficiency of reporting, analysis and Data Warehousing and is not complete in the business intelligence area
	Discuss the products and technologies rather than a business point of view
	Not well documented and criteria to evaluate the maturity level are not well defined
Ladder of business intelligence (LOBI) (Cates, Gill, and Zeituny 2005)	Apply the knowledge management field
	Author constructed maturity levels from a technical point of view but can consider as incomplete
	Not well documented and criteria to evaluate the maturity level are not well defined
Business intelligence development model (BIDM) (Sacu and Spruit 2010)	Not well documented and criteria to evaluate the maturity level are not well defined
	Concentrates on the technical aspects rather than a business point of view

It is worth mentioning that, all of these maturity models try to show the evolution of BI systems through the passage of time. Accordingly, the authors may improve and change different part(s) of maturity models in order to adapt the latest trends and evolutions available in the market.

Among all these maturity models, Gartner's maturity model alongside with TDWI's maturity model seems to be the most complete and advanced ones.

In the TDWI's model, the viewpoint is mainly on technical aspects and this model evaluates the maturity of BI systems around eight key categories which are: Scope, Sponsorship, Funding, Value Architecture, Data, Development, and Delivery (Hribar Rajterič 2010).
These eight aspects of maturity model are assessed based on five different classifications, that genuinely resemble the life cycle of human beings, which are(Eckerson 2007b, 2007a):



These five ladders of Business Intelligence growth process are well depicted by TDWI's research group as follows, Figure 65, (Pries 2015):

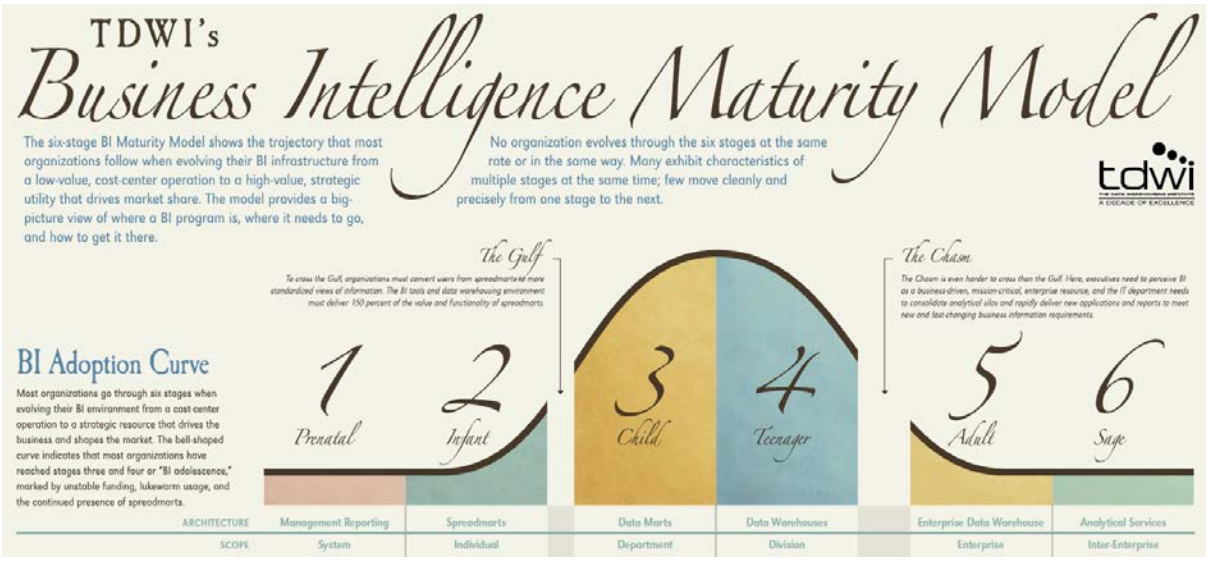


FIGURE 65- BUSINESS INTELLIGENCE ADOPTION CURVE BY TDWI

On the other hand, there is Gartner's maturity model, which assesses the growth level of Business Intelligence systems alongside with Performance Measurement systems. Since, in order to have BI systems successfully implemented in the organization, Business Intelligence should be part of organizations' strategy, and performance measurement is one of the core competencies of each successful enterprise, we cannot separate BI and PM in companies. Thus, this is one the competitive advantages of Gartner's maturity model.
This maturity model consists of five different levels which are:

1. *Unaware*
2. *Tactical (Opportunistic)*
3. *Focused (Standards)*
4. *Strategic (Enterprise)*
5. *Pervasive (Transformative)*

These different levels of maturities assess the growth level of enterprises' BI and PM systems around three critical areas, which are: People, Processes, and Metrics and Technology(Burton 2007; Rayner 2008).

Figure 66, illustrates the details of these five maturity levels(J. Hagerty and Hostmann 2010):

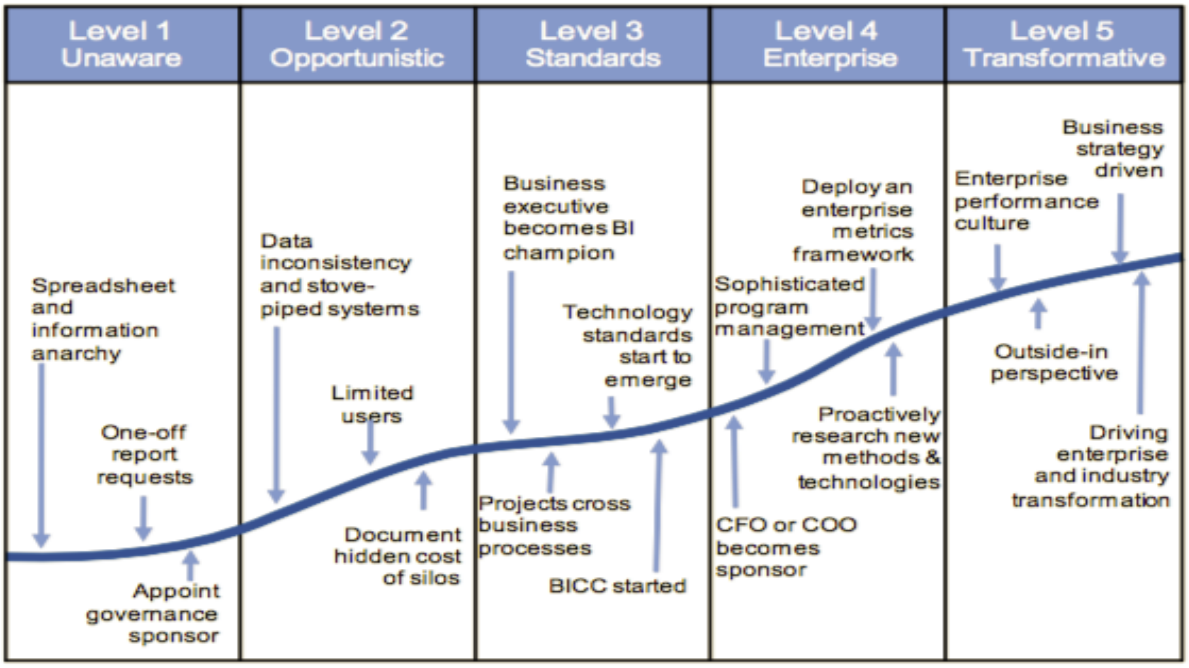


FIGURE 66- GARTNER'S MATURITY MODEL FOR BUSINESS INTELLIGENCE AND PERFORMANCE MEASUREMENT

Then, after getting know the framework of Gartner's maturity model, followings are the introduction through different maturity levels of this model:

