Success Factors of Business Intelligence and Performance Dashboards to Improve Performance in Higher Education

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Abstract: The need for more effective communication becomes more important as the size of an organisation increases. This underlines the importance of using tools like Business Intelligence (BI) and dashboards to monitor and improve their output, as well as to improve accuracy and efficiency of the data that is available. However, there is a lack of understanding of applying analytics and strategic insight into analytics in Higher Education (HE), compared to other sectors such as business, government, and healthcare. In addition, the use of BI and dashboards in HE has been studied by a small number of papers, which is particularly limited in investigating the factors to ensure successful application within this context or understanding the metrics that determine this success. This highlights the importance of understanding successful adoption of such technologies to improve performance and decision-making processes, particularly within HE institutions. In this paper, we concentrate on investigating successful adoption of business intelligence and department-related level of tactical dashboards to support performance measurement and decision-making processes in HE. As the research area is complex and multidimensional, the triangulation method has been applied to support a rich set of data and a mixture of a qualitative approach to gather insights into potential factors, and a quantitative approach to confirm these factors. By adapting the concept of Balanced scorecard to measure the success factors, we conjecture that it would enhance successful adoption within this sector.

1 INTRODUCTION

The need for more effective communication becomes more important as the size of an organisation increases. This underlines the importance of using tools like dashboards to monitor and improve their output, as well as to improve accuracy and efficiency of the data that is available (Koopman et al., 2011). Since 1970, performance measurement has been supported with the development of technology replacing paper-based reports (Vallurupalli and Bose, 2018). Consequently, Decision Support Systems (DSS) emerged to enhance information access and recognition of patterns and trends (Vallurupalli and Bose, 2018). Following this, Executive Information Systems (EIS) appeared to support top-level managers and remained widespread until 1990 when BI systems featured as an umbrella term in response to the vast growth of data to improve integration, access and analysis to support performance measurement and decision making (Teixeira and Misaghi, 2013). The term BI emerged at the early of 1990s to be considered as an umbrella of various decision support applications. BI can be defined as "a broad category of technologies, applications, and processes for gathering, storing, accessing, and analysing data to help its users make better decisions" (Wixom and Watson, 2010). However, the BI definition is believed to be identical to that of Business analytics (BA), as "the extensive use of data, statistical and quantitative analysis, explanatory and predictive models, and fact-based management to drive decisions and actions" (Arnott and Pervan, 2016).

1.1 BI and Analytics in HE

It is crucial to establish a common language of analytics in Higher Education (HE) based on what we mean by analytics, what type of analytics we need,

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and what technologies are involved, as Van Barneveld et al. (2012) argue. There are different types of analytics in HE such as academic analytics, learning analytics, predictive analytics, and action analytics. However, there is a lack of understanding of applying analytics and strategic insight into analytics in HE, compared to other sectors such as business, government, and healthcare (Siemens et al., 2013).

Business Intelligence and Dashboards target three different levels: strategic, tactical and operational. Operational dashboards concentrate on tracking and monitoring the operational process, while tactical dashboards focus on analysis and departmental process more than monitoring; and strategic dashboards converge and monitor the fulfilment of strategic objectives as summarized in table 1 (Eckerson, 2010).

Table 1: Three different types of dashboards (Eckerson, 2010).

	Operational	Tactical	Strategic
Purpose	Operations/ monitoring	Measuring progress	Strategy execution
Users	Supervisors/ specialists	Managers, analysts	Executives/ managers staff
Scope	Operational	Departmental	enterprise
Information	Detailed	Detailed/ summary	Detailed/ summary
Updates	Intra-day	Daily/ weekly	Monthly/ quarterly
Emphasis	Monitoring	analysis	management

However, one of the main limitations of BI and dashboards that there is no explicit link to a corporate strategy (Taylor and Baines, 2012). There is a misalignment between measures and targets which might cause failure (Rahman et al., 2017). Further, several organizations misunderstand how or whether measures used for the decision-making process are associated with their goals (Trinkenreich et al., 2017). Consequently, these measures might not be beneficial if they are not being trusted by users (Schwendimann et al., 2017).

1.1 Goal and Content of This Paper

Higher education should advance their approaches of thinking, doing, evaluating, and demonstrating impact (Siemens et al., 2013). Universities face high levels of pressure from different factors such as raised competition, government constraints, increased number of students, and increasing demand for accountability (Taylor and Baines, 2012; Guitart and Conesa, 2015). Consequently, HE should develop appropriate techniques to overcome such pressure by adopting supporting technologies and strategies such as BI and dashboards. As BI and dashboards are recognised technologies within business sectors, demand exists to investigate the efficiency of these technologies in HE and investigate ways to utilise such tools. However, applying tools which are widely utilized within profit sector could be different, complex and unique at universities because they have different missions and visions compared to business (Guitart and Conesa, 2015).

