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Success factors of business intelligence and dashboards to improve performance in higher education

by

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Abstract

Information overload is a recognised phenomenon related to the continuous increase of data that need to be dealt with. This overload can be managed using dashboards (DB), which are considered some of the most useful tools in business intelligence (BI), merging concepts such as scorecards to assist stakeholders and employees to improve performance and make the appropriate decisions. However, many software vendors do not draw the necessary level of attention to the effectiveness and usefulness of DB; instead, they promote the ability to visualise as much data as possible for marketing purposes, and they focus on display features and visualisation mechanisms. Also, there is a limited number of studies that investigate the use of BI and DB in higher education (HE) to improve decision-making and enhance performance. Having a better understanding of these technologies in the HE context boosts our comprehension of critical factors and measures, and helps us to visualise them appropriately, which in turn improves performance. For this complex and multidimensional research area, triangulation is applied using qualitative and quantitative approaches to gather insights, modify the presented factors, or identify new ones to construct the framework. In more detail, the literature review is used to build a holistic understanding of the proposed framework of the success factors. After that, a qualitative approach is adopted to investigate and validate the framework. Then, the final version of the framework is presented after applying quantitative methodology with an alternative group of participants to confirm the final version of the framework. The case study approach is used to evaluate and introduce a list of metrics to measure the factors presented in the framework. The measures of these factors are evaluated and constructed by applying goal question metrics (GQM) within three case studies.

In terms of results, it is clear that almost all the proposed factors are important and belong to the proposed perspectives, highlighting the use of balanced scorecards (BSC) in measuring the success factors of BI and DB. In light of this, a framework for successfully using BI and DB is constructed by triangulating the literature review, expert reviews, and questionnaires. In addition, the instrument that includes metrics for the success factors framework is introduced.

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Glossary

Abbreviation	Definition
BA	business analytics
BI	business intelligence
BSC	balanced scorecards
CMM	capability maturity model
CON	consultant
DB	dashboards
DPSL	dataset publishing language
DS	data storytelling
DSS	decision-support system
DSS	decision-support systems
DW	data warehousing
EIS	executive information system
ETL	extract, transform, and load
GPDE	Google's Public Data Explorer
GQM	goal question metrics
HE	higher education
HEI	higher education institution
HESA	Higher Education Statistics Agency
IDV	integrated data viewer
KPI	key performance indicator
M	overall maturity score
P&S	planning and strategy
PA	performance appraisal
PI	performance indicator

PLS	partial least squares
PM	performance measurement
PMS	performance measurement system
ROI	return on investment
RQ	research question
RSSU	Russian State Social University
SDG	sustainable development goal
SEM	structural equation model
SSM	soft systems methodology
TDWI	The Data Warehousing Institute
THE	Times Higher Education
TTF	task-technology fit
UEB	university executive board
UK	United Kingdom
ULG	University Leadership Group
US	United States
VLE	virtual learning environment

List of Publications

Abduldaem, A. and Gravell, A., 2019. Principles for the design and development of dashboards: literature review. *Proceedings of INTCESS*, pp.1307-1316.

Abduldaem, A. and Gravell, A.M., 2021. Success Factors of Business Intelligence and Performance Dashboards to Improve Performance in Higher Education. In *ICEIS (2)* (pp. 392-402).

Al Hashimi, H., Abduldaem, A. and Gravell, A., 2022, October. Common Spikes Success Factors: An Industrial Investigation within Agile Software Development. In 2022 12th International Conference on Software Technology and Engineering (ICSTE) (pp. 1-7). IEEE.

Al Hashimi, H., Gravell, A. and Abduldaem, A. 2022. The roles of spikes in agile software development: A systematic literature review. Journal of Information and Software Technology (ISI). (Accepted subject to corrections).

Research Thesis: Declaration of Authorship

Print name: Asmaa Abduldaem

Title of thesis: Success factors of business intelligence and dashboards to improve performance in higher education

I declare that this thesis and the work presented in it are my own and have been generated by me as the result of my own original research.

I confirm that:

1. This work was done wholly or mainly while in candidature for a research degree at this University;
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Abduldaem, A. and Gravell, A.M., 2021. Success Factors of Business Intelligence and Performance Dashboards to Improve Performance in Higher Education. In ICEIS (2) (pp. 392-402).

Signature: ..... Date:.....

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For the first and the most important person in my life, my grandmother. I will never forget your prayers, you are in my heart forever, and I wish you were with me to share this moment. Rest in peace.

Thank you, my friends, for your support.

Chapter 1 General Introduction

Information overload is a recognised phenomenon related to the continuous increase of data and the corresponding need to process that information. Business Intelligence (BI) has attempted to manage overload through the use of tools like dashboards (DB), which enable concepts like scorecards to be merged, providing valuable information for stakeholders and employees to improve performance and make more effective decisions (Yigitbasioglu and Velcu, 2012). The need for effective communication becomes more important as the size of an organisation increases. This underlines the importance of using tools like DB to monitor and improve output, as well as to improve accuracy and efficiency of the data that are available (Koopman et al., 2011). Since 1970, digital technology has enabled highly sophisticated performance measurement systems (PMSs) that are a far cry from paper-based reports (Vallurupalli and Bose, 2018). In the early days of technology, decision-support systems (DSS) emerged to enhance information access and the recognition of patterns and trends (Vallurupalli and Bose, 2018). Executive information systems (EIS) supported top-level managers and remained widespread until 1990, when business intelligence (BI) systems arose in response to the vast growth in data to improve integration, access, and analysis to support performance measurement (PM) and decision-making (Teixeira and Misaghi, 2013).

There are substantial advantages to identifying the purpose of BI and DB based on the targeted managerial level and the features that fulfil this purpose (Rahman et al., 2017). The main objectives of using a DB are to ensure consistency and to enable efficient planning, communication, performance monitoring, and performance analysis (Pauwels et al., 2009; Rahman et al., 2017). However, the higher education (HE) sector, in comparison with others such as business, government, and healthcare, has been found to lack an understanding of how to use analytics systems successfully for strategic insight, planning, and performance management (Siemens et al., 2013). In discussing analytics in the HE context, it is first crucial to establish a common language based on what we mean by analytics, what type of analytics we need, and what technologies are involved, as Van Barneveld et al. (2012) argue. There are various types of analytics in HE, such as academic analytics, learning analytics, predictive analytics, and action analytics.