UNAWARE

- Information in spreadsheets
- Ad hoc reports
- One-off requests
- No responsible sponsor
- Little to no trust

As the name of this level demonstrates, in this level of maturity, enterprises are not aware of Business Intelligence and Performance measurement system. Among different available academic literature, this level is also known as "information anarchy", which means that organizations who fall into this level are storing most of their data in the form of spreadsheets, usually, Microsoft Excel files and the report requests are usually ad-hoc to satisfy one-off type requests of executives.
In this level indicators and metrics are not defined and companies are not aware of performance measurement systems. CEO and other executives are not aware of Business Intelligence and Performance Measurement prominence, so these systems are not deployed within these organizations. With this logic, executives leave the management of Information Systems and reporting tasks to the IT department. For this reason, the budget of BI and PM systems are very limited in the enterprises who fall into this level of maturity.

OPPORTUNISTIC (TACTICAL)

- Inconsistent data
- Stove-pipe storage
- Limited users
- Off-the-shelf tools
- No staff training

One of the signs of this level of maturity is the existence of stove-pipe storage systems which are designed to satisfy specific and limited needs at a departmental level. Most of the information alongside with applications and business tools are stored and located in “Silos”. In this level, enterprises start to understand the basic values of Business Intelligence and Performance Measurement systems, and accordingly, they are willing to invest in these systems. Because of PM systems, in different departments of this type organizations, metrics and indicators are started to define.
The work-force who are the users of BI and PM systems are not skilled and they even don’t get training about these systems. These issues force these employees to use off-the-shelf software tools which are not customizable to satisfy companies’ needs. Accordingly, CEOs and executives have no trust in reports’ accuracy and quality which are generated by these systems and this cause to have low support from managers of the enterprise.

STANDARDS (FOCUSED)

- Inconsistent metrics
- Basic staff training
- Department-level dashboards
- Moderate executive engagement

In this level of maturity, some sort of standards is starting to appear and enterprises start to enjoy the basic benefits of Business Intelligence and PM systems, thus only at the departmental level. Again, at this level, the generated support for BI systems is not enterprise-wide, but just from departmental level or form a member of senior management responsible for IT (Hostmann 2006).
Finally, in this level, dashboards appear in order to optimize the efficiency level of each department or business unit without spreading the usage of them to organization-wide level.
Although, in this level, organizations understand the benefits of creating and using metrics and defined-goals in their systems, having some inconsistencies among this metrics are quite normal. In this level, companies are starting to train their work-force, but only limited to introductions and very basic levels of BI and PM systems.
In this level, the information flow is not integrated enterprise-wide, but just only at the departmental level or at each business unit.
Gartner introduced a new term in this part which is BICC. This new term stands for Business Intelligence Competency Center which is a center in an enterprise in which BI experts and IT guys are linked together to evaluate different needs of users in the more effective way.

ENTERPRISE (STRATEGIC)

- Established metrics
- Oversight for data quality
- Multiple users of BI
- Significant staff training
- Executive sponsorship & trust

Within this level of maturity model, support for BI development comes from high levels of organizational hierarchy and there is a clear business strategy exist for Business Intelligence systems in enterprises. This kind of organizations, accept Business Intelligence and Performance Measurement as critical part of business processes, and the usage of these systems become widespread all along the enterprise, from suppliers to business partners and in some occasions even customers.
Business Intelligence Competency Centers (BICC) which include experts from different business areas in collaboration with IT department are formed, and in this level of maturity, have enough resources and funding to achieve their goals.
The reason that this level is called Strategic is, in this level thanks to establishing a strategic framework, enterprises integrate measurements which are related to different organizational levels, such as operational, departmental and functional, with financial and other strategic targets of the company. Organizations employ data management policies and monitor data quality on a regular basis, thanks to the existence of data quality metrics.
More importantly, in this level, the users of BI and PM systems are trained to be able to use the advanced functions of BI systems, such as data processing, which enables them to be effective in making strategic and tactical decisions. Accordingly, there is a strong sense of trust created among senior staff and CEO towards BI and PM systems, and they convinced to use them in strategic decision-making processes.

TRANSFORMATIVE (PERVASIVE)

- Comprehensive metrics linked to goals
- Exhaustive staff training
- BI driving strategy

In this level of maturity model, which is the last stage, Business Intelligence, and Performance Measurement systems are prevalently used among all organizational parts of the enterprise and also became one of the important corporate ethics. Executives of enterprise, which at this level understand the significance of these systems, now they use them in different business process. The viewpoint of managers is changed toward these systems since they believe that BI and PM make them pliable in the dynamic world of the information age.
In this level, Business Intelligence Competency Centers are in their most proactive and dynamic conditions. And the trust level to BI and PM systems within different organizational levels is in its highest condition.

Not only the users of these systems are exhaustively trained to fully leverage the performance metrics and analytic functions, but there is an enterprise-wide access toward this integrated information-pool and data analytics becomes pervasive among all.
And at this level, BI and PM became one of the core competencies of organizations which positively affect the business performance of enterprises. Accordingly, the company enjoys the benefits of quantifiable results which also connected to their specific type of goals. In the most mature state of BI and PM systems, suppliers, business partners, and customers can easily leverage these systems based on their dynamic and different needs.

After analyzing different levels of Gartner's maturity model, we can understand that one of the advantages of this model is that, it evaluates the maturity of BI and PM systems both in departmental and enterprise-wide levels. Based on research results, not all of the departments of an enterprise are at the same maturity level which confirms the capability of Gartner's maturity model, regarding this aspect (Hribar Rajterič 2010). Accordingly, enterprises can easily find possible obstacles and take corrective actions in order to improve different departments, following enterprise-wide advancement of maturity condition.
Besides this, the other characteristic of Gartner's model is that, in comparison with TDWI's maturity model, it focuses on non-technical aspects of maturity and draw the attention to business-technical criteria of BI maturity state.
After having all these different BI/PM maturity criteria assessed, Gartner's model also provides an improvement roadmap as a framework for BI and PM, in which all different layers and components that need to be integrated and aligned are defined. In this way, implementing BI schemes have crystal strategic vision and deployment program(Hostmann 2006).
Another advantage of Gartner's maturity model is that it is well documented and have the ability to search the web, effortlessly.