The aim of this paper is to obtain a better understanding of effective usage of BI and performance dashboards within the Higher Education sector (HE), as well as to improve the quality of decisions and actions to enhance performance. This aim will be met through the following objectives: discovering the factors for ensuring adoption of BI and dashboards is successful, aligning these factors to be presented based on the framework of the common approach of the balanced scorecard (BSC), and confirming the proposed framework. BSC connects the different levels of the organisations to the corporate strategy based on four different perspectives: internal process, financial, customer and learning and growth (Kaplan and Norton, 1992; Martinsons, Davison and Tse, 1999).

2 SUCCESS FACTORS

Martinsons, Davison and Tse (1999) developed BSC to measure and evaluate information systems (IS) activities based on four perspectives named business value, user orientation, internal process and future readiness and generated specific measures for each dimension. They argue that the new generations of IT and IS applications cannot be measured based on only financial indices because they tend to provide wider range of services. This conceptual framework is approved by Delone and Mclean to enhance measures of IS activities (Delone and Mclean, 2003). They highlighted in their highly cited papers that input or independent variables are widely addressed while output or dependent variables need to be defined appropriately (Delone and Mclean, 2003; DeLone and McLean, 1992).

DeLone and McLean (1992) conducted a cumulative study to summarize the factors and measures that affect Information Systems' success between 1981 and 1987. They highlighted that input or independent variables are widely addressed while output or dependent variables need to be defined

appropriately. Bourne et al. (2000) highlight the importance of Performance Measurement System (PMS) implementation and suggest three main phases: the design of the performance measures, the implementation of the performance measures, and the use of the performance measures. Kennerley and Neely (2002) indicated that measures should be dynamic, not static, to stay relevant to any potential changes. Bourne et al. (2002) identified two main drivers of successful implementation: top management support and perceived benefits. Further, the commitment of the operative level and the tool being appropriate for the organisation's requirements are identified as key factors that affect successful implementation of measurement systems (Jääskeläinen and Sillanpää, 2013). De Waal (2003) stated that the use stage is the most important stage to ensure success of PMS and how it can be affected by the behavioural factors.

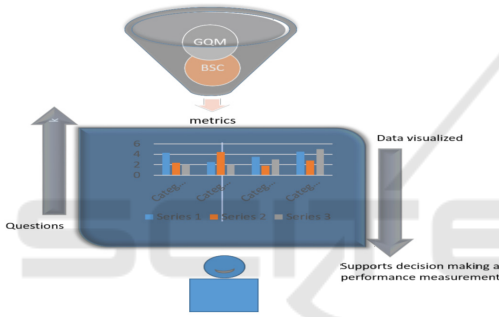

Figure 1: Adapting BSC to generate success factors of BI and dashboards (Abduldaem, Gravell, 2019).

BSC can facilitate the data analysis process by designing an appropriate framework of metrics to enhance input and displayed data, enabling a quality of output that is aligned with the strategy of the organisation as illustrated in figure 1 (Abduldaem, Gravell, 2019). This alignment would be improved by combining both measurement approaches BSC and Goal Question Metric (GQM) to generate the appropriate measures as stated by Becker and Boostlman (1999). However, we would like to emphasize that we are mainly concentrating on investigating the factors of successful adoption of BI and dashboards in HE by adopting BSC as the main framework. Integrating the approach of GQM to generate the appropriate measures will be considered later as future work.

2.1 The Research Questions

RQ1: How the balanced scorecard (BSC) approach could be adapted to measure successful adoption of Business Intelligence and Dashboards (DB) to support performance measurement and decision making in higher education?

- 1.1 What are the financially related factors to ensure successful adoption of BI and dashboards to support performance measurement in HE?
- 1.2 What are the customer related factors to ensure successful adoption of BI and dashboards to support performance measurement in HE?
- 1.3 What are the factors related to learning and growth perspective to ensure successful adoption of BI and dashboards to support performance measurement in HE?
- 1.4 What are the factors related to internal process perspective to ensure successful adoption of BI and dashboards to support performance measurement in HE?

3 METHODOLOGY

Mixed methods research adopts methodologies that include collecting, analysing, and interpreting qualitative and quantitative data in a single study, either simultaneously or sequentially (Leech and Onwuegbuzie, 2009). One example of this is the triangulation approach which is applied in this study to collect data from various resources. The researcher started by looking at the literature review and analysing the previously published factors of different studies and various contexts to generate the first copy of the proposed framework. This followed by examining the proposed factors using semi-structured interviews with 12 experts who are assortment of decision makers, consultants, and planning and strategy members within the sector of higher education to produce the second copy of the proposed framework. Finally, the questionnaire is applied to confirm the previously acknowledged results as it can be seen figure 2.