Despite massive increases in BI spending in recent years (Vallurupalli and Bose, 2018), many software vendors still fail to highlight the true value and effectiveness of BI and DB, instead focusing on display features and visualisation mechanisms for marketing purposes (Janes et al., 2013; Few, 2006). There is also little agreement on DB interface design and DB functionality, with developers tending to concentrate instead on specific features or customisation options (Yigitbasioglu and Velcu, 2012). In addition, there is a scarcity of literature on BI and DB use in HE (see Chapter 2), which limits particularly our knowledge of the factors and metrics that determine success in this

context. The HE sector, then, would clearly benefit from a better understanding of how analytics technologies can be used to improve performance and decision-making.

BI and DB target three distinct levels: strategic, tactical, and operational. Operational DB concentrate on tracking and monitoring the operational process, while tactical DB, which tend to be used by departments or small groups, focus on analysing departmental processes and projects, while strategic DB converge and monitor the fulfilment of strategic objectives, as summarised in Table 1.1 (Eckerson, 2010). However, one of the main limitations of DB is that there is no explicit link to a corporate strategy (Taylor and Baines, 2012). This could be improved by combining other approaches, such as the balanced scorecard (BSC), that aim to connect the various levels of the organisations to the corporate strategy based on four perspectives: internal process, financial, customer and learning, and growth (Martinsons, Davison and Tse, 1999; Kaplan and Norton, 1992).

Table 1.1: Three types of dashboard (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

Martinsons, Davison and Tse (1999) developed the BSC to measure and evaluate information systems (IS) activities based on four perspectives: business value, user orientation, internal process, and future readiness. The BSC generates specific measures for each dimension. The authors argue that the new generations of IT and IS applications cannot be measured on the basis of financial indices alone, because they tend to provide wider range of services. One of the suggested approaches is information economics, which advises that benefits and risks be evaluated on the basis of the two domains of business and technology. However, this approach fails to take advantage of the wide range of benefits that are provided by technology.

Consequently, it is usually suggested that BSC be used to support IS and IT evaluation (Martinsons, Davison and Tse, 1999). This conceptual framework is approved by Delone and McLean (2003) to enhance measures of IS activities. Their well-known studies show that input or independent variables are widely addressed, while output or dependent variables need to be defined appropriately (Delone and McLean, 1992, 2003).

In this study we concentrate on investigating the successful adoption of department-related level of tactical DB to support PM in HE by adapting the BSC concept to measure the success factors. Triangulation is applied using quantitative and qualitative approaches to investigate, validate, and confirm the success factors. Further, case-study methods are applied using GQM techniques to generate measures of the factors. We propose that the use of BSC in conjunction with the GQM approach will enhance the successful application of BI and DB in the HE sector.

For this study the following databases were searched: ACM, IEEE, and Google Scholar. The keywords ("dashboard" AND "higher education") and ("dashboard" AND "BSC" AND "GQM" AND "higher education") and ("BI" AND "higher education") were used. The search outcomes indicated that the majority of studies in this area discuss various aspects of DB use as a tool to support students with their learning, such as for feedback, brainstorming, performance tracking, and teacher awareness in group activities. Boosalis et al. (2016) used the Dataset Publishing Language (DPSL) and Google's Public Data Explorer (GPDE) with DB to analyse data on student learning outcomes in an attempt to keep them meaningful at various levels of the organisation. Overall, there is a lack of understanding regarding the factors influencing the successful adoption of DB in the HE sector, or regarding appropriate frameworks to support the production or visualisation of appropriate metrics related to the organisational level. Consequently, the researcher concentrates on analytics at the department level, which involve metrics for departmental management, staff, and students that have an impact on organisational performance as a whole. This research does not enable generalisation of the results to areas other than the specific context; however, based on the generated outcomes, it is suggested that future research takes into consideration particular regions or countries.

1.1 Motivation and Research Questions

HE should advance its approaches of thinking, doing, evaluating, and demonstrating impact (Siemens, Dawson and Lynch, 2013). Universities are under high levels of pressure from 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 DB. As BI and DB are recognised technologies within business sectors, demand exists to investigate the efficiency of these technologies in HE and ways to use such tools. However, applying tools that are widely used within the profit sector could be different, complex, and unique at universities, because their missions and visions differ from those in business (Guitart and Conesa, 2015).

The aim of this study is to obtain a better understanding of effective usage of BI and DB within the HE sector, as well as to construct the appropriate framework of the success factors to support PM. This aim will be met through the following objectives: to identify factors that ensure the success of BI and DB; to classify and organise these factors based on the perspectives of the BSC; to validate and confirm their inclusion in the final version of the framework; and to apply the GQM technique to enable measurement of the factors in the framework in alignment with the concept of the BSC.

1.2 Research Questions

RQ1: *How might the balanced scorecard (BSC) approach be adapted to measure the successful usage of Business Intelligence and Dashboards (DB) to support performance measurement (PM) in higher education?*

1.1 What are the financially related factors that ensure the successful use of BI and dashboards to support PM in HE?

1.2 What are the customer related factors that ensure the successful use of BI and DB to support PM in HE?

1.3 What are the factors related to the learning and growth perspective that ensure the successful use of BI and DB to support PM in HE?

1.4 What are the factors related to the internal process perspective that ensure the successful use of BI and DB to support PM in HE?

RQ2: *Depending on the confirmed framework, how can the confirmed factors be measured and evaluated?*

2.1 How might the higher education sector measure and improve its performance?

2.2 What is the role of business intelligence and dashboards in supporting performance measurement of higher education organisations?

2.3 What are the appropriate metrics to measure the effectiveness of using BI and DB?

2.4 What are the barriers to and opportunities for applying this technology?

To facilitate access to participants in this empirical research, data collection activities such as interviews and questionnaires will recruit participants from the middle management of HE institutions.