Based on these explanations and reasonings, and because of the research scope of this dissertation, which holds a non-technical view, the relevant case-studies from chapter four of this thesis will be evaluated based on five levels of Gartner's maturity model, as follows:

6.1. Case of Morocco

In this case, which is conducted during 2012, the maturity state of 65 Moroccan SMEs has been assessed. These enterprises are from different business sectors as following: Manufacturing, Information Technology, Insurance, Sales, and Distribution.

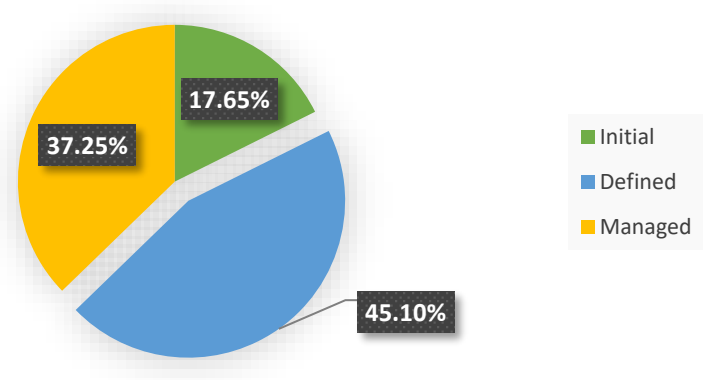


FIGURE 67- STATE OF MATURITY AMONG MOROCCAN SMES

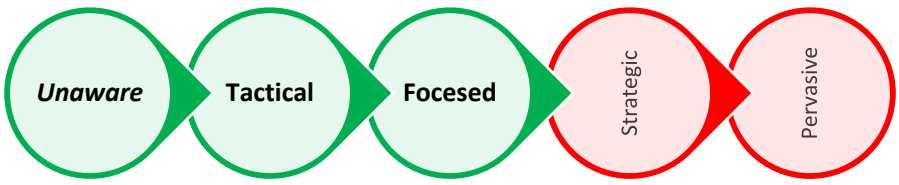


FIGURE 68- MATURITY LEVEL OF MOROCCAN SMES BASED ON GARTNER'S MODEL

6.2. Case of France

In this case, which is conducted during 2017, the maturity state of 10 French SMEs has been assessed. In this case, from each enterprise, the amount of 5 executives and 15 Junior employees were interviewed.

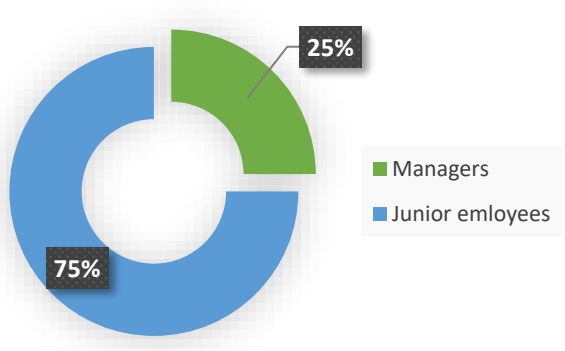


FIGURE 69- DISTRIBUTION OF INTERVIEWEES AMONG FRENCH SMES, BASED ON THEIR POSITION

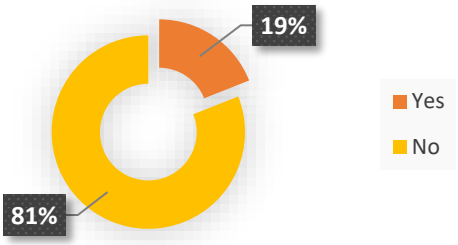


FIGURE 71- RESPOND OF MANAGERS TO BI USAGE AMONG ALL ORGANIZATIONAL LEVELS

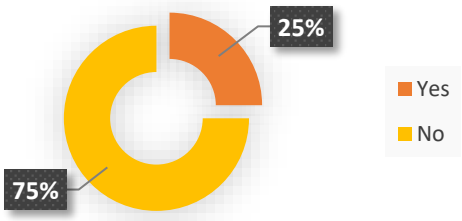


FIGURE 70-RESPOND OF MANAGERS TO THE AVAILABILITY OF SKILLED EMPLOYEES FOR MANAGE BI

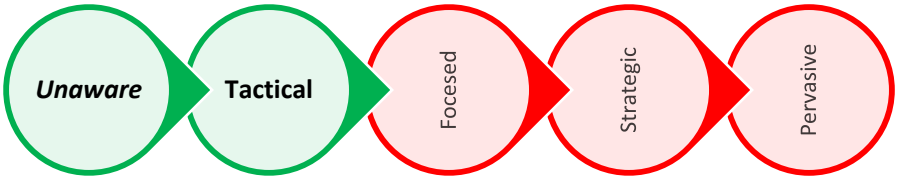


FIGURE 72- MATURITY LEVEL OF FRENCH SMES BASED ON GARTNER'S MODEL

6.3. Case of Thailand

In this case, which is conducted during 2016, the maturity state of 427 Thai SMEs has been assessed. These enterprises are from different business sectors as following: Manufacturing, Service, Wholesale, and Retail.

