

Business Analytics Maturity Models: A Systematic Review of Literature

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Abstract

Organizations are increasingly using analytical tools to extract strategic information from data that have been collected over many years, in order to derive a competitive advantage in the global market. The level of use of such tools vary, and different maturity models are used to represent different analytics implementations within organizations. Maturity models have been developed for both business analytics and business intelligence separately. Objective of this study is to evaluate the maturity models developed recently. The business analytics maturity models consider both technical and business aspects. A few models have considered both theoretical and practitioner knowledge. Nevertheless, a lack of consideration for theoretical knowledge in developing maturity models was noted. Most models consisted of stages where maturity is described under each level corresponding to the factors relevant to each stage. Lot of similar factors can be seen among these models. These models act like a road map to achieve business analytics maturity within enterprises. It was also found that the maturity models were developed in a developed country setting. A need for an integrated maturity model with both technical and business aspects, incorporating the theoretical knowledge base and taking factors affecting business analytics maturity in developing countries was established.

Keywords

Business analytics, Business intelligence, Maturity models

1. Introduction

Business Analytics refers to use of computing to get insight from data. It includes Business Intelligence and also statistical analysis. Collection, storage, analysis and interpretation of data is business analytics (Davenport and Harris 2007). Organizations are using analytics in various types to make their business functions effective and optimal. These data driven companies use predictive analytics, descriptive analytics, diagnostic analytics and prescriptive analytics to solve day to day operations and run business in the long term. Analytics is primarily used in marketing related functions for understanding customer behavior and sales functions. Analytics is also used for financial related processes. Current development in technology especially with the advent of Industry 4.0 era, data and information has gained attention from stakeholders in organizations. Analytics is not a novel concept but when organizations do not get the strategic information from available data using current technology that has been invested, it would be difficult to progress to the next stage of maturity. Business analytics also includes Business Intelligence which is however somewhat familiar area to organizations. Organizations who use analytics have been relatively more successful and gained competitive advantage, compared to others who do not use analytics. Use of analytics is not a one off exercise, but is a continuous process with varying factors coming into prominence depending at the level of maturity within the organization. Both academics and practitioners have studied maturity in business analytics and developed Business Analytics maturity models. The various models have wide similarities but some have distinctive features. However, most of them provide a roadmap to achieve maturity when using Business Analytics within organizations. It specifies the main factors that have to be addressed when moving up the maturity scale and how organizations should acquire those capabilities. With the rapid development of information technology over the last three decades, business analytics has been intertwined with technology, where data and systems are involved. Some models have considered both technical and business views of Business Analytics while some have prioritized one aspect. The objective of this study was to examine available Business Analytics maturity models including Business Intelligence maturity models. This paper provides a review of some of the more widely used business analytics maturity models and indicates the need for an integrative model with which takes into account both business and technical aspects.

2. Methodology

The initial step of the analysis consisted of searching and reviewing of literature for Business Analytics and Business Intelligence maturity models. Fourteen related models or studies were found from Google Scholar, Emerald Insight, ResearchGate and IEEE Xplore Digital Library and an initial screening led to twelve of them being identified for further evaluation. Finally, a total of ten models were selected for evaluation. Although this search may not be exhaustive, it is believed that the papers selected and reviewed comprise a reasonable representative and comprehensive body of the research work being accomplished in this area. Even there are industry specific Business Intelligence maturity models developments they were not considered for this study. The literature review was conducted with the aim of identifying and revealing research gaps in the Business Analytics Maturity area. The review focused on research institutes' papers and conference papers within the period of 2007- 2018. Summary of the methodology is shown in Figure 1.

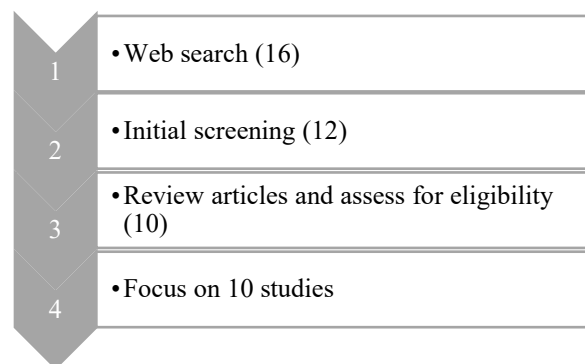


Figure 1. Selection process of the study

3. Results

Business Analytics maturity models were studied mainly under two categories as Business Analytics and Business Intelligence maturity models.