1.3 Structure of the Thesis

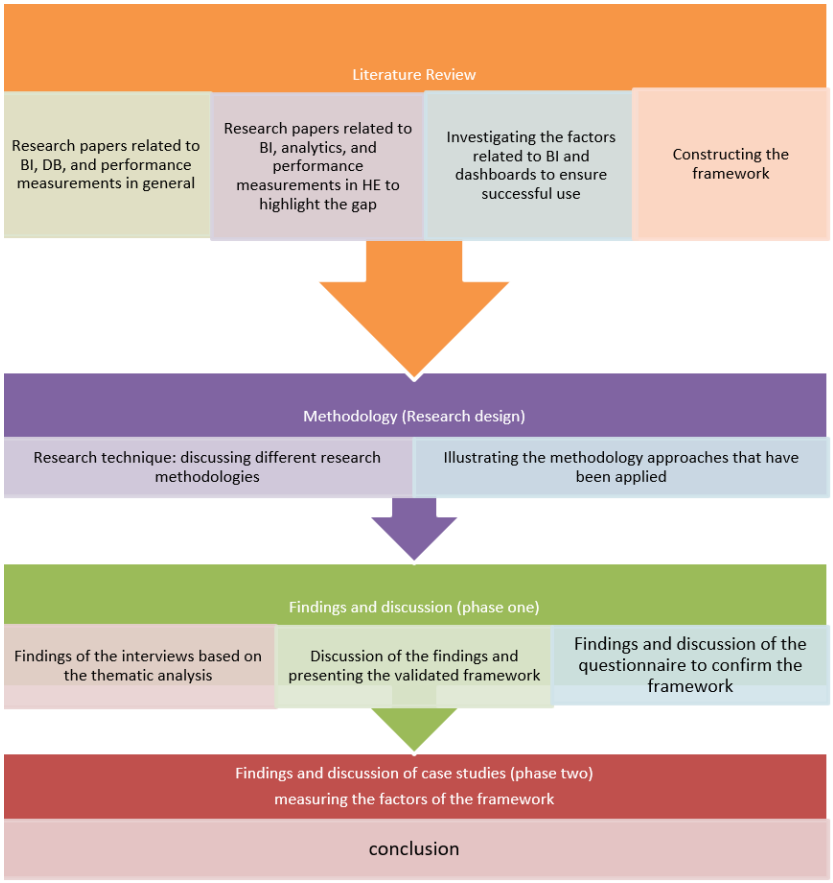

Figure 1.1: Structure of the thesis

Chapter 2 Literature Review

2.1 Introduction

This chapter aims to provide a general background to the key concepts in this research. It then critically reviews the relevant literature to situate the contributions and originality of this study. The process of developing the framework used in this study is then discussed and explained. Finally, a brief conclusion about the identified gaps and the overall aim of this study is presented.

2.2 Business Intelligence (BI)

Organisations constantly seek to manage and improve their performance and create knowledge out of the information they have. Knowledge management is an integrated and systematic method of identifying, managing, and sharing information by leveraging the support of technologies and innovative individuals. In this thesis, business intelligence is a knowledge management approach to enable decision-makers to access data and information and gain the required knowledge.

The term BI, which emerged in the early 1990s, can be considered as an umbrella term encompassing various decision-support applications. Data are generated from various source systems such as ERP systems, emails, Word documents, and third-party data, and are subsequently extracted, transformed, and loaded into a data warehouse (DW). Users such as information producers and information consumers, as well as applications such as DB, can access the DW, as seen in Figure 2.1. 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). The definition of BI is identical to that of business analytics (BA), which has been described 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).

Nowadays, BI is the most extensively adopted IT solution to support decision-making processes and boost the capability of information management (Musa et al., 2018). One of the principal objectives of BI is to enhance the quality and timeliness of data to assist decision-makers within an organisation (Nyalungu, 2011). Other benefits of using BI are that it translates data into purposeful meaning and combines the required information to deliver the necessary insights into the performance of an organisation. This contributes to the incoming and potential business opportunities to thrive, improves the understanding of different issues and helps formulate strategy. Further, if the

performance of the organisation deviates from its key performance indicators (KPIs), BI tools can alert managers to monitor and improve the process behaviour (Nyalungu, 2011).

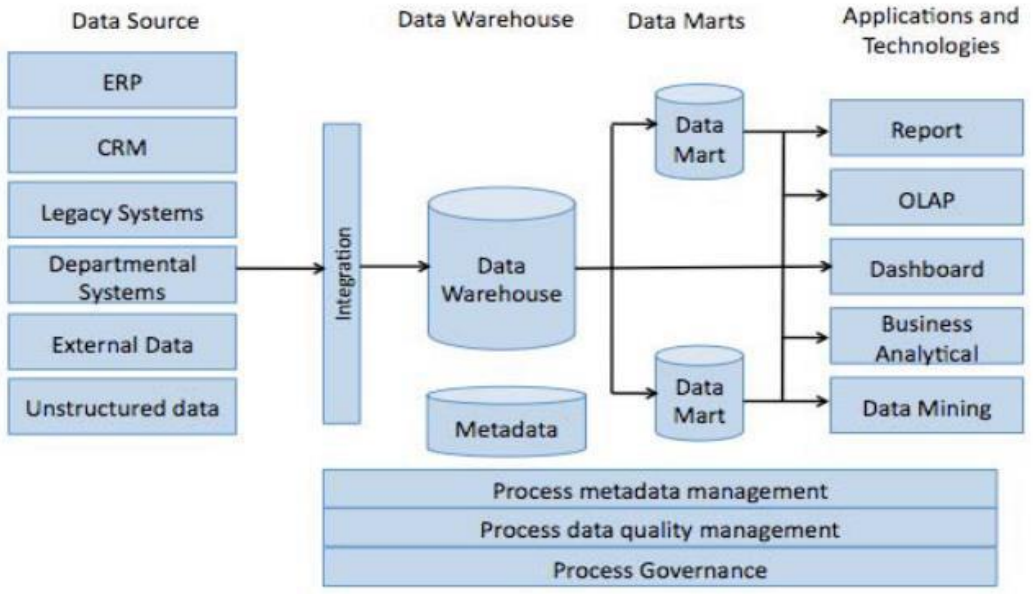

Figure 2.1: Architecture of a business intelligence system (Guitart and Conesa, 2015)

There are various technologies and commercial tools that construct the concept of BI, such as Cognos, Integrated Data Viewer (IDV), and QlikView, which provide a DB interface. However, to optimise the value of these tools, some elements should be taken into consideration, such as data quality, availability of up-to-date information, consistent definition of data, and integration with the business strategies of the organisation to expand its capabilities.

2.3 Dashboards

2.3.1 Purposes and features of dashboards

There are substantial advantages to identifying the purpose of the DB, based on the targeted managerial level and the features that fulfil this purpose (Rahman et al., 2017). The main objectives of using DB are to ensure consistency, planning, communication, and monitoring (Pauwels et al., 2009; Abdul Rahman et al., 2017). Abdul Rahman et al. (2017) found that 13 out of 23 studies in a review of publications between 2010 and 2017 dealt with operational DB. The remaining categories were tactical DB (six studies), strategic dashboards (three) and a combination of operational and tactical DB (one). The scarcity of research into strategic DB made it difficult to investigate the usage of DB at a strategic level. The main arguments for the use of DB and the application of such purposes within each

managerial level of the organisation, along with the most salient visual and functional features, are outlined below in Table 2.1.