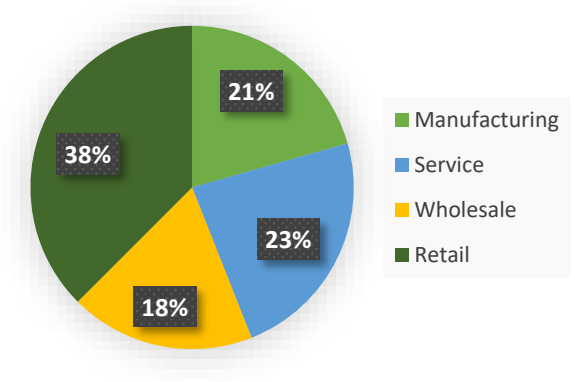


FIGURE 74- DISTRIBUTION OF THAI SMES BASED ON THEIR BUSINESS SECTORS

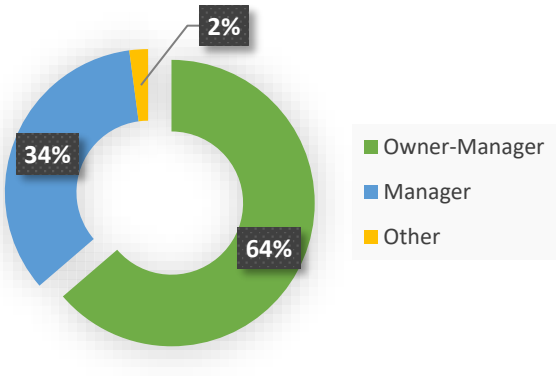


FIGURE 73- DISTRIBUTION OF RESPONDENTS IN THAI SMES BASED ON THEIR POSITION

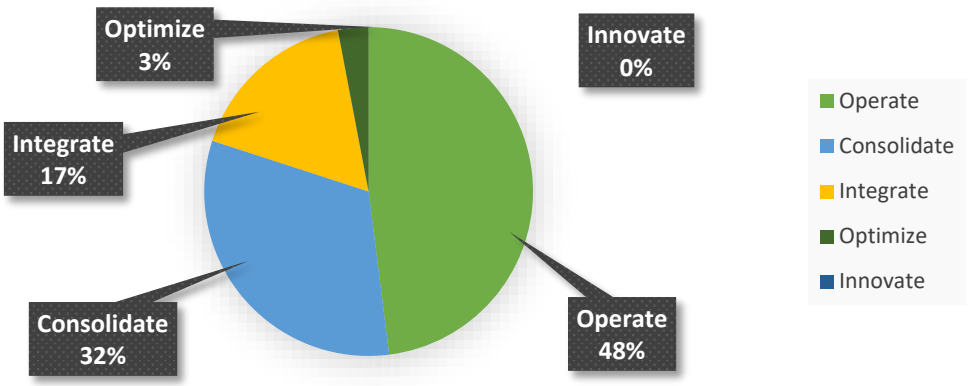


FIGURE 75- STATE OF MATURITY AMONG THAI SMES

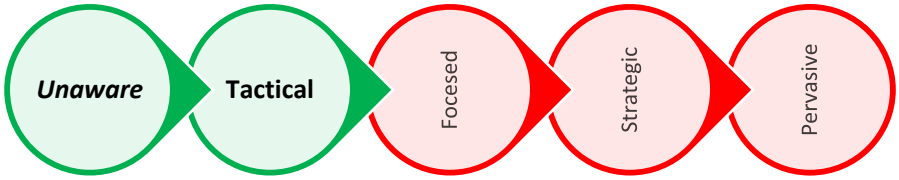


FIGURE 76- MATURITY LEVEL OF THAI SMES BASED ON GARTNER'S MODEL

6.4. Case of Sweden

In this case, which is conducted during 2015, the maturity state of 4 Swedish SMEs has been assessed. These enterprises are from different IT business sectors as following: IT-solutions, IT-consultant, and Programming.

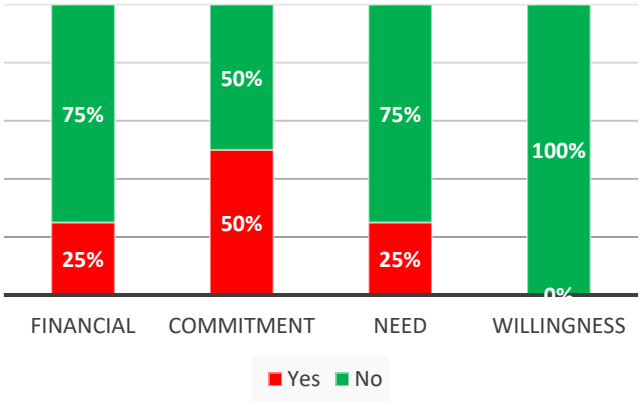


FIGURE 77- ATTITUDE OF SWEDISH RESPONDENTS TOWARD BARRIERS TO BI IMPLEMENTATION AS AN OBSTACLE

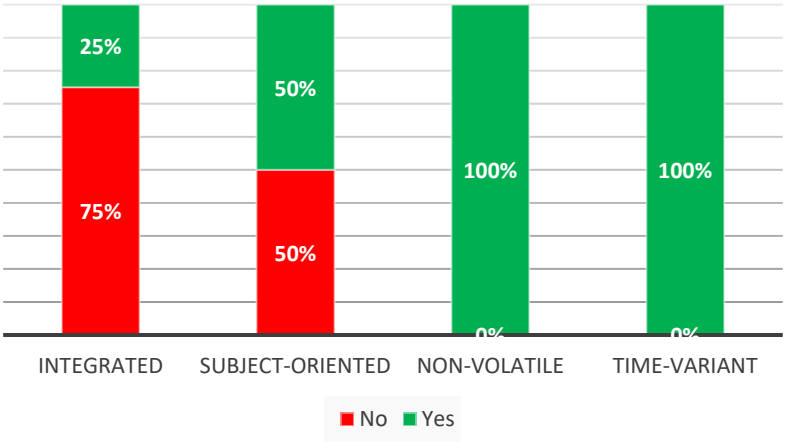


FIGURE 78- STATED OF DW USAGE WITHIN SWEDISH RESPONDENTS

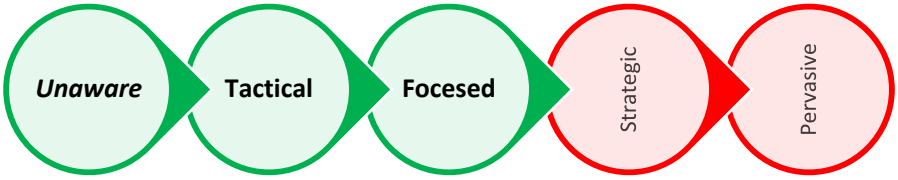


FIGURE 79- MATURITY LEVEL OF SWEDISH SMES BASED ON GARTNER'S MODEL

6.5. Case of North Africa

In this case, which is conducted during 2016, the maturity state of 300 North African SMEs has been assessed.

