A maturity model for Business Intelligence System project in Small and Medium-sized Enterprises: an empirical investigation

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Abstract

In the recent years many studies on maturity model have been carried out. Some refer specifically to maturity models for Business Intelligence (BI). Starting from an analysis of the existing literature, the aim of this paper is to develop a maturity model for the business intelligence system project in small and medium-sized enterprises (SMEs) based on the concept of critical success factors (CSFs). This model will be validated by two approaches.
The first is a pilot test of the model in a Moroccan medium-sized enterprise to demonstrate his capacity of assessing the maturity of BI System project and whether it can develop an improvement roadmap. The second is an empirical investigation in Moroccan SMEs by using a survey to depict whether it can evaluate the maturity of BI System project in different industries.
Keywords: Business intelligence, Maturity model, Business intelligence system project, Project management, Small and medium-sized enterprise.

1. Introduction

Under the circumstances of increasing market pressure, enterprises try to improve their competitive position by looking for instruments that would facilitate effective acquiring, processing and analyzing vast amounts of data that come from different and dispersed sources and that would serve as some basis for discovering new knowledge [1], and a business intelligence system, further abbreviated to BI System, is one tool for that. Indeed, the project of developing and implementing BI System has become one of the critical issues for gaining competitive advantages for companies and replying to ever increasing market pressure.
In fact, small and medium-sized enterprises (SMEs) have been described as catalysts for the future economy and there is a special need to accelerate SMEs' growth and to improve their competitiveness. Forsman support the idea that to SMEs may differ from larger companies by a number of key characteristics, e.g. resource and knowledge limitations, lack of money, reliance on a small number of customers and need for multi-skilled employees. Some of the above-mentioned characteristics are putting a greater strain on the SMEs inducing that the successful implementation of BI System may be more challenging in this context [2].
There are many business intelligence maturity models developed such as Business Information Maturity Model [3], TDWI's Business Intelligence maturity model [4], Business Intelligence Maturity Hierarchy [5], and others that are available for large companies to improve their decision making and strategic thinking. However, none of these models of maturity address the project of designing and implementing BI System in SMEs specifically. Also, there is a lack of guidelines informing how to create BI systems that might be used as examples for SMEs.
In this paper, we will describe a maturity model for the project of designing and implementing BI System in SMEs. In order to develop this maturity model, we will use the concept of critical success factors (CSFs) [6] and we will try to validate it through a pilot test and empirical investigation in Moroccan SMEs.

2. Business intelligence system

Today, information and knowledge represent the primary capital of an organization. Enterprises try to utilize this wealth to gain competitive advantage when making important decisions [7].With the demands for information technology, application software and enterprise information tactics constantly are enhanced and expanded. The deployment of SCM, ERP, CRM, PM systems, etc. has become mature, and the growth of BI System will become a new direction for enterprises'developpement.
The term BI was first used in 1958 [8] and it is defined as a set of tools, technologies and process in order to transform data into information and information to required knowledge for improve decision making in organization [9]. The role of BI systems and their influence over organizations have been subject to change. From simple, static analytical applications they have evolved into solutions that can be used in strategic planning, customer relationship management, monitoring operations, studying the profitability of products, etc [10]. Efficient BI has consequently become a potentially

valuable method of securing a competitive advantage and improving firm's performance. According to Okar and al., 2012, the concept of BI can be decomposed to three parts: Data Capture/Acquisition, Data Storage and Data Access & Analysis.

Also BI System is defined as an information system specially used for data analysis, which adopts information technologies to collect business data spread in different regions, and use flexible reporting tools to quickly provide analytical data as reference for enterprise's decision-making [11]. In contrast to operational systems, which focus on the fast and efficient processing of transactions, BI System provides quick access to information for analysis and reporting. Indeed, BI System not only entails substantial material and managerial resources, but also requires a significant degree of organizational redesign to accommodate system requirements [12].

Building and implementing BI Systems require organisations to have some culture of working with information and information technologies, which is related to:(I) thorough and ongoing research into organizations' informational needs (present and future); (II) authentic cooperation of the users involved (i.e. decision makers and operational personnel) with organizations' IT departments and knowledge management canters; (III) information sharing; and (IV) abilities to interpret analyses and use such analyses in management properly.