3.1 Interviews

In order to discover and validate the factors of the proposed framework related to successful adoption of BI and dashboards to advocate performance measurement within HE organisations, this study conducted semi-structured interviews with 12 experts. The target experts are classified into three categories: decision makers, strategy and planning members, and consultants. Strategy and planning members indicate individuals who work with strategies related to organisational performance measurement; and consultants refers to individuals

who have been part of the consultation process with the HE sector. As the study looked to improve the understanding of, and advocating for, organisational performance measurement in the HE sector, the researcher decided to drill down from university-wide level into faculty-based level because accessibility to decision makers should be more possible. Therefore, decision makers were one of the following: head of school, dean, or vice-dean of a faculty.

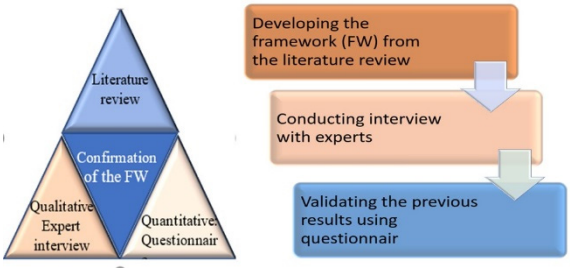

Figure 2: Triangulation to validate the proposed FW.

3.1.1 Interview Design

The interview design involved using a semi-structured approach, including open- and closed-ended questions. Open-ended questions are designed to investigate the factors presented in the proposed framework, whether factors belong to the appropriate perspective, and if other factors should be included. Closed-ended questions were designed using a Likert 5-point scale was applied with a response scale from 1 to 5, where 1 equal strongly disagree, then disagree, neutral, agree, and strongly agree, respectively. Before conducting interviews, ethical approval was applied and approved. In qualitative studies, sampling techniques are non-random, non-probability such as convenience, and expert sampling which is applied in this phase (Bhattacherjee, 2012).

In the beginning, the communication with experts occurred using either email or messages using 'WhatsApp' to invite them to participate. When the invitation is accepted, they receive the following documents: the consent form, the proposed framework, and information about the study. Further, the suitable time, date and the communication method to conduct the interview are determined.

Most of the interviews were conducted via phone and a few were conducted face-to-face. Only two of the interviews were accomplished via email and messages. They received the interview questions, list of definitions and wrote down their answers. This was because of their time limitation. They were informed at the beginning that the interview was expected to last for an hour.

3.2 Questionnaire

The questionnaire is designed and published to accomplish the three main phases of the triangulation methodology that is applied during this stage of the study and conducted to confirm the previously acknowledged results.

3.2.1 Questionnaire Design

The questionnaire includes two main sections. The first section contains 35 close-ended questions with answers structured based on Likert scale of the following options: absolutely essential, very important, of average importance, of little importance, not important at all. The second section consists of open-ended questions to gain an insight of participants' opinions and suggestions.

The questionnaire was designed and generated using iSurvey tool and distributed by contacting participants throughout their email address which is stated in their profile or organisation's web site based on their role. The emails comprised the participant information sheet, a brief description of the study, and a link to access the survey. A reminder was sent to participants every two or three weeks to remind them in case they did not complete the survey.

The chosen method of sampling is convenience sampling technique, and the main aimed participants are individuals who their major responsibilities include strategic or operational decisions, beside people who are taking part in developing or designing business intelligence systems or dashboards. However, achieving the required response level was challenging as there was around a thousand attempts over more than three months and only 37 participants at the end completed the survey as it can be seen in figure 3.

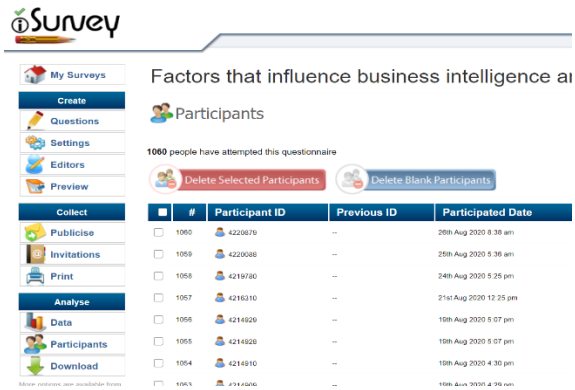

Figure 3: Number of attempts to the questionnaire.

I sought to find out a justification to overcome this obstacle. One suggested reason was the desired time to submit the questionnaire was too long. However, this is unlikely to be the situation as the majority accomplished the survey within 10 minutes. Another reason could be that participants might decide they are not suitably qualified to fill in the survey and it seemed likely to be the reason. This could be because that the concept of using business intelligence and dashboards is not clear enough within the sector of higher education. Since I found the appropriate people by contacting two of non-profit organisations that support institutions of higher education and research with various aspects including business intelligence, I received more responses and reached the required number of participants.