3.1 Business analytics maturity models

Business Analytics maturity model developed by Gartner group is a more organization oriented maturity model. The program management, technology and complexity of skills are associated with Business Analytics. Since all the requirements cannot be fulfilled at once, organizations need a framework to align Business Analytics through several methods. The main dimensions in the model are performance, people, processes, platform, program management, metadata and services. In order to improve organizational performance, it is imperative that enterprises measure their performances. Once organizational performance is measured, strategies should be changed or adjusted to minimize performance gaps. Then aligning analytics with these goals and objectives would be much easier. The model implies the significance of people in the organization where they act as producers, consumers and enablers of analytics. In order to increase efficiency and effectiveness in using analytics, the roles and abilities of these people must be understood and taken into account. Processes of organizations are categorized into three areas like decisions, analytics and information governance. To get mature in analytics organizations should acquire capabilities relevant to each three processes. Decision capabilities imply collaboration, decision automation and various applications of analytics within the organization while using prescriptive, diagnostic, predictive and descriptive analytical capabilities. Data governance and integration with other systems like Enterprise Resource Planning systems, Customer Relationship Management systems and Supply Chain Management Systems are highlighted as information and governance capabilities. Those systems assist enterprises to manage daily operations therefore integrity between them with analytics cannot be neglected. Except that resource allocation on analytics, collaboration, and data sharing is also important in getting mature in analytics. Chandler et al. (2011)

TDWI's analytics maturity model was developed by Halper and Stodder (2014) as an assessment tool to assess enterprises' analytics capabilities. The model is described under five main dimensions such as organization, infrastructure, data management, analytics and governance. This model is more of a benchmark tool in business analytics and acts as a road map to gain maturity in analytics. Model is defined under five stages where organizations' analytics capabilities are shown in each dimension. There is a chasm between fourth and fifth stages. Strategy, leadership, skills, policies, data access, technologies and security and privacy are few of factors considered under above five dimensions. Stages define how organizations move from one stage to next stage getting more capabilities in analytics. This model is a combination of both technical and business aspects in Business Analytics maturity.

Davenport et al. (2010) developed the analytical maturity model DELTA. The model is named as DELTA because it has five dimensions such as Data, Enterprise, Leadership, Targets and Analysts. It also describes the five stages of analytics maturity. These stages show how to initiate analytics in organizations and gradually move towards maturity getting competitive advantage in the market. Data quality, integration, resource management, leadership support and organization's strategies are noted as the main factors at the different stages. This is more of a business view of Business Analytics where technical aspect is considered a minor detail.

Cosic et al. (2012) developed the theoretical based Business Analytics capability maturity model. This is developed based on available maturity models in analytics and related functions. Model has four main capability areas and four low level capabilities under each main area. Business Analytics capability maturity in main areas leads enterprises to value and sustain competitive advantage. There is also a five level scale in maturity from non-existent to optimize. Main capability areas are governance, culture, technology and people. Under these strategic alignments, change management, leadership, agility, system integration, data management and skills and knowledge are mentioned as low level capabilities.

3.2 Business intelligence maturity models

Hewlett-Packard (2007) has developed the Business Intelligence maturity model defining success of analytics as a function of business enablement, information management and strategy and program management. In these three dimensions, advancement of analytics used in organizations for business needs, advancement in information solutions and management skills needed are described. This model contains five levels where each gains maturity in those dimensions. In these stages business enablement and strategy and program management dimensions' maturity are explained as a continuous process from running business to achieve excellence at the end through improvement and empowerment. Performance management, integration, strategic agility and shared resources are main factors in this model too. Even though Business Intelligence is more technical oriented this model can be considered as a more business oriented maturity model.