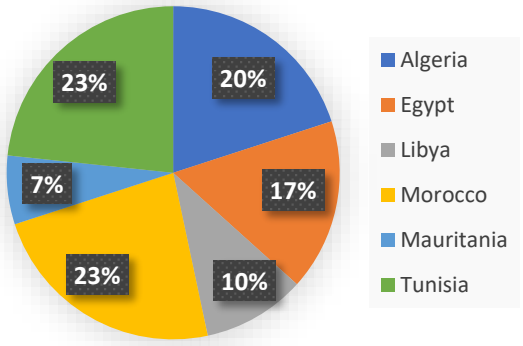


FIGURE 80- DISTRIBUTION OF NORTH AFRICAN SMES BASED ON COUNTRY OF ORIGIN

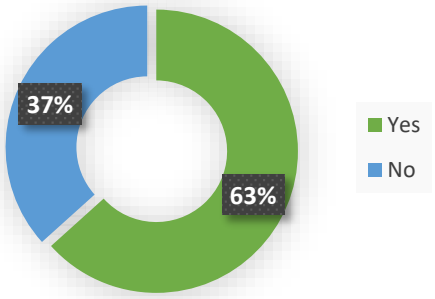


FIGURE 81- PERCENTAGE OF SMES WHO APPLIED ONLY BI DEVICES

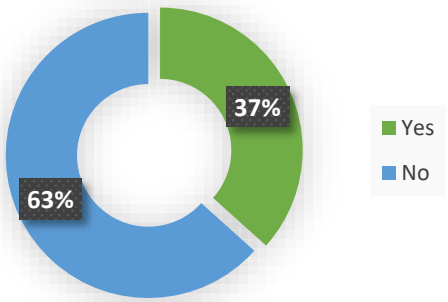


FIGURE 82- PERCENTAGE OF SMES WHO APPLIED TOTALLY OR PARTIALLY DEVICES OF ENTREPRENEURIAL COMPETITIVE INTELLIGENCE

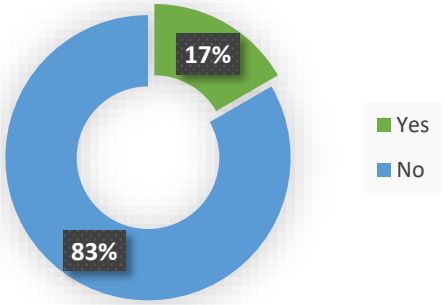


FIGURE 83- PERCENTAGE OF SMES WHO APPLIED TOTALLY OR PARTIALLY INTERNAL AUDIT DEVISES OF ENTREPRENEURIAL COMPETITIVE INTELLIGENCE

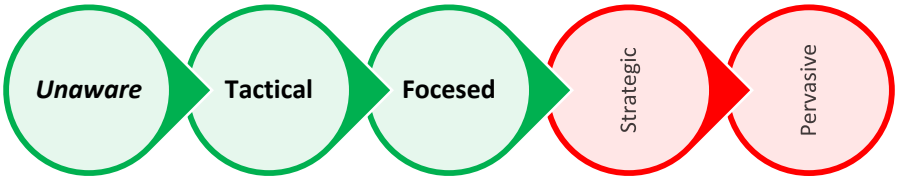


FIGURE 84- MATURITY LEVEL OF NORTH AFRICAN SMES BASED ON GARTNER'S MODEL

6.6. Case of Poland

In this case, which is conducted during 2012, the maturity state of 20 Polish SMEs has been assessed. These enterprises are from different business sectors as following: Commerce, Service, and Consulting.

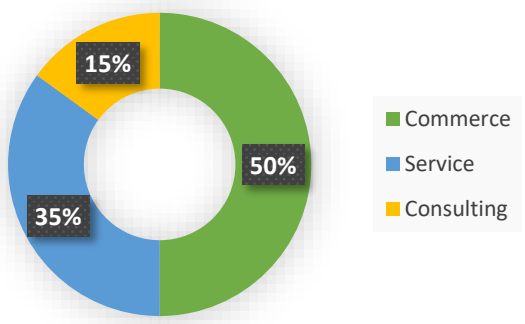


FIGURE 85- DISTRIBUTION OF POLISH SMES BASED ON THEIR BUSINESS SECTOR

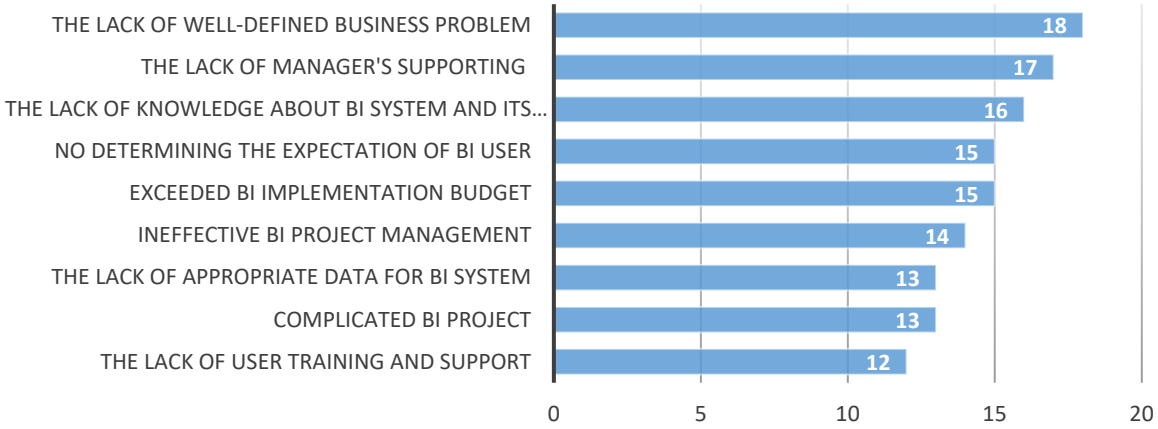


FIGURE 86- IMPLEMENTATION BARRIERS OF BI IN POLISH SMES

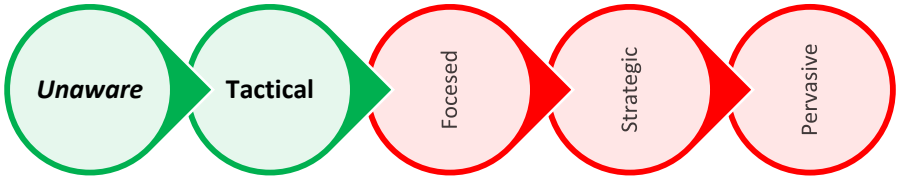


FIGURE 87- MATURITY LEVEL OF POLISH SMES BASED ON GARTNER'S MODEL

6.7. Case of UK

In this case, two British companies have been selected which are active in the insurance sector of the market and performing as a one-unit insurance group. Then, the authors have implemented a case study approach in order to evaluate the different aspects of BI systems implementation which was deployed partially at the time that case study was performed, that was during 2016.

The executives of this insurance group mentioned that, because of the positive effect of implemented BI systems in the following operational areas, they enjoy 30% revenue increasing;

- Lead Data Trend Analysis - planning and determining new lead strategies
- Campaign Dialer and Agent Analysis
- Estimating and forecasting sales
- Claim Analysis – Claim data, claimed customers and products
- Monitoring and compliance with internal and external rules

Despite the fact that, managers see the high potential of BI systems, they did not use the technology of Data Warehousing, which prevents them to climb to the highest ladders of BI maturity.
The other negative aspect is, even though one of two companies of this group activity's is web-based, there is not any cloud-based BI solution, implemented in their organization.