4 RESULTS AND DISCUSSION

In this section, the results of the interviews and surveys experts are presented. As mentioned in the methodology section, the qualitative data are generated from semi-structured interviews with 12 experts from different organisations. The main purposes of the interviews were to examine and identify the factors of successful adoption of BI and dashboards to support performance measurement in HE.

4.1 Results and Discussion of Interviews

Each perspective included in the framework will now be reviewed and the findings related to the factors of these perspectives discussed, to specify which parts of the framework are confirmed, what modifications and identifications of factors have been proposed, and what parts of these modifications and identifications are approved by the researcher. Further, whether these factors belong to the specified perspectives, and what experts think about the proposed framework will be outlined. In addition, some potential relationships among different factors will be presented and the updated framework will be illustrated.

Within the following paragraphs the researcher presents the confirmed factors and discusses some of the main points related to these factors.

Regarding vision and strategy, all experts except one have confirmed all the factors. It is confirmed that it is essential to have clear vision and strategy within HE organisations. This emphasizes the importance of defining and understanding the concepts behind both expressions ‘vision’ and ‘strategy’. This is assisted by Expert-06 who had an attempt to define vision as ‘your dreams’. However, this definition could be ambiguous, as Expert-12 believes that this is the most difficult thing to be put into meaningful and measurable words of statement rather than being dreams. Dreams are more related to fancy, rather than being applicable. This is because the HE sector is not used to adopting strategic approaches to deal with different aspects, as profit organisations do. Accordingly, goals and objectives should be declared. Interestingly, goals are described by Expert-06 as ‘the purpose’ that will be accomplished by defining the objectives, while Expert-04 defined goals as groups of KPIs presented using dashboards that illustrate if these goals are reached or not. This underlines the significance of this factor, bearing in mind being doable, as Expert-12 stated. Within this perspective, all experts agreed that the presented factors belong appropriately to it.

Here to the internal process perspective, there is general agreement of the factors. However, there are some suggested modifications.

Clearly, management support is approved as a crucial factor to adopt BI successfully. This support commences by having top management that believes in data-driven performance measurement and decision making, otherwise adoption would be challenging and fail. This is because of the importance of their role in increasing awareness among employees and following up with them. Further, empowering them with the appropriate environment, requirements and solving the raised problems.

In addition to this factor, management process is important to ensure clear and well-defined policies. clear, detailed and well-defined policies are vital, and policies should be checked frequently. Project management is another factor that could play a major role to gain successful adoption. However, there is a lack in understanding and applying this concept within HE sectors. It is suggested that specialized people in project management, including risk management, proper planning and scoping of projects, feasibility studies and so on, should be available.

Additionally, effective governance is important to boost the understanding of various management positions and the required tasks. It encourages smooth and flexible execution of projects. the importance of system quality inclusive of ease of access, capability and accessibility were confirmed. Moreover, proper infrastructure and data quality are approved as essential factors.

In the learning and growth perspective, the majority of experts confirmed the presented factors, even though some amendments are proposed. Obviously, training can save and maintain resources

such as time, money and human: which was presented clearly in the example provided by Expert-2. This is supported by another example from Expert-08 about receiving training over four different stages to use the system. In addition, training would increase efficiency: firstly, by overcoming the lack of skills to assist accomplishment of tasks; secondly, to have a better understanding and support of strategy by all members in all levels. This emphasises that training should be provided to members at various levels. Interestingly, training is seen as a form of involvement, being part of the process, or understanding decisions made, which reduces resistance, as pointed out by Expert-08 and Expert-09. It is crucial to evaluate the services by collecting and receiving feedback. This includes understanding commitment and usage of the system and services provided, that would improve decisions, measures and gain new ideas. However, it is stated that feedback is not applied sufficiently and there is no clear mechanism towards collecting, receiving or dealing with feedback.

Interestingly, expert opinions on external support varied according to their role. Decision makers believe that, as HE sectors have competencies, consultation is supposed to be internal rather than external. For example, Expert-03 does not believe in external consultation because it is expensive, prestigious and useless and can be replaced with internal consultation "consultants are more prestigious than demanded" and explained "when we bring a consultant and have a meeting, at the end of the meeting we find that what we got is nothing extra than what we already know". He believes that "They say or do things that we can do without their consultation, it is more expensive than being supportive". In other examples, Expert-06 and Expert-12 think that it depends on the organisation itself. So, if the appropriate consultation could not be obtained internally, they use an external consultant. Similarly, planning and strategy members have similar opinions to decision makers: as Expert-07 says "If the organisation depends on external support, I do not think you should be there".

