The Integrated Framework of Business Intelligence and Data Analytics for Organizational Performance Management in Public Sector

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***Abstract*— In the era of information and technology today has shown a rapid development in the field of data management. Data not only important for report analysis but it should be harvested analytically to obtain insight information as an important source in decision making process. Business Intelligence (BI) is a technology that enables users to manage data from multiple platforms. Despite studies had been conducted on the implementation of BI in performance management, analytical aspects are not getting adequate attention. This causes lack of impact in BI implementation in organisation performance management which involves strategy formulation and performance enhancement. The existing frameworks were built separately and this limits the implementation of Business Intelligence and Analytics (BIA) and could not meet the current performance management needs and expectations. The objective of this study is to establish a framework that integrates elements of BI, analytics and performance management to improve the implementation of BIA in management of organisational performance. This study identifies four main components of this integrated framework: Process, People, Governance and Ability. Each component consists of several key elements and sub-elements.**

***Index Terms*— Business Intelligence, Data Analytics, Organizational Performance Management, Public Sector**

I. Introduction

Business Intelligence (BI) implementation in managing organisations in public sector performance had drawn attention of academicians, researchers and government officers.

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This is due to the impact of the performance of public sector to nation and people. People are now wiser to evaluate the transparency of public sector administration in managing national resources. Therefore, managing and measuring organizational performance had been critical agenda in public sector transformation process[1]. BI has been identified as an effective technology in strategically managing performance. BI enables the users to gather, integrate, access and analyse data to assist efficient decision making in the organisations.

Performance management is a process to facilitate in managing resource and measuring outcome in the organisation [2]. It analyses organisational goals and divides it into specific benchmarks to ensure the goals are measurable. Performance management is important to determine organisational success. In public sector, organisational performance management become more challenging due to generality of public sector objectives involving different level of people. It also consists of multi-level hierarchy that cause complexity in decision making process and dissemination of information. Public sector involves tight rules and procedures in financial and decision making process [3]. Therefore, managing public sector performance is more challenging and complicated. BI implementation enables to manage and coordinate information within organisation effectively [4]. However, current BI implementation in managing performance does not help enough for the organisation to stay competitive. This is because the large volume of information is beyond the ability of decision makers to conduct analysis for best actions in decision making [5]. In addition, scattered piles of data that led to the provision of information for analysis takes longer time [5], [6].

Therefore, BI implementation should emphasise analytic aspects in order to meet current performance management needs. Analytic generally means skills in applying data analysis, especially in thinking or reasoning process. In the context of this study, analytic refers to the process of develop an understanding of action through defining problem and use of statistical models on existing data[7]. The integration of business intelligence and analytics (BIA) improves the sustainability of organisation in their business environment and stays competitive. The increasing in complexity and

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competitive in current business environment had urge managers to use analysis, trends and forecasting[8] in their business operations. Base on this situation, BIA is highly demanded to drive actionable insight for better decision making. Nowadays, BI implementation had shift to new perspective that require advance analytic adaptation. Both BI and analytic should be implement parallel to maximise the impact in organizational performance management.

Therefore, the objective of this study is to develop an integrated framework of BI, analytics and performance management in an attempt to improve BIA implementation in managing organisational performance. The Integrated Business Intelligence and Analytic for Performance Management Framework (BIAPM) is developed in four main phases. The phases are: 1) literature study and conceptual framework development; 2) empirical study; 3) framework development; and 4) framework validation. Empirical study is conducted by interviewing experts in business intelligence, analytics and performance management. This is to identify the essential and required components and elements in BIAPM framework. The components and elements identified from the empirical study are compared to the analysis from literature using inductive and deductive method in an attempt to produce an integrated framework of BIAPM.

II. Related Works

A. Business Intelligence

The concept of data collection and integration to simplify report generation was introduced since 1970-ies known as Management Information System (MIS). The foundation had been upgraded to Executive Information System (EIS) in early 1980-es. In 1990-es, the term BI was used extensively. It had improved EIS by introducing data warehouse to extract, coordinate and store data from various database platforms. Data warehouse was introduced by Bill Inmon to overcome problems regarding integration, integrity and credibility of data used in generating reports[9]. One of the goals of data warehouse is to store data from various sources into a uniform structure from the early stage of data collection.