Table 2.1 : Purposes and features of dashboards (Rahman et al., 2017)

Level	Purpose	Features
Strategic	**Consistency** • Improve business processes • Track KPI. **Monitor** • Monitor organisational performance. **Planning** • To plan the future of the organisation.	**Visual Features** • Fit single screen • Grid overlay **Functional Features** • Graphical presentation (bar chart, pie chart, graph, gauge chart) • Time horizon
Tactical	**Consistency** • To standardise the service. **Monitor** • Self-monitoring the performance of management. **Understand employee's performance** • Summarise information by department • Monitor trend over the period. **Communication** • Communicate with the operational level. **Analysis** - Improve decision-making among departments.	**Visual Features** • Fit single screen **Functional Features** • Graphical presentation (fusion, historical, bar, gauge chart) • Drill down • Scenario analysis • Drag and drop • Hide/flag component • Report • Alert mechanism • Print • Icon
Operational	**Consistency** • Increase speed and consistency of analysis • For information transparency. **Monitor** • Monitor individual or group information • Monitor activity • Monitor and detect relevant information Measure individual performance. **Communication** • Provide feedback on their performance • To extract information among team members. **Analysis** • Analyse learning analytics • Analyse user's own information. • Analyse effects.	**Visual Features** • Fit a single screen **Functional Features** • Percentage indicator • Graphical presentation (bar, line pie, network, spider, trend, gauge) • Concept map • Table • Filter • Badge • Zoom • Rating • Calendar • Alert mechanism

2.3.2 Dashboards and performance measurement

It is crucial for any organisation to measure and improve its performance, and the ability to measure and analyse performance accurately helps to improve its quality (Arora and Kaur, 2015). Dashboards used in the clinical sector have been found to be more effective in measuring performance than electronic medical records and computerised decision-support systems, as they can provide performance summaries and enable easy visualisation of data (Dowding et al., 2015).

The amount of information available to individuals and businesses is increasing at an exponential rate, with some experts claiming that the actual amount increases by 60% every year (Donhost and Anfara Jr, 2010). However, it has been argued that "a wealth of information creates a poverty of attention" (Donhost and Anfara Jr, 2010). In the era of big data, the power of data to manage our decisions indicates that fact-based decision-making is increasingly important within organisations (Mandinach, 2012). Therefore, specialists able to support decision-making using descriptive, predictive, and prescriptive analytics are increasingly in demand to provide data analysis of the vast amount of information that is available (Chen et al., 2012). Consequently, all sectors, including education, are under increased pressure to provide evidence to support and manage the decision-making process (Donhost and Anfara Jr, 2010). Access to data does not mean that they are inevitably utilised effectively; the data are restricted to silos, which causes insufficient integration to support decision-makers (Sokhn et al., 2014). In the education sector, many administrators are under increasing pressure to make decisions, leading some to experiencing difficulties in dealing with data-driven decision-making, since "accruing data without analysing and using it will not help your student learn" (Donhost and Anfara Jr, 2010). Effective decision-making requires data to be integrated and interpreted, which transforms them into useful information (March and Hevner, 2007).

The DB is intended to function as a support mechanism to facilitate multiple avenues of decision-making, such as measuring life cycle sustainability of products and consumption levels (Traverso et al., 2012). In other words, non-experts who are targeted by experts and scientists are part of the process of decision-making, necessitating the clear presentation of information (Traverso et al., 2012). To this end, tools such as DB are increasingly used to sort and display data (Donhost and Anfara Jr, 2010). In addition, the rise of distributed decision-making has increased the importance of examining the influences of the decisions being made by operational level managers, rather than only the executives (March and Hevner, 2007).

The Russian State Social University (RSSU) produced a personnel performance assessment system in an attempt to improve and optimise the quality of its faculties (Bakhtina et al., 2015). This system

demonstrated that supporting and developing the motivation system is a main priority to assisting the performance assessment system (Bakhtina et al., 2015). The Key Performance Indicators (KPI) metric was also used to define the official functional tasks and the importance of these tasks (Bakhtina et al., 2015), showing that the main elements driving the success of PMSs in the RSSU DB are design, data, and display. The design component means constructing a model or framework then developing the appropriate metrics, with the data as the actual inputs, which are then displayed graphically to express both data and design (Harbour, 2011).

The design of a DB is important because this affects its efficacy. For example, the use of colour can enhance the visual clarity of information in a DB, but the overuse or misuse of certain colour palettes has been found to have a negative impact on decision-making (Bera, 2016). Research using eye-tracking technology has shown that while the random use of colours in DB may not directly cause bad decisions, it may still delay the length of time needed to make an appropriate decision (Bera, 2016).

2.4 The Need to Decide on the Appropriate Data

The explosion in data can overcome humans' cognitive capacity. Given the wealth of data available and the possible inconsistency or unreliability of those data, it can be challenging to obtain the information required to support the creation of an appropriate visualisation while improving the quality of visualised data. In this capacity, DB can be a useful tool to support users in achieving their goals. Useful DB are characterised by two main functions: the selection of appropriate data; and the choice of the most appropriate visualisation technique (Janes et al., 2013). Figure 2.2 illustrates the general framework for data generated using GQM and BSC to be visualised to support end users.

