

Review

A review of business intelligence and its maturity models

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There has been a great deal of recent interest that is driving research and development in the area of Business Intelligence (BI), due to the purported advantages it provides to organizations that deploy them skillfully. Although the concept of BI has been established for the past decade, it is fairly new and there is a limited study to provide systematic maturity guidelines and readiness assessment for such resourceful initiative. This shortcoming arises from the fact that, the BI market is a relatively new phenomenon, with most of the pioneering work being driven in an informal, ad-hoc basis by various vendors in the IT industry. This paper explores the numerous of BI maturity model through a comprehensive review of academic as well as practitioner's literature. Several maturity models have been reviewed such as business intelligence development model (BIDM), TDWI's maturity model, Business Intelligence Maturity Hierarchy, Hewlett Package Business Intelligence Maturity Model, Gartner's Maturity Model, Business Information Maturity Model, AMR Research's Business Intelligence/Performance Management Maturity Model, Infrastructure Optimization Maturity Model and Ladder of business intelligence (LOBI). Among the findings, most of them do not consider all factors affecting on BI. Some of BI maturity models focus on the technical aspect and some of the models focus on business point of view. This paper represents the first rigorously researched step towards understanding the business intelligence maturity model. The goal of the research presented in this paper is to bridge this missing gap between academia and industry, through a thorough formal study of the maturity model pertaining to BI. The driving motivation is to develop a better maturity model that can serve as a useful guideline for enterprises which are planning, or undertaking large-scale BI initiatives.

Key words: Business, intelligence, maturity model.

INTRODUCTION

According to Gartner research report on 2009, business intelligence (BI) market has gone through high growth recently. BI applications have become the most essential technologies to be purchased (Gartner, 2007, 2008, 2009). However, the success for implementing BI is still questionable (Lupu et al., 1997). About 60 to 70% of business intelligence applications fail due to the technology, organizational, cultural and infrastructure issues (Lupu et al., 1997). In additional, EMC corporation claimed that many BI initiatives have failed because tools were not accessible through to end users and the result

of not meeting the end users' need effectively while Computerworld (2003) avowed 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.

In fact, the entire BI project planning and implementation always require a large amount of resources and countless enterprise stakeholders over a period of years (Moss and Atre, 2003; Olszak and Ziemba, 2007; Reinschmidt and Francoise, 2000). Therefore, there is need a maturity model to guide and provide systematic

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maturity and readiness assessment BI stakeholders for implementing BI. There are many BI maturity model developed by different authors. In this paper, several maturity models have been reviewed such as business intelligence development model (BIDM), TDWI's maturity model, Business Intelligence Maturity Hierarchy, Hewlett Package Business Intelligence Maturity Model, Gartner's Maturity Model, Business Information Maturity Model, AMR Research's Business Intelligence/ Performance Management Maturity Model, Infrastructure Optimization Maturity Model and Ladder of business intelligence (LOBI).

BUSINESS INTELLIGENCE MATURITY MODELS

Here six types of business intelligence maturity models are described by different authors and a summary is shown in Table 1.

Business Intelligence Development Model (BIDM)

BIDM proposed by Sacu and Spruit (2010) in the technical report, Utrecht University, Netherlands. This model consists of six stages namely predefined reporting, data marts, enterprise-wide data warehouse, predictive analytics, operational BI and business performance management (BPM). This model concentrates on three perspectives: people, process and technology.

This model is new and documentation of this model is not defined and is not available on the Web. Furthermore, criteria to evaluate the maturity level are not well defined. This model is used for business intelligence development rather than business intelligence implementation.

The Ladder of Business Intelligence (LOBI)

The LOBI is model used to create the information technology (IT) plan and apply IT to business (Cates et al., 2005). This model applies three key process areas: technology, process and people across six levels namely facts, data, information, knowledge, understanding and enabled intuition. This model applied the knowledge management field and the author constructed maturity levels from a technical point of view but can considered as incomplete. It is not well documented and criteria to evaluate the maturity level are not well defined. This model is concentrates on IT perspective only and does not specific on components of business intelligence.

The Infrastructure Optimization maturity model

The Infrastructure Optimization maturity model consists of four levels of maturity namely basic, standardized, rationalized or advanced and dynamic (Kasnik, 2008). It

has three classes for infrastructure optimization: Core infrastructure optimization (Core IO), business productivity infrastructure optimization (BPIO) and application platform infrastructure optimization (APIO) but business intelligence only apply two classes: BPIO and APIO (Rajteric, 2010). The BPIO class concentrates on business process, business management and management of IT technologies and the APIO concentrates on decision making (Rajteric, 2010).

This maturity model mainly focuses on the measurement of the efficiency of reporting, analysis and data-warehousing and is not complete in the business intelligence area (Rajteric, 2010). This model discussed about the products and technologies rather than business point of view (Rajteric, 2010). It is not well documented and criteria to evaluate the maturity level are not well defined.

AMR research's business intelligence/ Performance Management Maturity Model

AMR research's business intelligence/ performance management maturity model consists of three key area: technology, processes and people, cross four maturity levels namely "Reacting", "Anticipating" and "Collaborating".

At level 1 "Reacting", organizations rely on the desktop tools and ad-hoc queries performed by individuals (Rajteric, 2010). At level 2 "Anticipating", data becomes essential and dashboards are being used (Hagerty, 2006). In level 3 "Collaborating", dashboards and performance indicators are used. In the level 4 "Orchestrating", identification of business goals is done in top down approach. This model concentrates on the performance management and balanced scorecard rather than business intelligence. It is not well documented and criteria to evaluate the maturity level are not well defined. There is no questionnaire to evaluate the maturity levels and is very hard to analysis the model (Rajteric, 2010).