Data warehouse application in managing organisational information has altered the landscape of decision support technology. The architecture, methodology, implementation process and data analysis using data warehouse had coined BI concept that is used nowadays. In 2000-es era, BI software started to emerge and float in the market and draw attentions among industry practitioners. Focus in BI implementation had shifted from analysing historical data into analysing real-time data. In addition, attractive visualisation feature in BI such as dashboard and scorecard able to facilitate strategic decision-makers for strategic planning to improve organisational performance [10].

In recent years, BI had been implemented in various field such as medical [11], [12], education [13], [14], retail [15], banking [16], manufacturing [17] and public sector management [18], [19]. Previous studies revealed that BI had been implemented to increase the effectiveness of strategy, action plan and operational planning; improve customer relation; as well as analyse and enhance business process and operation. This indirectly increases the collaboration between departments and improves performance throughout the organisation [20], [21]. Currently, BI technology is growing rapidly because of the demand from users in obtaining forecast information and trend. Therefore, BI implementation should be integrated with advance analytics so that it can be applied in current challenging business environment and requirements.

B. Business Analytics

Business Analytics (BA) is a domain that focuses in applied analytics to support business strategic activities [7]. It consists of human and technology involvement in the process of collecting, analysing and transforming data to support decision making [22]–[24]. [25] [25] C. Holsapple et al. reviewed BA definition and formulate it into six categories according to different perspectives that are analytic movement, application in decision making, data for information transformation process, competitive ability, decision making paradigm and specific activities in business process [25].

Generally, BA is implemented to retrieve insight of data that enable actionable and effective decision making in organisation [26]. The concept of BA implementation lead to the development of forecasting model, scenario simulation, and other quantitative and qualitative analysis methods [24], [27], [28]. It is to enhance the organisational ability in rebuilding routine process and eliminate obsolete and inefficient procedures[27]; improve competitiveness[25]; adopting more efficient behaviours [27],[29]; better decision making process [5],[25] and create strategic decisions that align with organizational objectives [25], [27].

BA implementation aims to provide high impact to organisation especially in customer and marketing analysis (marketing, sale and service), manufacturing (operational and supply chain) and human resource management [27]. BA is also well suited for organisational performance management implementation [27],[30]. However, to maximise the impact of BA implementation, organisational problems should be understood clearly to ensure appropriate selection of suitable analytical approach to be used and applied. Different analytical approach provides different data perspectives; implement to different problems and produce different information insight to guide decisions and actions [31]. Therefore, to implement BA in Organisational Performance Management (OPM), organisation must always aware of the appropriate data to be used. [32] had identified suitable and potential data that increase organisational performance which were performance observation data, progress report, audit report, assessment and consultation, scorecard performance, customer survey and economic value added metrics. Organisation that successfully applied BA has been

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acknowledged better than their competitor, easy to adapt with uncertain environment and grows effectively [5],[25].

Previous study had revealed that 70% of organisation that applied BI did not reach maturity level due to lack of analytic implementation[33]. Organisations are still unclear with the concept of BA implementation and how to adapt it effectively [25]. Main aspect to increase BA implementation is to strategically integrate it with BI. On the other hand, BI enables to integrate data efficiently and improve data management process that could simplify BA implementation. Data regarding economic factors toward business strategic could be gathered using BI and will drive effective BA practices [27].

However, the challenge to integrate BI and BA implementation is to get consolidated implementation framework. The framework should able to itemise BIA concept and clearly explain its structure and implementation limitations [31]. Formal and structured framework on integrated implementation of BI and BA currently are very limited in current literature. BIA implementation should able to answer the question of the current organisation situation, predict future condition and suggest actions to be taken [31]. Majority of the previous developed frameworks do not contain comprehensive components to be implemented in current requirements. Therefore, further study on framework of integrated BI and BA implementation is essential and needed to manage organisational performance in current demands and expectations [34].

III. The Empirical Study

The empirical study was conducted to understand issues and problems in current implementation of BIAPM and to identify the essential elements for the development of integrated business intelligence, analytics and organisation performance management framework in public sector. In this study, 18 individuals were interviewed as the respondents with various positions in their organisations. They are divided into 3 different categories of backgrounds which are business intelligence (BI), business analytics (BA) and organisation performance management (OPM). They are considered as the referral person in their organisations based on the appropriate high position and their expertise where duration of working experience in the related category are considered. Five years' minimum working experience is needed for the respondents to qualify in this study.