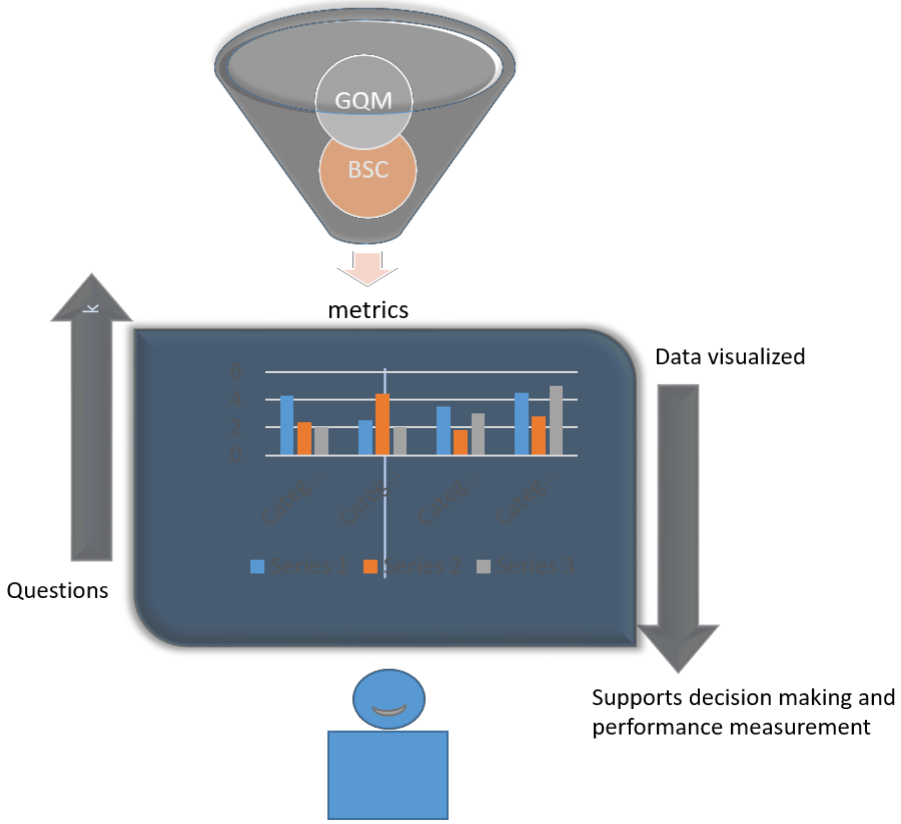

Figure 2.2: General framework for data and visualisation to support the end user

2.4.1 Selecting the appropriate data

Effective data require the development of an appropriate measurement model that can define the data to be collected, based on clear reasoning and criteria (Janes et al., 2013). Measurement is "a mechanism for creating a corporate memory and an aid in answering a variety of questions". The process of specifying the correct measurements to use, and how they should be interpreted, requires suitable models informed by appropriate goals (Basili, 1992).

Data and information quality are crucial concepts for organisations to consider. Applying analytical tools to inaccurate data generates inaccurate information, which has a negative impact on decision-making (Haupt et al., 2015). Information quality can be specified in terms of four dimensions: accuracy; completeness; representation; and objectivity (Arazy et al., 2017). Several factors affect the quality of data and reduce reliability, such as the abundance of data that have not been analysed properly or that have potentially not even been recognised as valuable, resulting in data that can be accidentally removed and corresponding opportunities missed (Gitzel et al., 2015). This issue of excessive, non-selective data collection is a real problem within many organisations, and it can be solved by better understanding, as well as structuring ongoing measurements to inform the exploration of the collected data (Mendonca and Basili, 2000).

2.4.1.1 Soft systems methodology

Systems thinking is concerned with trying to perceive the world through other people's perspectives (Paucar-Caceres et al., 2021). However, the concepts of systems thinking need to be applied using a methodology such as soft systems methodology (SSM) to deal with the inevitably complex and messy issues. SSM was first developed by Peter Checkland and his colleagues at the University of Lancaster in 1970. It is one of the methodologies that have emerged to introduce the system of human activities (Aarabi et al., 2020). Additionally, it is among the most extensively employed in both the UK and countries across the world (Paucar-Caceres et al., 2021).

Soft systems in software design can guide the interaction between the real world and the mental world, and the issue is not seen as a problem but rather as an inefficient procedure that has to be changed (Aarabi et al., 2020). Further, the word 'system' indicates the process of dealing with the world, instead of the world itself. Consequently, the differences between 'soft' and 'hard' systems can be highlighted. Hard systems are related to well-defined technical issues, while soft systems concern ambiguous and poorly defined cases that include human factors and cultural considerations (Checkland and Scholes, 2007). Consequently, the following concepts are presented to improve the understanding of developing an appropriate framework of success factors and how to measure them.

2.4.2 Balanced scorecards (BSC)

Combining objectives with formal methods is a way to support the production of comprehensive guidelines in order to develop a framework that can support the assessment of performance (Barclay and Osei-Bryson, 2010). Given the complexity of managing organisations, managers need to simultaneously view performance in multiple areas. This can be achieved using a balanced scorecard (BSC), which draws the attention of users towards a smaller set of decisive measures elicited from four specific perspectives. For instance, shown in Figure 2.3, managers can focus on criteria that reflect their mission to create specific metrics that measure factors related to the customer satisfaction perspective. In this scenario, the chosen perspectives might be to formulate goals for time, quality, performance and service (Kaplan and Norton, 1992). Here, the corresponding BSC definition might be a “carefully selected set of measures derived from an org’s strategy… I see this tool as three things: measurement system, strategic management system, and communication tool” (Niven, 2008). Furthermore, there is some evidence that poor enforcement has a greater role in failure than poor strategy (Niven, 2008).