TDWI (2009) has developed a separate Business Intelligence maturity model where the Business Intelligence implementation in organizations evolves cost and value, to gain market share. It is developed in six stages in a curve, with a gulf and chasm. Dimensions in this model are type of system where the purpose of Business Intelligence is described, analytical tools where Business Intelligence techniques organization is using is described and the architecture where data and information architecture is described. This model also indicates the maturity as from moving driving the business to driving the market.

Gartner has also developed a separate Business Intelligence maturity model where maturity of Business Intelligence is expressed under three key areas people, processes, matrices and technology. This has five levels which is different from Gartner's Business Analytics maturity model. Moving from one maturity level to another requires changes in all characteristics that are, business model, management's vision and data management. According to this model achieving Business Intelligence maturity is not difficult. Wilen (2018)

Chuah and Wong (2012) developed an Enterprise Business Intelligence Maturity Models to fill the gap between academia and industry in Business Intelligence development. The integrated model developed following the Capability Maturity Model and consists of two representations; staged and continuous representation. There are five stages as initial, managed, defined, quantitatively managed and optimizing. Continuous representation consists of thirteen dimensions including: change management, organization culture, strategic management, people, performance management, information quality and knowledge management. It highlights the importance of change management, organization culture, people, skills and data quality for Business Intelligence success.

Sacu and Spruit (2010) developed the Business Intelligence Development Model developed which contains six stages: predefined reporting, data marts, enterprise-wide data warehouse, predictive analytics, operational BI, business performance management with several characteristics categories like temporal, data, decision insight and output insight.

Lukman et al. (2011) studied Business Intelligence maturity in Slovenian context considering BI in three different segmentations as technological, business and information quality viewpoints. According to the model, immature organizations should follow two paths to gain business intelligence maturity. Mainly organizations should focus on advanced analytical technologies, data integration, fast access to information and fact based decision making. Model is not exactly represented in stages but it indicates level development.

4. Analysis

Maturity models studied under both Business Analytics and Business Intelligence mostly have similarities with differences in few areas. Three main factors should be taken into consideration. First, the perspective of the model. There are two insights, previous research has considered while developing those maturity models: technical insight and business insight. Some models have focused on both aspects equally while some have prioritized one aspect. Davenport et al. (2010) model, Hewlett-Packard's model and (Chuah and Wong, 2012) model are more business oriented models while (Sacu and Spruit, 2010) is more technical oriented. However, most of maturity models have considered both aspects in maturity development since Business Analytics is consisted of both business and technical perspectives. Second, the basis of developed model. The model can be developed based on theoretical background as well as practical background. Studied maturity models have both approaches. Maturity model developed by (Sacu and Spruit, 2010) is based on theoretical knowledge while (Cosic et al., 2012) and (Chuah and Wong, 2012) are based on both theoretical and empirical knowledge. Except that models developed by Halper and Stodder (2014) by TDWI, Chandler et al. (2011) by Gartner and Hewlett-Packard (2007) are more practitioner knowledge based. Third consideration is the environment of the research conducted. The developed models constructs are based on developed countries like the United States, European countries and in Australia. However, the contexts in developing countries are very different from these countries. Developing countries may use the latest technologies similar to those in the developed countries, but may be inhibited in realizing the full potential since the factors affecting Business Analytics maturity can be different. Table 1, shows a summary of models studied.

Table 1. Summary of models

Model	Perspective		Basis		Staged model
	Business bias	Technical bias	Theoretical	Practitioner	
Chandler et al. (2011)	*			*	
Halper and Stodder (2014)	*	*		*	*
Davenport et al. (2010)	*		*		*
Cosic et al. (2012)	*	*	*	*	*
Hewlett-Packard (2007)	*			*	*
TDWI (2009)	*	*		*	*
Wilén (2018)	*	*		*	*
Chuah and Wong (2012)	*		*	*	*
Sacu and Spruit (2010)		*	*		*
Lukman et al. (2011)	*	*	*	*	*

When we consider the factors used in the above models, it can be categorized into two as business related factors and technical related factors. As business related factors people, culture, performance management, business strategy, leadership and skills were noted. Data management, integration, quality, governance and technology were the most common technical related factors. Another similarity among these models is many of them are stage developed models where stages or levels are defined with different factors. Most of these models have five stages while two models (Sacu and Spruit, 2010)'s model and TDWI (2009) have six stages. Only Gartner's Business Analytics model Chandler et al. (2011) is not stage based even though Gartner's Business Intelligence maturity model Wilen (2018) has five stages.