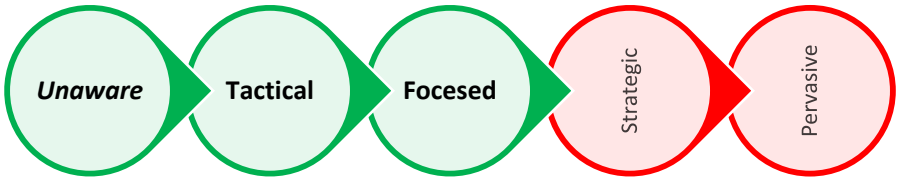


FIGURE 88- MATURITY LEVEL OF UK BASED SME BASED ON GARTNER'S MODEL

6.8. Case of Greece

In this case, which is conducted during 2015, the maturity state of 37 Greek SMEs has been assessed. These enterprises are from different business sectors as following: Commercial, Manufacturing, Service, and Tourism.

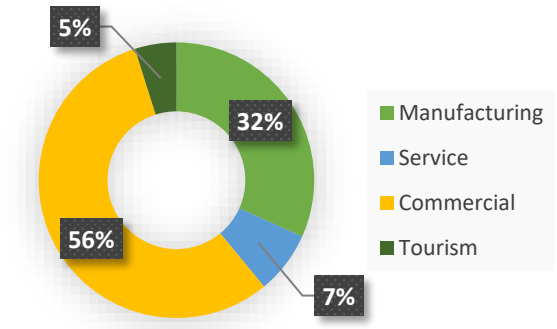


FIGURE 89-DISTRIBUTION OF GREEK SMES BASED ON THEIR BUSINESS SECTOR

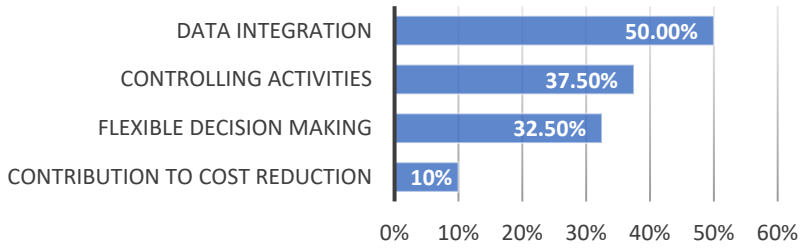


FIGURE 90- PERCEIVED ADVANTAGES OF BI FUNCTIONALITIES OF IMPLEMENTED ERP SYSTEMS, IDENTIFIED BY GREEK SMES

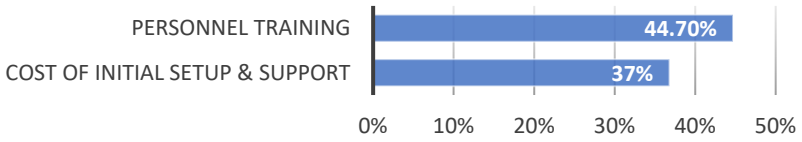


FIGURE 91- DETERRENTS FOR ERP ADOPTION BASED ON GREEK SMES RESPONSE

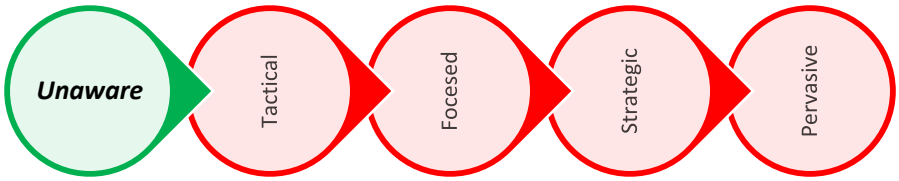


FIGURE 92- MATURITY LEVEL OF GREEK SMES BASED ON GARTNER'S MODEL

6.9. Case of Czech Republic

In this case, which is conducted during 2012, the maturity state of 112 Czech SMEs has been assessed. These enterprises are from different business sectors as following: Manufacturing, Service, and Retail.