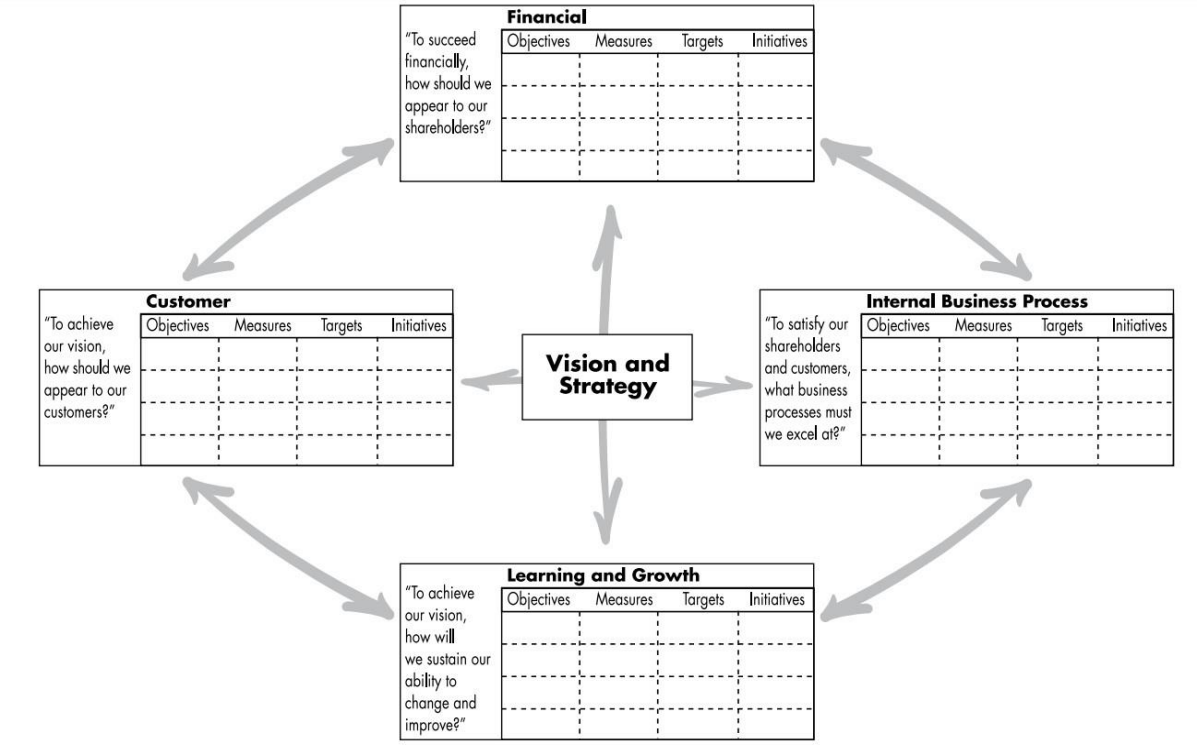

Figure 2.3: The Balanced Scorecard (Kaplan and Norton, 1996)

One real world example was seen at the University of Phayao, where BSC was used in conjunction with the decision-support system of the School of Information and Communication Technology to track performance over the four dimensions of BSC. This enabled selection of the most effective strategies for departmental planning (Cheowsuwan, 2016).

2.4.2.1 Goal Question Metric (GQM)

Goal Question Metric (GQM) is a top-down measurement tool that functions by "defining and evaluating a set of operational goals" as presented in Figure 2.4. A noticeable difference exists between theory and practice regarding the usability of strategy tools. Even though GQM is recognised as being useful, there is a lack of support to make the approach more practical and usable, as well as little to no information being available on how to identify strategies (Trinkenreich et al., 2017). The required strategies for these approaches are either assigned by leaders, as a top-down approach, or by teams in a bottom-up approach, yet the relationship between IT service strategies and goals is unclear (Trinkenreich et al., 2017). This scenario also exists in HE, where IT is understood to be useful and valuable, but must be applied in accordance with suitable strategies and policies.

There are some drawbacks related to using the GQM approach, such as the possibility of creating a large number of metrics (Berander and Jonsson, 2006). Additionally, a GQM measurement framework will only focus on the defined perspectives, so may neglect other potentially valuable data (Berander

and Jonsson, 2006). As measures derived from the GQM approach cannot be reused, Lavazza (2000) suggests that organisations should develop a library of goals, questions and metrics to compact measurement programmes. Even reusable results need to be carefully packaged, as the future requirements of measurements are often unclear. Furthermore, the extent to which measures can be adopted or reused depends on the strategic goals of the organisation and how carefully experiences and context have been specified (Van Latum et al., 1998; Lavazza, 2000).

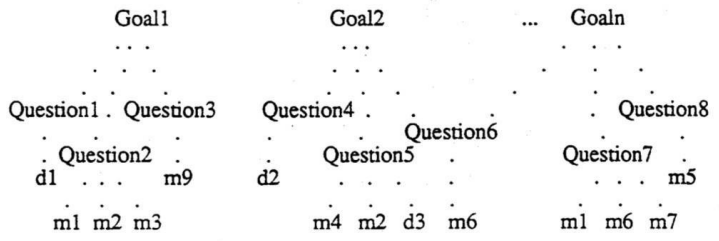

Figure 2.4: Goal Question Metric (Basili, 1992)

2.4.2.1 BSC and GQM

Executives should define a clear strategy based on factors such as their vision, experience, and insight, in order to ensure alignment between their strategic and goals. Alignment can be more effectively achieved by combining the two communal measurement tools of BSC and GQM as can be seen in Figure 2.5. In this way, the organisational vision can be specified in accordance with the perspectives provided by the BSC, while the measurement is developed using the GQM approach to introduce a comprehensive measurement mechanism. Becker and Bostelman (1999) applied these integrated approaches and found that stratifying the perspectives of the BSC in conjunction with the GQM approach was a highly viable method. However, they could not prove whether or not success was due solely to the application of these combined approaches, without external control from the managers. The size and scope of the study was also limited, meaning that further investigation should be undertaken to monitor the impact of this strategy over different terms of usage.

Barclay and Osei-Bryson (2010) state that cooperation between managers is essential in order to clearly identify objectives and fulfil all organisational goals. Despite the importance of this planning, these objectives are often produced based on experience, which may lead to conflict due to a lack of completeness, depending on the team members engaged. This underlines the importance and the challenge of specifying a clear method that ensures that objectives are achieved in light of the main organisational goals and that this is assessed in terms of clear, suitable and unambiguous performance measures.

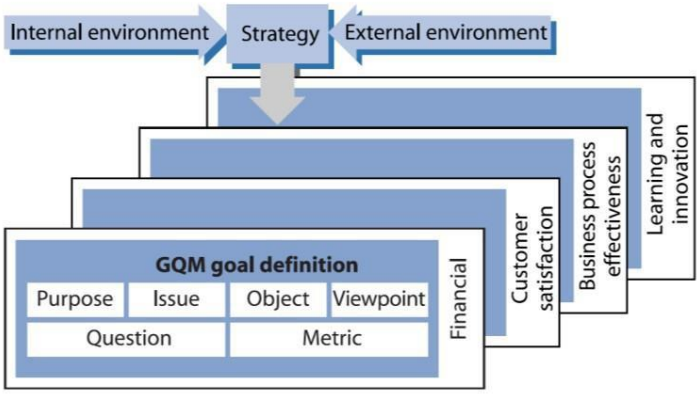

Figure 2.5: Integration of BSC and GQM (Becker and Boostlman, 1999)

2.5 Successful Application and Use of Performance Measurement Technologies

Organisations aim to improve their performance and implement evidence-based decision-making processes by applying supportive tools and technologies. However, it is essential to ensure the successful application and efficient usage of these technologies by examining various aspects, such as the meaning of success, how it is measured, and the factors that influence it. This review examines the research literature on three main aspects of business success: the meaning of success, organisational PM, and technologies that aid performance improvement and decision-making processes. After constructing a good understanding of these elements, the chapter goes on to explore the connections between them, leading to the comprehensive design of an appropriate framework.