However, Expert-08 pointed out that external support could help to overcome the ambiguity **"**There is lots of ambiguity about quality. So, we ask the quality department to provide us with people to support us to have better understanding. So, I think external support is important". Further, external consultation can identify problems that are not noticed internally and avoid politics and cultural boundaries "when I provide a consultation for another organisation, I can avoid courtesy and such social restrictions and be critical comfortably. Sometimes I become part of internal consultation but, in this case, politics play a role regarding my consultation. For example, I do not want to make the chairman of the committee unsatisfied and so on. Especially as you know our culture is based on social aspects" stated Expert-09**.** He tried to highlight why consultation might fail because consultants do not understand their roles "Consultants sometimes do not understand their role are they part of making decisions or not? Are they facilitators to the decisions? Do they have the chance to approve or disapprove some decisions?

Moving to the customer perspective, User and stakeholder involvement should improve the belief in a project and support usage. Further, this involvement would enhance information accuracy, services and increase motivation. Involvement should be over all processes and includes various people such as instructors, students and stakeholders. Additionally, satisfaction plays a major role to encourage usage of the system and indicates usefulness and performance of the system. However, satisfaction could be affected by expectations, as per the question raised by Expert-09 "what the limit of the satisfaction should be? Should satisfaction be within a specific range: either partly or fully satisfied for example" and a comment added by Expert-07 "I need to know user's expectations to grow and then reach satisfaction". Understanding and managing expectations should consolidate satisfaction. This would clarify the misunderstanding in the statement of Expert-12 "I do not pay that much attention to their expectations as long as they feel the system is not complicated and easy to use. The latter is more important for me. I do not care about their satisfaction about the system".

4.2 Results and Discussion of the Survey

Based on the frequency tables, more than half of the participants believed that the following factors: Management Process, Governance, Proper Infrastructure, System Quality, Data Quality and Data Governance, Change Management, Management Support, Internal Consultation, Information and Output Quality Monitoring, Net Benefits, Feedback, Training, User Involvement, Stakeholder Involvement, Stakeholder Satisfaction, User Satisfaction, User Expectations, Stakeholder Expectations, Budgetary Resources, Financial Sustainability, Proper Scoping, Return of Investment, Clear Vision, Define Objectives and Goals are absolutely essential or very important as it can be seen in table 2. It summarizes the frequency of the factors

Table 2: Frequency table of the factors.