A survey from Gartner and Forrester shows that majority of the firms are interested in investing the BI Systems [13]. Various industries and so many enterprises were permeated by BI System and this last one was been successfully implemented to improve their customer loyalty and increase their return on investments [14]. However other organizations have not been as successful in utilizing BI to increase their profit and achieve their expected performance [15]. The implementation of BI System is not a conventional application-based IT project (such as an operational or transactional system), which has been the focus of many CSF studies [16]. Instead, it shares similar characteristics with other infrastructural projects such as enterprise resource planning (ERP) systems implementation. That is, implementing a BI System is not a simple activity entailing merely the purchase of a combination of software and hardware; rather, it is a complex undertaking requiring appropriate infrastructure and resources over a lengthy period [17, 18, and 19]. Under the speed-oriented operation mode, in order to improve management effects and performance, BI will surely become the tool enterprises would like to actively deploy as well as the solution that can bring enterprises competitive edge [20]. However, current BI application in SMEs is still at its fledging stage and most of the enterprises fall short of sufficient understanding towards BI [20].

3. Business intelligence in SMEs

SMEs play a pivotal role and can be considered as a back bone of national economy [30]. They contribute to the employment rate in their respective countries and they are a good indicator of a healthy economy [31]. From the review it emerged that, SMEs are socially and economically important and need tools and solutions to preserve their competitiveness in challenging environments [21], particularly because they operate in highly competitive, turbulent and uncertain markets [22].

Usually they do not have control or influence over the market and thus they need to adopt a reactive approach and adapt to market changes [23].

Many authors highlight scarcity of resources as one of the main problems and typical characteristic of SMEs [24]. In addition also skills are limited, not only among staff [24], but also owner-managers often do not have enough managerial expertise or organizational capabilities and this implies poor strategic business planning and human resource management [25].

Even though size represents a weakness in terms of available resources, on the other side, it favors a flat organizational structure with lack of bureaucracy and this has a positive impact on flexibility, adaptablity and rapidity in responding to the changing environment [26].

For this reason SMEs have usually a high potential for innovation and the ability to satisfy customers' emerging and evolving requirements [27].

The rapid development of SMEs in Morocco makes the competition that must be faced by SMEs becomes very tight [27]. To be able to survive in such competition, SMEs need a set of patterns, tools or technologies that change the raw data into meaningful information and knowledge, which are used for decision making to drive profitable business action [28;29], namely Business Intelligence.

The growing use of cloud computing, Software as a Service, as well as open source BI, open the opportunities for SMEs to implement BI. Despite of this, it still carries high level of risk of failure and consumes great resources [30]. Related to this, we need a maturity model that could assist SMEs to implement BI project, so that SMEs can evaluate their level of readiness and identify aspects which are still considered weak. Thus it is expected that this maturity model could further assessing the maturity of BI system project and improve the success rate of BI implementation in SMEs.

4. Business intelligence implementation project

A project is a set of activities and processes that mobilize human and material resources in order to create a product or service that meets the objectives in terms of quality, cost, schedule and performance [32].

Ramirez confirms that the life cycle of a project is not generic and varies depending on the product, service, industry and organization. Almost every kind of engineering project, structural engineering as well as software engineering goes through six stages between inception and implementation [33]. Indeed, on the basis of empirical data and an analysis of previous BI System projects, Moss described the progressive development of BI System projects along six dimensions (Justification,

planning, business analysis, business design, construction and deployment) as illustrated in Figure1.
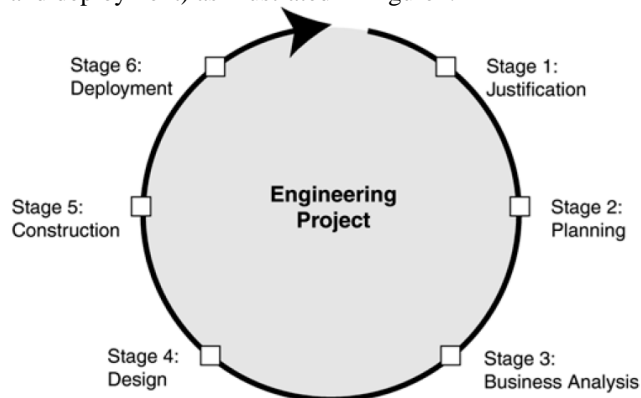

Figure1: engineering project steps [33].