The results reveal 20 elements needed for development of BIAPM framework. The method used in this analysis was content analysis for qualitative data which was gathered through the interview protocol done in public sector organisations in Malaysia. The 20 elements are classified into 4 main components: Process, Governance, People and Ability. The elements are broken down into 64 sub elements which will be included in the framework. The 20 elements are: Top Management, Performance Manager, BI implementer, Data Scientist, Domain Expert, Skill, Work Culture, Technology, Strategic Planning, Requirement Analysis, Decision Maker, Performance Evaluation, BI implementation, Software, Finance, Data and Change Management, Documentation, Analytics and Visualisation.

Furthermore, in order to obtain the detail implementation of each element in BIAPM, the relationship analysis between sub elements was conducted. The analysis involved quoting the passages or interview scripts collected and recorded during the interview sessions. The detail analysis is reported in separate document [35].

IV. The BIAPM Framework

The development of BIAPM framework is based on findings of theoretical and empirical study discussed in previous sections. The findings revealed that four main components and 20 elements are required in BIAPM integrated development. Fig. 1 shows the proposed BIAPM framework with the four main components: Process, Governance, People and Ability and their relationships between components and elements. The following sub sections discuss the components and the framework in more detail.

A. Process

Process component refers to series of activities regarding preparing and executing BI, analytics and performance management activities to improve organizational performance. It consists of eight elements which are classified into three groups. The first group represents the process of requirement analysis, BI implementation and data management. The process continues and links to BIA integration process group that consist analytics and visualization elements. Finally, the process continues and links to BIA application group. This group represents elements that use BIA integration information to support organisational performance management activities such as decision making, strategic planning and performance evaluation. Previous research revealed that overall process should be in closed-loop orientation which had been identified as a good practice in managing organizational performance [6]. The closed-loop process encourages innovation and enhancement in the implementation and thus improves organizational performance.

B. Governance

Governance component consists of elements which are needed in managing BIAPM implementation efficiently. The elements are divided into two groups: supporting management and technology. Among important elements to support BIAPM implementation and management are documentation, finance and change management. Meanwhile technology refers to software and hardware required to perform BIAPM. Based on the mapping analysis, this study found out relationships between process and governance components. Most processes will produce documentations meanwhile finance and change management are required to support BIAPM process as well.

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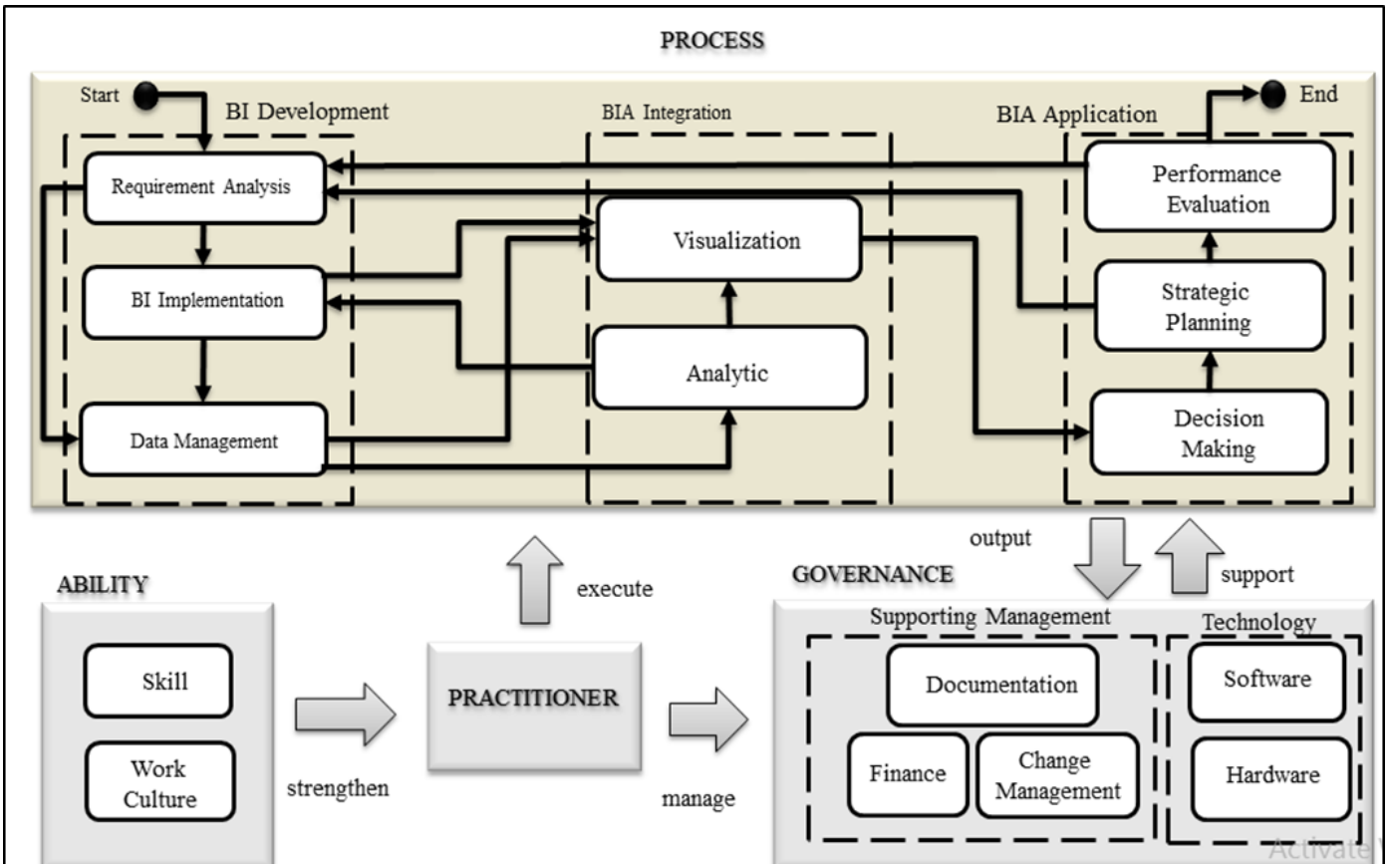