2.5.1 Meaning of success

In establishing the definition of success, we find that the Oxford Dictionary defines it as “the fact that you have achieved something that you want and have been trying to do or get”, which places the emphasis on attainment of the desired results. The Cambridge Dictionary defines it as “the achieving of the results wanted or hoped for” or “something that achieves positive results” which, again, focuses on reaching a goal. The meaning of success can be characterised, then, in terms of achievement and results. Interestingly, both dictionary definitions refer to output regardless of the input or the independent elements contributing to success. This constructs an abstract but incomplete picture of

the meaning of success. In reviewing the literature on success in organisations, this meaning is explored in more depth.

DeLone and McLean (1992) conducted a cumulative study between 1981 and 1987 in an attempt to better understand the meaning of success and to summarise the factors and measures that affect the success of information systems. They highlighted that the input or independent variables that impact success should be widely addressed, while output or dependent variables need to be defined appropriately. The output is translated into various measures and levels to determine success. For example, measuring the output of information systems was defined by Shannon and Weaver in 1949 based on three levels — technical, semantic and effectiveness — to represent the accuracy of the system, the success of the system to convey the expected meaning and the impact of the information on the receiver respectively. Figure 2.6 depicts the outputs that express success, as adopted by different researchers.

DeLone and McLean also generated a model to represent success, which includes system quality, information quality, use, user satisfaction, individual impact, and organisational impact (Figure 2.7). The model applies both process and causal concepts to represent the interrelationships between these dimensions. The process model indicates steps or phases that the system has created, which are then experienced by users and managers, and which have an impact on individuals and consequently the organisation. The causal model examines the correlations between dimensions (Delone and Mclean, 1992).

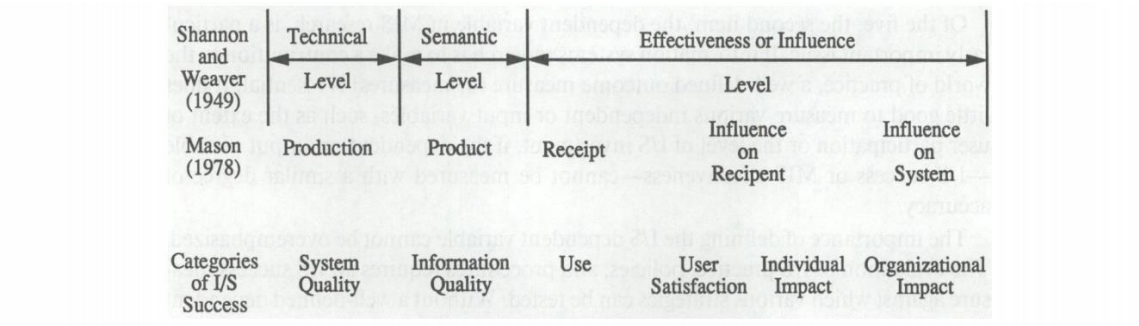

Figure 2.6: Categories of IS success (from DeLone and McLean, 1992)

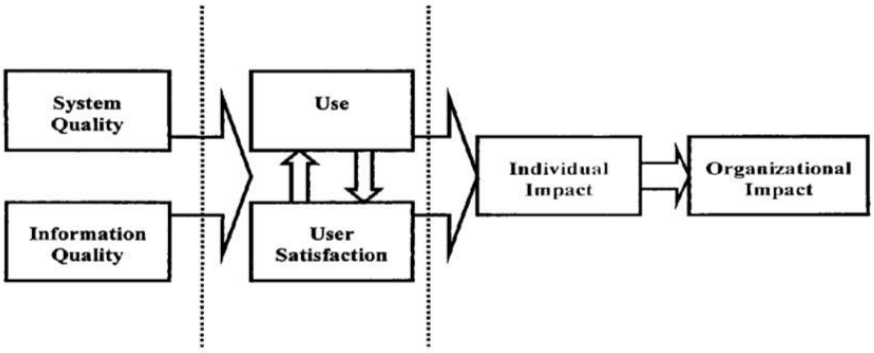

Figure 2.7: Success model for IS (from a highly cited study by DeLone and McLean, 1992)

Wixom and Watson (2001) devised a model illustrating the relationship between different aspects that affect successful implementation of data warehousing, based on three dimensions of system success: system quality, data quality, and perceived net benefits (Figure 2.8). It is suggested that those dimensions are affected by various factors, categorised as organisational, project, and technical implementation (Wixom and Watson, 2001). Organisational factors are management support, champion, resources, and user participation. Project factors are user participation, team skills, resources, and champions. Regarding technical success, the factors are team skills, sources systems, and development technology (Wixom and Watson, 2001).

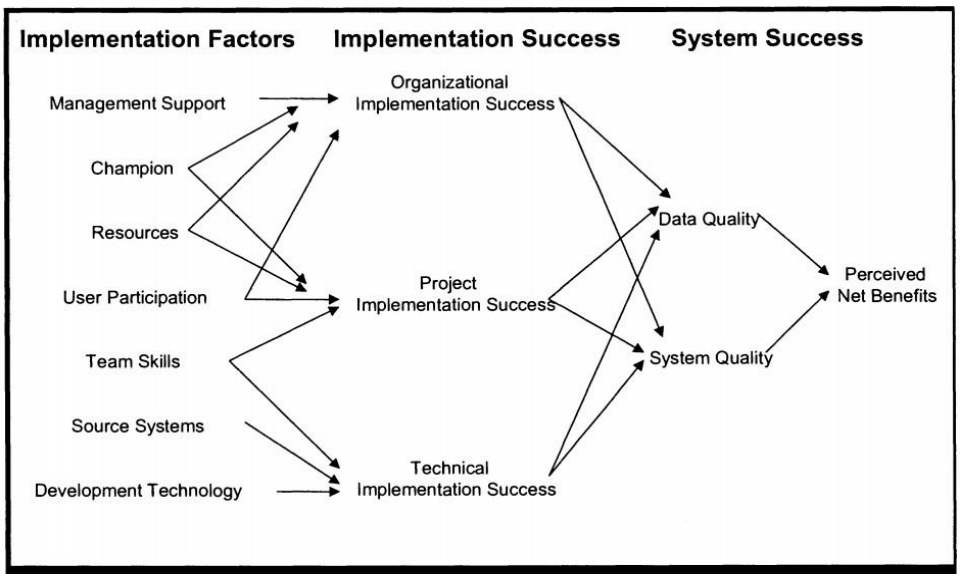

Figure 2.8: Research model for data warehousing success (Wixom and Watson, 2001)

Mukherjee and D'Souza (2003) studied the failure factors of DW and then ascertained the success factors. Poor quality of data, lack of user involvement, lack of training, organisational politics, misalignment of business goals and technology, and lack of management sponsorship are examples

of failure factors. Success factors in the technical category are data- and data management-related factors, and in the organisational category they are leadership- and sponsorship-related factors.