Factors	Frequency						Percent						Valid Percent						Cumulative Percent
	5	4	3	2	1	T	5	4	3	2	1	T	5	4	3	2	1	T	
Management Process (1)	14, 13, 10, 0, 0, T = 37						37.8, 35.1, 27.0, 0, 0, T = 100.0						37.8, 35.1, 27.0, 0, 0, T = 100.0						37.8, 73, 100.0
Management Process (2)	10, 19, 6, 1, 1, T = 37						27.0, 51.4, 16.2, 2.7, 2.7, T = 100.0						27.0, 51.4, 16.2, 2.7, 2.7, T = 100.0						27.0, 78.4, 94.6, 97.3, 100.0
Project management office	2, 5, 15, 11, 4, T = 37						5.4, 13.5, 40.5, 29.7, 10.8, T= 100.0						5.4, 13.5, 40.5, 29.7, 10.8, T= 100.0						5.4, 18.9, 59.5, 89.2, 100.0
Governance (1)	14, 20, 3, 0, 0, T = 37						37.8, 54.1, 8.1, 0, 0, T = 100.0						37.8, 54.1, 8.1, 0, 0, T = 100.0						37.8, 91.9, 100.0
Governance (2)	8, 19, 9, 1, 0, T = 37						21.6, 51.4, 24.3, 2.7, 0, T= 100.0						21.6, 51.4, 24.3, 2.7, 0, T= 100.0						21.6, 73.0, 97.3, 100.0
Proper infrastructure	18, 18, 1, 0, 0, T = 37						48.6, 48.6, 2.7, 0, 0, T =100.0						48.6, 48.6, 2.7, 0, 0, T =100.0						48.6, 97.3, 100.0
System quality	16, 18, 3, 0, 0, T = 37						43.2, 48.6, 8.1, 0, 0, T= 100.0						43.2, 48.6, 8.1, 0, 0, T= 100.0						43.2, 91.9, 100.0
Data quality & data governance	19, 17, 1, 0, 0, T = 37						51.4, 45.9, 2.7, 0, 0, T = 100.0						51.4, 45.9, 2.7, 0, 0, T = 100.0						51.4, 97.3, 100.0
Automation	1, 17, 14, 5, 0, T= 37						2.7, 45.9, 37.8, 13.5, 0, T= 100.0						2.7, 45.9, 37.8, 13.5, 0, T= 100.0						2.7, 48.6, 86.5, 100.0
Change management	4, 18, 14, 1, 0, T = 37						10.8, 48.6, 37.8, 2.7, 0, 100.0						10.8, 48.6, 37.8, 2.7, 0, 100.0						10.8, 59.5, 97.3, 100.0
Management support	13, 21, 3, 0, 0, T = 37						35.1, 56.8, 8.1, 0, 0, T = 100.0						35.1, 56.8, 8.1, 0, 0, T = 100.0						35.1, 91.9, 100.0
External consultation	0, 2, 20, 15, 0, T= 37						0, 5.4, 54.1, 40.5, 0, T = 100.0						0, 5.4, 54.1, 40.5, 0, T = 100.0						5.4, 59.5, 100.0
Internal consultation	10, 17, 10, 0, 0, T = 37						27.0, 45.9, 27.0, 0, 0, 100.0						27.0, 45.9, 27.0, 0, 0, 100.0						27.0, 73.0, 100.0
Networking	1, 13, 19, 4, 0, T =37						2.7, 35.1, 51.4, 10.8, 0, T =100.0						2.7, 35.1, 51.4, 10.8, 0, T =100.0						2.7, 37.8, 89.2, 100.0
Information & output quality	13, 20, 4, 0, 0, T = 37						35.1, 54.1, 10.8, 0, 0, T = 100.0						35.1, 54.1, 10.8, 0, 0, T = 100.0						35.1, 89.2, 100.0
Monitoring	12, 14, 11, 0, 0, T= 37						32.4, 37.8, 29.7, 0, 0, T = 100.0						32.4, 37.8, 29.7, 0, 0, T = 100.0						32.4, 70.3, 100.0
Net benefits (1)	5, 17, 13, 2, 0, T = 37						13.5, 45.9, 35.1, 5.4, 0, T = 100.0						13.5, 45.9, 35.1, 5.4, 0, T = 100.0						13.5, 59.5, 94.6, 100.0
Net benefits (2)	7, 19, 10, 1, 0, T = 37						18.9, 51.4, 27.0, 2.7, 0, T = 100.0						18.9, 51.4, 27.0, 2.7, 0, T = 100.0						18.9, 70.3, 97.3, 100.0
Feedback	8, 19, 10, 0, 0, T = 37						21.6, 51.4, 27.0, 0, 0, T = 100.0						21.6, 51.4, 27.0, 0, 0, T = 100.0						21.6, 73.0, 100.0
Training	13, 20, 2, 2, 0, T = 37						35.1, 54.1, 5.4, 5.4, 0, T=100.0						35.1, 54.1, 5.4, 5.4, 0, T=100.0						35.1, 89.2, 94.6, 100.0
User involvement	7,18, 9, 3, 0, T = 37						18.9, 48.6, 24.3, 8.1, 0, T= 100.0						18.9, 48.6, 24.3, 8.1, 0, T= 100.0						18.9, 67.6, 91.9, 100.0
Stakeholder involvement	7, 25, 4, 1, 0, T = 37						18.9, 67.6, 10.8, 2.7, 0, T = 100.0						18.9, 67.6, 10.8, 2.7, 0, T = 100.0						18.9, 86.5, 97.3, 100.0
User satisfaction	10, 23, 3, 1, 0, T = 37						27.0, 62.2, 8.1, 2.7, 0, T = 100.0						27.0, 62.2, 8.1, 2.7, 0, T = 100.0						27.0, 89.2, 97.3, 100.0
Stakeholder satisfaction	7, 27, 3, 0, 0, T = 37						18.9, 73.0, 8.1, 0, 0, T = 100						18.9, 73.0, 8.1, 0, 0, T = 100						18.9, 91.9, 100.0
User expectations	10, 22, 5, 0, 0, T = 37						27.0, 59.5, 13.5, 0, 0, T = 100.0						27.0, 59.5, 13.5, 0, 0, T = 100.0						27.0, 86.5, 100.0
Stakeholder expectations	11, 18, 8, 0, 0, T = 37						29.7, 48.6, 21.6, 0, 0, T= 100.0						29.7, 48.6, 21.6, 0, 0, T= 100.0						29.0, 78.4, 100.0

Table 2: Frequency table of the factors (cont.).