Business Information Maturity Model

Business information maturity model developed by William and William (2007). This model concentrates of three success factors namely alignment and governance, leverage and delivery; and seven key areas namely BI strategic position, partnership between business units and IT, BI portfolio management, information and analysis usage, process of improving business culture, process of establishing decision culture and technical readiness of BI/DW.

This model consists of three levels. The first level concentrates on the information "what" users want to access; the second level concentrates "who", "when" and "where" while the third level concentrates on "how" information can be improved. This model is adapted from

Table 1. Summary of various maturity models.

Maturity model	Description
TDWI's maturity model	(i) The maturity assessment tool is available in the web to evaluate BI's maturity level as well as documentation. (ii) Concentrates on the technical viewpoints especially in data warehouse aspect. (iii) Can be improved on business viewpoint especially from the cultural and organizational view.
Business intelligence maturity hierarchy	(i) Applied the knowledge management field (ii) Author constructed maturity levels from a technical point of view but can considered as incomplete. (iii) The documentation of this model in the form of one paper and is not enough for maturity level assessment.
Hewlett package business intelligence maturity model	(i) Depicts the maturity levels from business technical aspect. (ii) This model is new and need to improve to add more technical aspects such as data-warehousing and analytical aspects.
Gartner's maturity model	(i) Uses to evaluate the business maturity levels and maturity of individual departments. (ii) Provides more non technical view and concentrates on the business technical aspect. (iii) Well documented and can search easily on the Web. (iv) The assessment offers the series of questionnaire to form of spreadsheet.
Business information maturity model	(i) Well documented with the series of questionnaire to assist the users to perform self evaluation. (ii) However, criteria to evaluate the maturity level are not well defined.
AMR research's business intelligence/ performance management maturity model	(i) Concentrates on the performance management and balanced scorecard rather than business intelligence. (ii) Not well documented and criteria to evaluate the maturity level are not well defined. (iii) No questionnaire to evaluate the maturity levels and is very hard to analysis the model (Rejteric, 2010).
Infrastructure optimization maturity model	(i) Focuses on the measurement of the efficiency of reporting, analysis and data-warehousing and is not complete in the business intelligence area (Rejteric, 2010). (ii) Discuss about the products and technologies rather than business point of view (Rejteric, 2010). (iii) Not well documented and criteria to evaluate the maturity level are not well defined.
Ladder of business intelligence (LOBI)	(i) Apply the knowledge management field (ii) Author constructed maturity levels from a technical point of view but can considered as incomplete. (iii) Not well documented and criteria to evaluate the maturity level are not well defined.
Business intelligence development model (BIDM)	(i) Not well documented and criteria to evaluate the maturity level are not well defined. (ii) Concentrates on the technical aspects rather than business point of view

TDWI's model from the technical aspect and mostly focuses on the management perspective especially from the cultural perspective. It is well documented with the series of questionnaire to assist the users to perform self evaluation (Rajteric, 2010). There is an only assessment range 0 to 5, where 1 stands for "do not agree", 3 stands for "neutral" and 5 stands for "strongly agree" (William and William, 2007).

Gartner's Maturity Model

Gartner's maturity model concentrates of three key areas namely people, processes and metric or technology across five maturity levels: unaware, tactical, focused, strategic and pervasive. This model is used to evaluate the business maturity levels and maturity of individual departments. This model provides more non technical view

and concentrates on the business technical aspect. It is well documented and can search easily on the Web. The assessment offers the series of questionnaire to form of spreadsheet. However, criteria to evaluate the maturity level are not well defined. Categorization mainly based on the individual maturity levels but not based on the business users and IT employees (Rajteric, 2010).

Hewlett Package Business Intelligence Maturity Model

Hewlett package BI maturity model consists of three dimensions namely business enablement, information technology, strategy and program management. The business enablement dimension describes sorts of business requirements and problems that are solved with BI solutions; the information technology dimension describes information solutions a company adopts to serve differences of business needs while the strategy and program management dimension describes management skill as a key enabler and catalyst for BI success (Hewlett, 2007). Hewlett Package BI maturity model depicted the maturity levels from business technical aspect. This model is new and need to improve to add more technical aspects such as data-warehousing and analytical aspects.

Business Intelligence Maturity Hierarchy

Business intelligence maturity hierarchy proposed by Roger (2007). This model consists of four levels of business intelligence maturity: data, information, knowledge and wisdom. This model applied the knowledge management field and the author constructed maturity levels from a technical point of view but can considered as incomplete.

DISCUSSIONS AND CONCLUSION

Although the BI applications have been the primary agenda for many chief information officers, the literature review indicates little academic research on the maturity model. This paper can be valuable to researchers, practitioners and BI vendors who are studying, planning or implementing a BI maturity model. This paper has reviewed the numerous of definition of business intelligence as well as various types of business intelligence maturity models. Among the findings, most of BI maturity models do not consider all factors affecting on BI as shown in the Table 1. For example, TDWI's model only concentrates on the data warehousing while business intelligence maturity hierarchy only concentrates on knowledge management. It is not complete to represent business intelligence. We know that business intelligence covers not only data

warehousing, but also business performance, balanced scorecard, analytical components.

In addition, the documentation of some maturity models above is not well defined and they do not provide any guidelines or questionnaire to evaluate maturity levels. If the organizations want to know exact their business intelligence maturity levels as whole, they have to use multiple models and that it is time consuming. Furthermore, the results are not comparable since multiple models do not share the common maturity levels and key process area. Therefore, there is need to have integrated maturity model to combine existing different maturity model and questionnaires and evaluation criteria should be provided. It is also recommended that additional key process areas or factors such as user satisfaction, user readiness for further development, system acceptance, system quality from the content point of view, customization to specific user group, volume of customized reports and analysis should be added.

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