Fig.1. BIAPM Framework

The analysis also shows that requirement analysis, BI implementation, data management and analytic process produce documentation that will be referred by internal and external parties involve in BIAPM implementation. Meanwhile, strategic planning and performance evaluation process produce change request and will be handled by the change management element in supporting management element. Therefore, BIA requirements should adapt with frequent requirement change so that it can evolve with organizational performance. In other point of view, BIAPM process requires technology and financial support constantly. Elements such as BI implementation, data management, analytics and visualization too require suitable software and hardware support. Complex procedure in software and hardware acquisition in public sector requires proper financial management in order to ensure BIAPM implementation executes effectively.

C. People

People component refers of people that manage, use and support BIAPM implementation. It consists of top management, performance managers, BI practitioner, data scientist and subject matter expert that directly involve with BIAPM implementation. This people plays important roles in BIAPM process. They also have to manage elements in governance component such as documentation, financial change management, software and hardware. Findings of this research reveal that BI practitioner involves in BI implementation and data management process. Meanwhile analytics involve data scientist and subject matter expert. Furthermore, visualisation elements require involvement of BI practitioner and data scientist while decision making, strategic planning and performance evaluation include top management and performance managers.

Next, the research findings through empirical study and analysis discover the existence of a relationship between practitioner and governance components. It shows that the act of control and manage require skills and abilities. BI practitioner manages all five elements in governance component. In addition, data scientist manages documentation related to data analysis.

D. Ability

The forth component is ability that contains elements that support practitioner in BIAPM implementation. There are two key elements which are identified as skill and work culture. By definition, skill or know-how is the efficiency in implementing something. Apart from skills, a positive work culture in the organisation environment also plays an important role to enhance the ability of all parties involved in

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the implementation of BIAPM. It covers how to act, behaviour and way of thinking in carrying out duties and tasks. Among the positive work culture that needs to be highlighted and embedded are cooperation, high motivation, ability to adapt to changes, and positive thinking. This study has identified the relationship of these elements in strengthening the capacity of BIAPM implementation. Both elements of skills and work culture play an important role in providing the capability and authority to Top Management, Performance Management, BI Implementer, Data Scientist and Subject Matter Expert in BIAPM implementation as a whole.

V. Conclusions

This paper has highlighted the issues of integration between Business Intelligence and Analytic in managing organizational performance for public sector. Nowadays, the BI implementation is unable to resolve challenges in managing public sector performance. To overcome this problem, this research proposes the integration of BI and BA for improving performance management in the organisation. Earlier stage of this research has conducted the empirical study to identify components and elements for integrated BI and analytics implementation. Mapping analysis approach had been performed to classified elements into components and identifies relationships between them. The proposed BIAPM framework consists of four main components which are process, people, governance and ability as describe in this paper. The framework is validated through case study and expert verification.

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