Factors	Frequency						Percent						Valid Percent						Cumulative Percent
	5	4	3	2	1	T	5	4	3	2	1	T	5	4	3	2	1	T	
Experience	6, 9, 16, 4, 2, T = 37						16.2, 24.3, 43.2, 10.8, 5.4, T =100						16.2, 24.3, 43.2, 10.8, 5.4, T =100						16.2, 40.5, 83.8, 94.6, 100.0
Technology experience	2, 4, 15, 15, 1, T = 37						5.4, 10.8, 40.5, 40.5, 2.7, T=100						5.4, 10.8, 40.5, 40.5, 2.7, T=100						5.4, 16.2, 56.8, 97.3, 100.0
Budgetary resources	19, 16, 2, 0, 0, T = 37						51.4, 43.2, 5.4, 0, 0, T = 100						51.4, 43.2, 5.4, 0, 0, T = 100						51.4, 94.6, 100.0
Financial sustainability	14, 19, 3, 1, 0, T = 37						37.8, 51.4, 8.1, 2.7, 0, 100.0						37.8, 51.4, 8.1, 2.7, 0, 100.0						37.8, 89.2, 97.3, 100.0
Budgetary resources	19, 16, 2, 0, 0, T = 37						51.4, 43.2, 5.4, 0, 0, T = 100						51.4, 43.2, 5.4, 0, 0, T = 100						51.4, 94.6, 100.0
Financial sustainability	14, 19, 3, 1, 0, T = 37						37.8, 51.4, 8.1, 2.7, 0, 100.0						37.8, 51.4, 8.1, 2.7, 0, 100.0						37.8, 89.2, 97.3, 100.0
Proper scoping	12, 14, 10, 1, 0, T = 37						32.4, 37.8, 27.0, 2.7, 0, T = 100.0						32.4, 37.8, 27.0, 2.7, 0, T = 100.0						32.4, 70.3, 97.3, 100.0
Return on investment	10, 17, 8, 2, 0, T= 37						27.0, 45.9, 21.6, 5.4, 0, T = 100.0						27.0, 45.9, 21.6, 5.4, 0, T = 100.0						27.0, 73.0, 94.6, 100.0
Clear vision	15, 14, 5, 3, 0, T = 37						40.5, 37.8, 13.5, 8.1, 0, T = 100.0						40.5, 37.8, 13.5, 8.1, 0, T = 100.0						40.5, 78.4, 91.9, 100.0
Define objectives & goals	14, 15, 7, 1, 0, T = 37						37.8, 40.5, 18.9, 2.7, 0, T = 37						37.8, 40.5, 18.9, 2.7, 0, T = 37						37.8, 78.4, 97.3, 100.0
Define mission & values	6, 13, 11, 6, 1, T = 37						16.2, 35.1, 29.7, 16.2, 2.7, T=100						16.2, 35.1, 29.7, 16.2, 2.7, T=100						16.2, 51.4, 81.1, 97.3, 100

based on the previously stated options of the survey Each number in the table 2 of the fields Frequency, Percent, Valid percent represent the number of participants who decided one of the following: absolutely essential, very important, of average importance, of little importance, not Important at all respectively. T represents total.

The questionnaire is analysed using SPSS software and one tailed t test is adopted to examine the significance of the proposed factors. The One Sample T-test is used to analyse the results of the quantitative data to compare the mean μ of the population with a hypothesized value μ0 = 3. the hypotheses for testing each factor are as following:

• H0: If the mean rating of the proposed factor $\mu < 3$, the factor is not significant.

• H1: If the mean rating of the proposed factor $\mu >= 3$, the factor is significant. The Bonferroni correction is used to test the significant of the questionnaires' statements.

Applying the Bonferroni correction means any observed p-value less than the corrected p-value $\alpha/n = 0.05/35 = 0.001$ is declared to be statistically significant. Using SPSS we got table 3 by selecting analysis using One-Sample T-test, setting the test

value to 3, and confidence interval percentage of 90% because we want to apply one tailed test to put the entire 5% of our $\alpha = 0.05$ into each tail of the test.

Almost all the factors are statistically significant and should be included in the proposed framework. The average rating of the factors is equal or higher than the average hypothesized rate which is 3. The t value of the factors exceeds the critical value CV (36) = 1.688 and the P value < 0.001, further, the confidence interval does not across 0.

However, the mean of the following factors: project management office, external consultation, and technology experience is 2.73, 2.65, 2.76 frequently which is less than the hypothesized value, so accept the H_0 and these factors are not statistically significant. Further, the P value $\alpha = 0.057$, 0.001, 0.053 frequently which is not less than the corrected P value 0.001.

Finally, the results of the following factors: automation, networking, define mission and values, and experience illustrate that the means of all these factors are greater than 3.0 but P value > 0.001 as it can be seen in table 3. These factors are included in the framework after analysing the results of the qualitative part of the previously conducted stage within the triangulation methodology. As the sample of the quantitative part (37) larger than the sample of the qualitative part (12), the researcher decided to remove these factors from the framework.

Table 3: T-test results.