The whole enterprise BI project planning and implementation always involve a significant amount of resources and various organizational stakeholders over a period of years [27]. Besides that, there are difficulties of implementing BI System widely cited in literature [8, 10, and 33] and the researches on the critical factors for initial and ongoing BI project design and implementation success in SMEs are rare.

For many Chief Information Officers, BI applications have appeared the top spending priority [34] and it remains the most important technologies to be purchased for past five years [35]. Although there has been a growing interest in BI area, success for implementing BI is still a questionable. Computerworld (2003) stated that BI projects fail because of failure to recognize BI projects as cross organizational business initiatives, unengaged business sponsors, unavailable or unwilling business representatives, lack of skilled and available staff, no business analysis activities, no appreciation of the impact of dirty data on business profitability and no understanding of the necessity for and the use of meta-data.

5. Critical success factors (CSFs) of BI implementation

Critical success factor (CSF) refers to an element that is necessary for an organization or project to achieve its mission. It is a critical factor or activity required for ensuring the success of a company or an organization [36]. The concept of "success factors" was developed by Daniel in 1961 of McKinsey & Company and was refined by Rockart in 1981. According to Boynlon and al. 1984, "Critical success factors are those few things that must go well to ensure success for a manager or an organization, and, therefore, they represent those managerial or enterprise area, that must be given special and continual attention to bring about high performance. CSFs include issues vital to an organization's current operating activities and to its future success."

An analysis shows that many BI projects frequently fail or are not undertaken at all. The reasons mentioned, among other things, include a relatively low level of knowledge in

organizations (especially SMEs) about the opportunities and benefits of BI systems, as well as about their critical success factors [37]. Indeed, there is a lack of research on BI critical success factors in SMEs, and they are becoming an important beneficiary of BI systems [37]. However, no systematic work exists on characterizing a collective set of CSFs for implementing BI in the SME sector. An appropriate set of CSFs which are relevant for SMEs will help them to keep in mind the important issues that should be dealt with when designing and implementing a BI initiative [37]. Much more, for a successful BI project's implementation that brings tangible business benefits to SMEs, study on the critical success factors for implementing BI in SMEs is crucial.

Based on the insights gleaned from the study of practices and experiences of leading companies in the BI field, Olszak highlighted three perspectives (categories) of CSFs: organization, process and technology. They mentioned that for a success BI project's implementation and for bring tangible business benefits to SMEs in the future, it is necessary to meet the following critical success factors: the most important for BI systems implementation from an organization perspective are 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 and the flexibility and responsiveness of BI on users' requirements. As slightly less important were effective change management, appropriate technology and tools and "user friendly"/usability of BI system. Regarded as less important is past experience and cooperation with BI suppliers.

For the present study, on the basis of the analysis of the different definitions of BI present in literature, the Critical Success Factors (CSFs) for Implementing BI Systems in SMEs proposed by Olszak and al., 2012 have been chosen.

6. Maturity model for a project of implementing BI System in SMEs

The concept of the process maturity was born in the Total Quality Management (TQM) movement and it was widely adopted in "Capability Maturity Model" for software organizations [38]. Then this concept migrated to organizational process and project management [39]. The project management maturity models provide means of identifying some crucial steps to be taken, the tasks that are necessary to accomplish and the sequence of events needed to realize significant and quantifiable results [40].

Essentially, maturity models describe the development of an entity over time. This entity can be anything of interest: a human being, an organizational function etc.

Maturity models are a certain result of the application of the life-cycle approach. Each entity develops through the levels over time until it reaches perfection – up to the highest level [41]. Maturity models are used to describe,

explain and evaluate growth life cycles. The basic concept of all models is based on the fact that things change over time and that most of these changes can be predicted and regulated [42].

According to Klimko 2001, Maturity models have the following proprieties:

- The development of a single entity is simplified and described with a limited number of maturity levels.
- Levels are characterised by certain requirements which the entity has to achieve on that level.
- Levels are sequentially ordered, from an initial level up to an ending level (the latter in the level of perfection).
- During development the entity is progressing forwards from one level to the next one. No levels can left out.