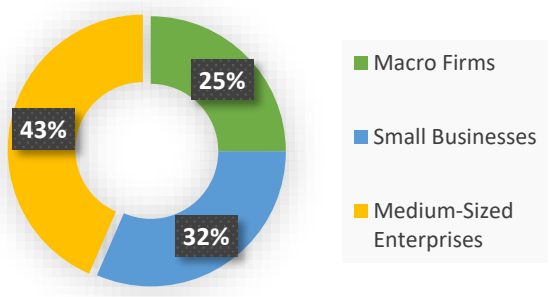


FIGURE 93- DISTRIBUTION OF CZECH SMES BASED ON THEIR SIZE

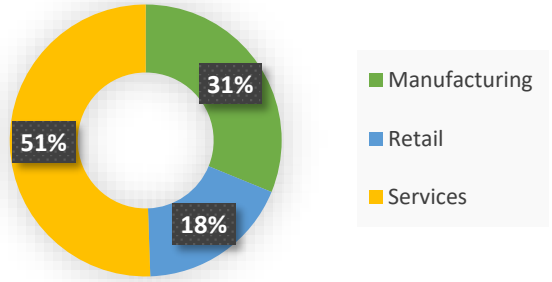


FIGURE 94- DISTRIBUTION OF CZECH SMES BASED ON THEIR BUSINESS SECTOR

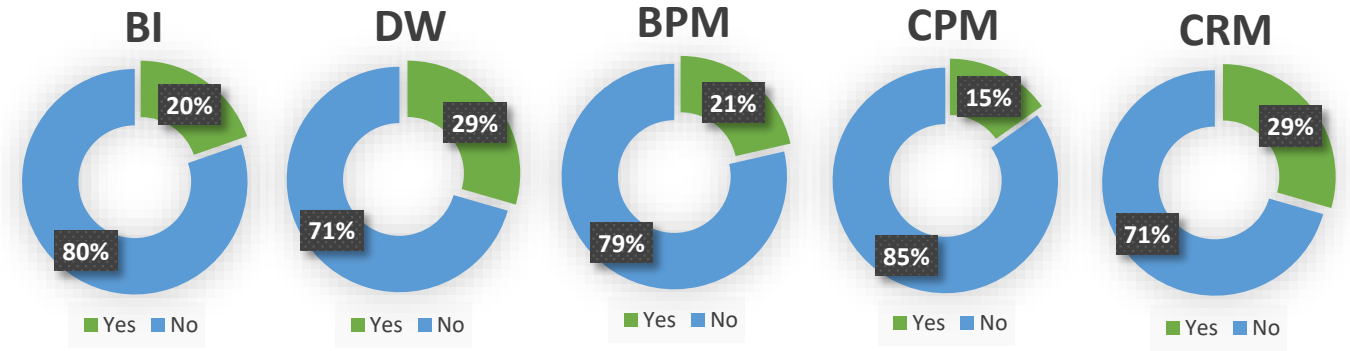


FIGURE 95- USAGE OF ICT TOOLS WITHIN CZECH SMES

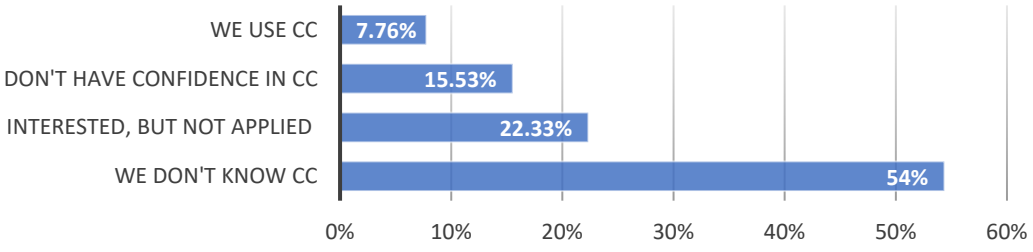


FIGURE 96- USAGE OF CLOUD COMPUTING SERVICES AMONG CZECH SMES

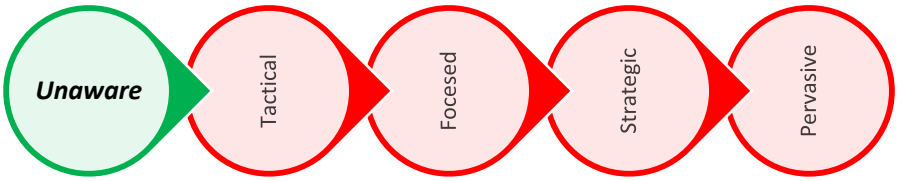


FIGURE 97- MATURITY LEVEL OF CZECH SMES BASED ON GARTNER'S MODEL

6.10. Case of Italy (Seica S.p.A.)

During the implementation of data-integration platform, the management systems and decision-making process of the company are also analyzed based on empirical investigation and some unstructured interviews with enterprise's top executives.
Surprisingly, there is an exact match between investigations and interviews results and definition of the first level of Gartner's maturity model of BI/BPM platforms.
None of the executives had any idea about BI/BPM platforms and information were mostly stored on spreadsheets which are based on Microsoft Excel or MySQL database, without any connection between them. Reports are generated ad-hoc off the request of executives and occasionally, and because of the lack of relational databases and connections between information, there was a little trust on the generated reports. There were lots of dirty data in the spreadsheets which needs to be cleaned out and because of company's information update policies, it was a challenge to find the responsible for the generated report.
The only management information system platform that general manager was using is the ISO 9001 form the quality management family of International Standards.

With all these said, and based on additional following information, the maturity level of BI/BPM platform based on Gartner's model is level 1, which is *Unaware*.

- No CRM system was available,
- There was not any performance measurement metrics and accordingly no Business Performance Management system was used by managers,
- There were no Process Manager and process management policies,
- Companies warehouse is not connected directly to the ERP system and materials are not codified,
- ERP system was used mostly for covering Accounting and Administrative issues, and users were not fully trained to be able to leverage all of the capabilities of the system.

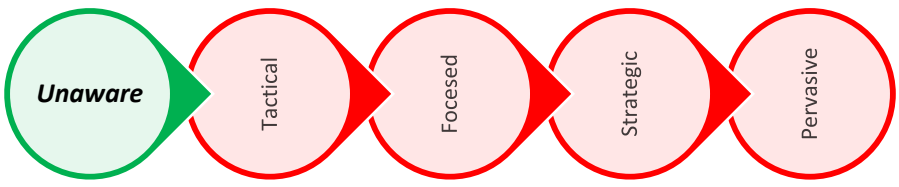


FIGURE 98- MATURITY LEVEL OF SEICA S.P.A. BASED ON GARTNER'S MODEL

Up to this point, the maturity level of enterprises is assessed based on their contemporary state of BI/BPM platforms usage. Based on literature there is a road map, that various authors agree upon, which helps enterprises to achieve data-driven intelligence core competencies.
Following is the summary of BI improvement roadmap introduced by Watson that in alignment with other authors improvement factors like Olszak and Pant (Watson and Wixom 2007; Ziemba and Olszak 2012; Pant 2009);

- High-level executives and senior managers should consider BI platform as a strategic resource and their viewpoint toward BI should be enterprise-wide.
- It is important that BI strategy should be in parallel with IT-strategy alongside with enterprise-wide goals.
- Executives should implement the culture of data-driven decision making rather than gutsy ones.
- There should be an effective data governance in enterprises alongside with effective data infrastructure.
- Data quality carries utmost importance in BI projects' success
- Leveraging both people and processes for developing and operating enterprise-wide data infrastructure
- BI integration with most employees' job description and make its usage widespread in the organization.
- There should be a warm collaboration between BI staff and its users
- Sufficient personnel alongside with appropriate tools and methodologies should available to support risk management, and scheduling tasks along with cost and efforts.
- Enterprises should maintain a strong portfolio of business-driven BI applications

But, on the way of the climbing ladder of success toward maturity of BI platforms, enterprises may encounter different obstacles, such as dedicated time and cost in order to deal with complexities of BI implementation along with user training and support in one hand, and difficulties regarding using of BI tools on the other.

For these bottlenecks, however, there are some remedies available in today's' market; like the suggestion of Watson regarding this issue (Watson and Wixom 2007).

- Open-source BI software solutions, like Pentaho
- Web-based application solutions, like MicroStrategy
- Implementing dashboards and scorecards
- Integrating BI with Microsoft Office, in particular, Microsoft Excel; e.g. Power BI
- Making BI tools easier to use

Figure 99 adopted form Deloitte Consulting published a paper (Pant 2009) and illustrates the alignment of Business Intelligence systems with organizations strategy to deliver more value.

FIGURE 99- BI ALIGNMENT WITH ENTERPRISE STRATEGY

There is evidence available form academic literature and research in which there are some other important factors that play a significant role in the success of BI projects implementation. For instance, based on a research study, managers who have stronger intentions to implement innovative systems in their organizations are those who are more involved in BI systems and its implementation steps (Wang 2014). This research brings support to the idea that there is a strong correlation between having support from senior executives and stakeholders and having successful implantation of BI platforms in the organizations.