Factors	Statements	Mean	P-value
Management process	How important is it that policies for system's implementation are clear and well-defined?	4.11	<0.001
	How important is it to check processes of the system frequently? (e.g. processes of collecting data)	3.97	<0.001
Project Management Office	How important is it to have project management office (PMO) to launch and control the system?	2.73	0.057
Governance	How important is it to have sufficient communication between different levels of the organisation?	4.30	<0.001
	How important is it that management roles are clearly defined and well understood?	3.92	<0.001
Proper infrastructure	How important is it to have an appropriate infrastructure (Hardware, Software, tools)?	4.46	<0.001
System quality	How important is it that the system is user friendly and has good accessibility?	4.35	<0.001
Data quality & data governance	How important is it to have clearly defined and valid data for the system?	4.49	<0.001
Automation	How important is it to reduce the need for humans to enter data?	3.38	0.002
Change management	How important is it to deal with people who might resist the system and refuse to use it?	3.68	<0.001
Management support	How important is it to make sure that any problems of the system are resolved?	4.27	<0.001
External consultation	How important is it to have external consultation for the system?	2.65	0.001
Internal consultation	How important is it to have internal consultation for the system?	4.00	<0.001
Networking	How important is it to have networking with other organisations for sharing ideas and overcoming obstacles?	3.30	0.007
Information and Output Quality	How important is it to learn from the information presented by the system?	4.24	<0.001
Monitoring	How important is it to monitor the impact of the applied decisions?	4.03	<0.001
Net Benefits	How important is it to measure positive and negative impacts of the system on users?	3.68	<0.001
Net Benefits	How important is it to measure positive and negative impacts of the system on the organisation?	3.86	<0.001
Feedback	How important is it to collect feedback from users to improve the system?	3.95	<0.001
Training	How important is to do training to increase the confidence of users in using or finding value in the system?	4.19	<0.001
User Involvement	How important is it to involve users in all stages of introducing the system?	3.78	<0.001
Stakeholder Involvement	How important is it to involve stakeholders to improve the system?	4.03	<0.001
Stakeholder Satisfaction	How important is it to consider Stakeholder's satisfaction?	4.11	<0.001
User Satisfaction	How important is it to consider user's satisfaction?	4.14	<0.001
User Expectations	How important is it to manage user's expectations of the system?	4.14	<0.001
Stakeholder Expectations	How important is it to manage stakeholder's expectations of the system?	4.08	<0.001
Experience	How important is it that users need to have different kinds of experience with the system (e.g. business planning and management strategy)?	3.35	0.025
Technology Experience	How important is it that users need to have technological experience?	2.76	0.054
Budgetary Resources	How important is it to have adequate budgetary resources to implement the system successfully?	4.46	<0.001
Financial Sustainability	How important is it to ensure financial sustainability?	4.24	<0.001
Proper Scoping	How important is it to scope the system carefully to avoid wasting resources?	4.00	<0.001
Return of Investment	How important is it that the system contribute to the financial performance of the university?	3.95	<0.001
Clear Vision	How important is it to have clear vision for the system?	4.11	<0.001
Define Objectives and Goals	How important is it to define objectives and goals of the system?	4.14	<0.001
Define Mission and Values	How important is it to define mission and values?	3.46	0.006

Regarding the open-ended questions, it is inquired about any additional comments towards the presented perspectives in the first question. It was mentioned that managing expectations of senior management and involving stakeholders in some stages should be emphasized. Further, it is suggested that enabling forecasting forthcoming events would be beneficial.

Communicating potential changes and ensuring transparency specifically while dealing with data and data provenance were also highlighted. In addition, capability of the system to deliver the required knowledge that can be used by many people for various purposes was introduced. Finally, it is suggested that the significance of these factors might vary based on the maturity level.

The second question investigating participants' opinion to find out if there are other perspectives should be considered. It is introduced that the selected tool should be as decision support system that is suitable to deliver the required function and enable easy access. Moreover, the adopted methodology to apply the system is essential to be taken into consideration. Additionally, increasing the awareness of data literacy which could be improved by having champions to optimize system usage besides change management was proposed. Having single sources of data to avoid conflict and mistrust was highlighted too. Finally, it is mentioned that assigning specific time to achieve related tasks should be realistic.

5 CONCLUSION

Supporting decision making processes to improve performance measurement is an essential task within organisations. The awareness of this importance has been raised not only by profit organisations but also non-profits. This correlates with the increase of data available, which can support organisations with their decisions. By focusing on performance measurement and decision making in HE, this study demonstrated the factors that have an impact on successful adoption of BI and dashboards through considering them in alignment with performance measurement strategy. Whilst other studies have touched upon success factors, this study emphasise the importance of alignment to improve the efficiency of using these technologies. Further, metrics that measure success should be multidimensional as the study advocates utilizing the four perspectives of BSC which are finance, internal process, learning and growth, and customer in alignment with the factors of success. this study adopted the sequential triangulation methodology which commenced by investigating the literature review to determine, this followed with collecting qualitative data through interviewing experts, who were categorized as decision makers, planning and strategy members, and consultants, to gain insight that is more comprehensive and consider different points of views. The main contribution will be through the data I collect to gain insight to people within this sector. To thus far, findings indicate that universities are not yet advanced to adopt BI and dashboards successfully. Further research will follow to generate the appropriate metrics, develop guidelines, and highlight the challenges and opportunities.

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