Literature overview shows that models for different domains evolve gradually, that these same models are improved and changed over time and that authors often build and improve their models based on the past experience of other authors.

There are many BI maturity models developed by different authors such as: Business Information Maturity Model [3], TDWI's Business Intelligence maturity model [4], Gartner's Maturity Model [43], Performance Management Maturity Model [44], Business Intelligence Maturity Hierarchy [5], The Infrastructure Optimization Maturity Model [45]…etc.

For each maturity level, the model defines key improvement factors and appropriate tools that a firm can use to move up to the next higher maturity level. So once an enterprise determines its maturity level, it can define an improvement roadmap using key improvement factors and appropriate tools.

Based on the literature review, there seems to be a lack of researches in the field of BI and maturity models in SMEs. Hence there is a need for a model that assesses the maturity of this type of project.

Purpose of the paper is to extend current knowledge and understanding of BI practice into the context of SMEs. In particular, the paper aims to develop a preliminary version of a maturity model for Business Intelligence System project in SMEs based on the concept of CSFs.

The structure of our maturity model is built upon the following three dimensions:

1. Maturity level dimension:

- Level 1(initial): there is no process area and 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 and;
- Level 3 (managed): SMEs BI process and activities are controlled and managed based on quantitative models and tools.

2. Life cycle stages of project of implementing BI System;
3. The critical success factors (CSFs) for a project of implementing BI System in SMEs.

The project management offers a systematic approach to all stages of a project by ensuring that every step is carefully planned, monitored, and measured. Although initially intended for application in large organisations with complex systems that require such a process [46], modern methods of project management can be adapted and altered to suit the needs of the smaller organisations. This is why the staged representation of our maturity model consists of three levels which are proposed for SMEs in reason of his less complex structure than that of a large company: (I) Justification and Planning, (II) Business analysis and Design, (III) Construction and Deployment.

The model incorporates CSFs proposed by Olszak and al., 2012 that have been identified in the previous sections.

We describe the maturity model for a project of implementing BI System in SMEs in table 1.

Within stages of BI system project life-cycle proposed, for each critical success factors the maturity level is assessed. The SME should document the evidence that supports the maturity level for each CSF. The level of maturity stage of BI System project life cycle is the minimum of all critical success factors maturity level. The BI System project's maturity level is the minimum of all stages maturity level.

The suggested Maturity Model makes it possible for a SME to see where it stands and how it can improve its BI System. Thus, it provides a methodology for a SME to develop an improvement roadmap to his BI System project. When the BI System project reaches a specified maturity level in a CSF, the improvement roadmap includes the next level. If level 3 is reached, the SME must keep it.

Table 1: Maturity model for a project of implementing BI System in SME

BI Project life cycle	CFSs 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.

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	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 change of processes).	The BI project does not include an effective change management	The BI project include a change management program	The BI project include an effective change management
	Support from senior management.	They aren't any support for the BI project by senior management.	Some senior managers support for 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 is 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 partially "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.

7. Model validation

The proposed model has two objectives: first provide a framework to assess maturity level of BI System project in SMEs, and second, offer a support for SMEs to develop an improvement roadmap to his BI System. Our model validation examines whether this model is suited for these two uses.

Two approaches are used to validate this model. The first is a pilot test of the model in a Moroccan in medium-sized enterprise to demonstrate whether it can assess the maturity of BI System project and develop an improvement roadmap. The second is a case study to verify practical values of the maturity model in Moroccan SMEs and to assess capability of the model in different industries.

7.1 The Pilot Test

To evaluate the model in an actual industry setting, we conducted a pilot test with Moroccan medium-sized enterprise that accepts to participate in the study. For confidential reasons we will call this society EXPERT.

The drive for implementing the BI System came from the CEO. The main reason for his decision was that he saw a future for this business and expected rapid growth in the future. He then looked for an appropriate tool that could help him to make the right decisions at right times and believed that the BI System would be of use in his organisation.

EXPERT is a company specialized in importation and distribution of technical materials for the national market with two several distribution warehouses. It belongs to a Moroccan group and employs 210 people.