According to the summary above, it is noted that most models have taken a combined perspective including both business and technical aspects. Business Analytics is a combination of both of these perspectives. Therefore, focusing on both business and technical aspects are very important when assessing maturity. However, it was noted that many models lacked a theoretical base when deriving the models, even though some of the factors were similar. Therefore, consideration of practitioner knowledge is crucial to understanding the real word applications and issues. Further, these maturity models are generic and does not factor in differences in enterprise capabilities.

5. Conclusion

Business Analytics and Business Intelligence maturity models have been developed considering both theoretical and practitioner knowledge. Many models have considered both business and technical aspects of Business Analytics with different factors. Even though there are several models, there is still a deficiency of an integrated model with both technical and business aspects that is derived from a theoretical base. None of these models is capable of assessing all relevant factors to Business Analytics. Stage level models have defined the capabilities that should be acquired to gain maturity, though there is still no consensus in the method of assessing current maturity level of organizations. Importantly all those models contain factors in a developed country setting which can be different to a developing country setting. Therefore, a need for an integrated model with both technical and business aspects incorporating a theoretical base to assess Business Analytics maturity in a developing country setting, is identified.

References

- Chandler, N., Hostmann, B., Rayner, N., Herschel, G., Gartner's business analytics framework, 2011, Gartner Inc, Available: https://www.gartner.com/imagesrv/summits/docs/na/business-intelligence/gartners_business_analytics_219420.pdf, June 29, 2018.
- Chuah, M. H., and Wong, K. L., An enterprise business intelligence maturity model (EBI2M) using an integration-approach: Conceptual Framework, 2010 Available: <https://www.intechopen.com/books/business-intelligence-solution-for-business-development/construct-an-enterprise-business-intelligence-maturity-model-ebi2m-using-an-integration-approach-a-c>; July 1, 2018.
- Cosic, R., Shanks, G., Maynard, S., Towards a business analytics capability maturity model, *Australian Conference on Information Systems*, Geelong, Australia, December 2012.
- Davenport, T. H. and Harris, J. G., *Competing on analytics: the new science of winning*, Harvard Business School Press, 2007.
- Davenport, T., Harris, J., Morrison, B., *Analytics at work: smarter decisions better results*, Harvard Business School Press, 2010.
- Halper, H., and Stodder, D., TDWI analytics maturity model guide, 2014, TDWI Research, Available: https://www.microstrategy.com/getmedia/9b914607-084f-4869-ac64-e0b3f9e003de/TDWI_Analytics-Maturity-Guide_2014-2015.pdf, July 5, 2018.
- Hewlett-Packard, The HP business intelligence maturity model: describing the BI journey, 2007, Hewlett-Packard Development Company, Available: download.101com.com/pub/tdwi/Files/BI_Maturity_Model_4AA1_5467ENW.pdf, June 30, 2018.
- Lukman, T., Hackney, R., Popovic, A., Jaklic, J., Irani, Z., Business intelligence maturity: the economic transitional context within Slovenia, *Information Systems Management*, vol 28, no. 3, pp. 211-222, 2011.
- Sacu, C., and Spruit, M., BIDM: the business intelligence development model, *Proceedings of the 12th International Conference on Enterprise Information Systems*, Madeira, Portugal, June, 2010.

TDWI, TDWI's business intelligence maturity model, 2009, TDWI Research, Available: http://www.jamesserra.com/wp-content/uploads/2013/05/TDWI_BIMaturity0609_lettersize.pdf, July 5, 2018.
Wilen, J., Business Intelligence, article 6: BI maturity model by Gartner, Available: <https://www.linkedin.com/pulse/business-intelligence-article-6-bi-maturity-model-gartner-juha-wil%C3%A9n>, October 10, 2018.

Biographies

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