On the other case study, which is conducted among 229 SMEs located in the Middle East, it turned out that there is a strong relationship between BI functions and Decision Support benefits and accordingly, these perceived benefits will lead to Organizational benefits at the end of the process. The authors of these studies explored 34 criteria as BI systems-enabler functions and grouped into six main following clusters (Rouhani et al. 2016; Rouhani, Ghazanfari, and Jafari 2012; Ghazanfari, Jafari, and Rouhani 2011):

- Analytical and Intelligent decision-making (AIDS)
- Providing related experiment and integration with environmental information (EEI)
- Optimization and recommended model (ORM)
- Reasoning (REAS)
- Enhanced decision-making tools (EDMT)
- Stakeholders' satisfaction

The authors of this research study claimed that, in order to have a roadmap to deploy the effective BI functions, enterprises should determine the most needed functions by taking into account their business requirements and making connections between these functions; thus, they believe that their model could be extremely useful to this end (Rouhani et al. 2016).

In a nutshell, as it takes years for human beings to become an adult with considerable accumulated experiences, so do organizations. It is not possible for an enterprise which is recently started implementing BI platforms to become mature enough and Transformative user of BI, overnight. Based on Deloitte Consulting LLP (Pant 2009), companies should avoid big-bang approach in the process of BI platform implementation and rather should employ iterative one. They must ***Think Big***, ***Start Small***, and ***Deliver Value*** through the process of BI platforms implementation and having a development strategy to coup with the latest challenges of the market.

Table 21 is demonstrating three different steps that shed more light on how to adopt an iterative approach to BI implementation within an enterprise (Pant 2009);

TABLE 21- ITERATIVE APPROACH TO BI

	1st Target	2nd Target	Final Target
Number of Tools	Few	More	Many
Impact	Department	Entire Organization	Pervasive
Governance	Department	Senior Management	C-Level
Strategy	Data Mart	Enterprise Data-Warehouse	BI-driven Strategy

7. Conclusion

The starting point of this hybrid thesis, which is composed of an empirical case and research-based case study analyses, was the implementation of data-integration platform in a fast-growing medium-sized enterprise, called Seica S.p.A.
This integration platform was designed and implemented in the mentioned above company as a part of the master of science program dissertation, and the project was successful enough to be able to reserve a table in the main intranet of the company as "*General Management*" tab. There was an exact match between the definition of managerial needs that supposed to be fulfilled via this project on one hand and the characteristics of BI systems on the other; thus, surprisingly neither General Manager nor any other top executives of the company have had any idea about Business Intelligence systems and its definition.

After assessment of different BI implementation case studies from academic literature though, it turned out that, there are different barriers to implementing BI systems, which prevent SMEs to adopt this powerful strategy as a part of their decision-support system or kill their enthusiasm about getting know this knowledge-management phenomenon better in details.
Based on research and literature, among various implementation barriers, the followings are fallen into top five bottlenecks for SMEs to have BI used in their enterprise; which are:

- The absence of top manager's involvement and supporting role
- SMEs are not aware of BI systems and their powerful capabilities
- Exceeding BI implementation budget
- The absence of a clearly-defined business problem
- Lack of determining the BI users' expectation

The final product of these barriers' assessment is a process of defining critical success factors from different organizational, process-based and technological aspects. Among all defined success factors, the issues like having an adequate budget, having senior management support, having business problems and processes to be well-defined alongside with crystal-clear users' expectation, and last but not least the possibility of integrating BI with other management-support systems are carrying utmost importance for SME's owner-managers.

There are some possible explanations that may cause these bottlenecks especially in SMEs and that is the distinct differences between characteristics of SMEs and large enterprises. One of these bold distinctions is the ownership of SMEs in which the owners are usually the managers and CEOs of their enterprises that cause major strategic management problems. Other issues which are common among SMEs are lack of human and capital resources which prevent SMEs from the adoption of modern technologies.
Recently, major ERP and BI vendors like SAP and Microsoft have noticed this gap in the market of SMEs and are seeing the extreme market opportunities in this field that they quickly changed their strategy and attituded toward SMEs, trying to satisfy their needs by offering specific and customized ERP and BI solutions designed for small and mid-size enterprises.

One of the remedies for implementing efficient BI systems is lying behind the fact that, SMEs should buy in iterative and step by step adoption approach rather than big-bang and pervasive theory at once. In this way, BI and its applications will start from departmental level and after having success in each department with designing departmental level data-marts in order to have clean and accurate data, it will move to enterprise level with the support of senior manager and it is in this organizational-wide step that data warehouses are created. Finally having all these initial steps passed successfully, the

SMEs can apply the pervasive approach to the BI systems to enjoy the full enterprise-wide benefits of this powerful decision-support systems.

There are some other important issues which will lead to a successful and productive BI systems implementation within SMEs. Big Data phenomenon and BI systems should not be seen as an application or software solution for a particular problem, but they must be a part of business strategy to help executives make timely and accurate strategic decisions based on data-driven decision-making culture. In addition, exhaustive training of BI staff alongside with their active involvement in the process of implementation is playing a crucial role in BI success. More importantly, enterprises should change their attitude toward data and consider it as a valuable asset which needs utmost care and protection. Even after implementing BI systems successfully, enterprises should grow a culture of continues improvement and assessment in order to constantly develop their BI systems to fit their latest challenges and needs.

Finally, after shifting from industrial-age to the modern age of information, it seems that surviving is pretty hard for that kind of SMEs which their management styles still belong to the obsolete industrial-age.

As Darwin well said;

> “It is not the strongest of the species that survives,
>
> not the most intelligent that survives,
>
> It is the one that is the **MOST ADAPTABLE TO CHANGE.**”
>
> *- Charles Darwin*

Appendix 1

The original version of project proposal of SEICA S.p.A., which is written in Italian language:

"Sviluppo di un modello di pianificazione integrata che utilizza le informazioni provenienti da diversi aree aziendali per realizzare un quadro sintetico dell'avanzamento dei progetti (commesse) nel loro complesso. Questa sintesi sarà utilizzata dalla Direzione Generale per le attività di verifica e controllo sulle varie commesse. I dati delle commesse sono attualmente presenti in diversi data base e fogli excel gestiti direttamente dall'ufficio preposto alle attività di una parte specifica del progetto. Le aree aziendali interessate sono la Produzione e Logistica, il reparto di Custom Manufacturing, la divisione che si occupa dei servizi per il cliente, la Ricerca e Sviluppo e l'ufficio Commerciale.

Il tirocinio è mirato allo studio e analisi dei dati disponibili e alla definizione del metodo di estrazione di solo quei dati utili per la verifica del rispetto della pianificazione generale.

Sarà data particolare enfasi ai progetti rivolti al settore automotive, che sono particolarmente articolati e richiedono una continua ripianificazione per esigenze che derivano soprattutto dal cliente."

Seica
The Road to Innovation

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