The maturity level of EXPERT's BI System project can be summarized in table 2 as it was assessed by EXPERT's BI manager.

After the assessment of maturity level, based on the proposed model, we developed an improvement

roadmap for EXPERT Company's BI System project as it is shown in table 3.

Table 2: 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 3	
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	

Table 3: 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.

7.2 The empirical investigation

To verify practical values and validity of the proposed model, we applied it to Moroccan SMEs. The study included 65 Moroccan SMEs which possess a BI System with a workforce of less than 250, a turnover of less than 10 millions USD.

We will try in this section to give an answer, with reference to the context investigated, to the following research question: What are the maturity levels that characterize BI System project's in Moroccan SMEs?

The research question will be answered through hypotheses testing. For this question we propose one hypothesis: A company could be very advanced regarding one stage of BI System project life cycle, while being rather antiquated regarding another.

In order to examine the above research question, a survey method was selected.

The sample is composed of SMEs from different economic sectors. This includes manufacturing, information technology, insurance, sales and distribution industries.

The maturity model of BI System project presented in this paper was used in developing a survey in order to evaluate the level of maturity of BI System project in Moroccans SMEs. The instrument used is a structured questionnaire and 14 variables that allow the researchers to collect data pertaining to maturity model of BI System at each stage of life cycle project. Also we make sure that the form and the questions would be unequivocal and easy to answer, in order to avoid possible ambiguity for the reader [47]. Most of the answers of questions are based on a categorical or ordinal scale.

The survey is sent to sample of 65 Moroccan SMEs by email attachment in Google drive. Within each company the survey was addressed to one person at management level (BI manager, IT manger, Management controller, CEO, Production manager, Commercial Manager, HR manager).

The survey covered a sample of 65 SMEs whose only 17 have completed responses to the questionnaire, a response rate of approximately 26%, which meets Malhotra and Grover's 20% response rate hurdle [48].

As exposed in table 4, it was found that the maturity of the different stages of life cycle BI System project was independent from each other and that a particular company could be very advanced regarding one stage, while being rather antiquated regarding another stage. The results show that the average of maturity level of different stages of life cycle BI System is near to the level 2.

From the analysis of the "Justification and Planning" maturity stage results, it emerged that only a 29.41% have a level 3. We can conclude that the majority of Moroccan SMEs don't pay attention to this stage.

In addition the Moroccan SMEs give more importance to "Business analysis and Design" stage (82.35% between level 2 and 3).

Indeed the "Construction and Deployment" is the more advanced maturity stage of the BI System project (52.95% in level 3 and only 11.76% in level 1).

This demonstrates that the Moroccan SMEs focus their efforts at BI System project on the technical aspects of the Construction and Deployment (Data quality, BI flexibility and responsiveness on users' requirements, appropriate technology and tools, friendly use of BI system and Integration between BI system and other systems).

The survey's results reflect a "defined" level of maturity of performance management BI, representing opportunities for Moroccan small and medium-sized enterprises' improvement. Also the empirical analysis demonstrates the capacity of the proposed model to assess the maturity of the BI System project in SMEs in different industries.

Table 4: Maturity level for each stage of life cycle BI System project

Maturity level	life cycle BI System project			
	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%

8. Conclusion

Based on the critical success factors on the one hand, and an analysis of the maturity models of business intelligence system on the other, a three-stages Maturity Model for BI System project for small and medium-sized enterprises has been developed. The suggested Maturity Model makes it possible for SMEs to assess their BI System project and how it can be improved.

Just as with the pilot test and the empirical investigation carried out to validate the maturity model for BI System project, these results seem to be more interesting in assessing maturity level and developing improvement roadmap. There are, also, some evidences from the results which that the maturity for BI System is at round "Defined" level.

It was found that the maturity of the different stages of life cycle BI System project was independent from each other. Indeed the pilot test is very advanced regarding one stage, while being rather antiquated regarding another stage. Hence we might conclude that the stages which are mainly determined by technical aspects are more advanced than those stages that are process and people related. Also, the basic maturity level in the last stage proves that the Moroccan small and medium-sized enterprises have to launch a new project to improve their BI System.

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While doing some works in the future the suggested Maturity Model should be examined with other empirical studies in different contexts.

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