In addition, it is stated that successful BI is characterised by illustrating less information and presenting information that is aligned with the strategy. In addition, effectively used BI can run a business smoothly, improve profitability, raise efficiency, increase success rate, and enhance decision-making. It assists in providing unified and reliable view of business and empowers users with insights. Consequently, effectiveness is presented as an aspect that can determine success. For example, the state of Ohio was able to save $1.1 million after applying BI effectively (Guster and Brown, 2012).

It is essential to consider precisely the business logic of an organisation in order to understand and determine the appropriate behaviour of the institution, which can be translated into a set of metrics to demonstrate success and use BI effectively. However, this could be challenging because of aspects such as politics, various levels of expectations, and management style. Within HE institutions, this could be even more challenging, notably if it is public and if it is an emerging process. Many executives at universities do not realise the importance of BI and tend to avoid additional costs. Despite the vast amount of data, they may not be integrated or may be conflicted due to differing sources, or lacking in value because of their raw state (Guster and Brown, 2012).

2.6 Performance Measurement

The literature relating to PM may be classified into three main categories. The first category of research concentrates on PM metrics, regardless of technological aspects. The second category focuses on the position of technology to implement PMSs, neglecting the communication of technology with PM practices, its impact, and other aspects like goal setting. The third category looks at organisational problems associated with implementation of IT-based PMS, ignoring the impact of the various stages of implementation on each other (Vallurupalli and Bose, 2018).

Among the commonly used PM tools are scorecards, DB, and KPIs. These three tools are explained in the following subsections.

2.6.1 Balanced scorecards

A measurement system plays a crucial role in an organisation, since what is measured constitutes knowledge gained, which may affect the behaviour of managers and employees. Cooper and Kaplan (1988) propose using a simple set of financial measures to support performance. However, traditional financial indicators such as return on investment (ROI) and earnings per share can be deceptive when

it comes to improving and innovating to meet the needs of the competitive market. Others might forget about financial metrics and, instead, concentrate on operational metrics such as cycle time and defect rates. In 1992, Kaplan and Norton suggested that organisations should use balanced and multidimensional sets of measures, which are composed of operational and financial metrics. Consequently, the balanced scorecard (BSC) was introduced to assist this view by introducing a balanced set of measures to provide comprehensive view for top managers.

Table 2.2 below shows a comparison of BSC and traditional measures.

The company ECI used the BSC as a method for top-level executives to define, simplify, and operationalise their vision. Goals were established on the basis of the following: customer perspective, internal process, learning and growth, and the financial perspective, as detailed in Table 2.3. The benchmarking technique is also used to compare the performance of the company with that of competitors. The perspectives of the BSC answer the following questions: How do customers see us? What must we excel at? Can we continue to improve and create value? How do we look to shareholders? (Kaplan and Norton, 1992).

Table 2.2: Comparison of BSC and traditional measures

Balanced Scorecard (BSC)	**Traditional measures**
Financial and operational measures	Only financial or operational measures
Limiting and comprehensive set of measures	Inadequate set of measures, which can be misleading
View performance from various areas side by side	View performance from a single angle
Avoid improvement in one area at the expense of another	Concentrate on one area regardless of others

Table 2.3: Applying the perspectives of BSC at ECI (Kaplan and Norton, 1992)

	Mission	**Concerns**	**Measures**
Customer perspective	"To be number one delivering value to customers"	Time: time it takes for a corporation to meet the needs of its customers, quality, performance and service, cost.	Time: time from receiving an order to time of delivering the order, time of defining new product until time of shipment. Quality: defect level, level of accuracy for delivery forecasting.

Internal perspective		Processes, decisions, actions	Factors affect cycle time, quality, employee skills, and productivity.
Innovation and learning		The ability to learn, improve and innovate	Launch new products, create more value for customers, and improve operating efficiency, increase revenues and margins.
Financial		To survive, to succeed, and to prosper	Cash flow, quarterly sales growth, operating income by division, increased market share by segment and return on equity.

Douwe P. Flapper et al. (1996) emphasised the importance of consistent performance indicators (PI) based on three dimensions: (a) decision type such as strategic, tactical or operational; (b) aggregation level such as overall or partial; and (c) measurement unit such as monetary, physical or dimensionless. PI can be defined from a top-down perspective, whereby the functions in an organisation that are in charge of carrying out these activities are the beginning point for defining PIs, while a bottom-up perspective is concerned with the tasks that must be carried out within an organisation (Flapper et al., 1996). Table 2.4 summarises some of the main studies concerning the first category, highlighting existing PM research. The researcher has adapted the table to distinguish the sector and methodology applied to enable comparison of available research concerning for-profit sectors and the HE sector.

Table 2.4: Summary of published research on performance measurement, adapted from Vallurupalli and Bose (2018)

Paper	Major contribution	Sector	Methodology
Cooper and Kaplan (1988)	Suggested use of simple financial measures as proxies for measuring performance.	Profit organisations	Discussion using examples
Kaplan and Norton (1992; 1996)	Suggested the use of a balanced set of measures (both financial and non-financial) to measure performance, and an effective cascading of goals across hierarchy through the use of these measures (balanced scorecard framework).	Profit organisations	Research project with 12 companies over a year.
Douwe P. Flapper, et al. (1996)	Focused on consistency of performance measures and proposed a method for developing a consistent	Profit organisation	Case study

	performance measurement system (consistent PMS framework).		
Bititci et al. (2000)	Suggested that a PMS should be dynamic to reflect changes in internal and external environment (dynamic PMS framework).	Profit organisation	Case study
Neely et al. (2001)	Proposed design and development of performance measures considering interests of all stakeholders and not just shareholders (performance prism framework).	Profit organisation	Case study
Kanji and Sá (2002)	Proposed the development of performance measures so as to achieve business excellence by ensuring both shareholder satisfaction and other stakeholders' delight, organisational learning and process excellence (Kanji's Comparative Business Scorecard Framework).	Not specified	Company "X" using partial least square (PLS) estimation
Sureshchandar and Leisten (2005)	Proposed the use of an integrated scorecard for managing performance; covering financial, customer, business process, intellectual capital, employee and social perspectives (holistic scorecard framework).	Software industry	Case study
Barnabè (2011)	Proposed integrating the balance scorecard method with a systems dynamics approach (system dynamics-based balanced scorecard).	Service-based business	Case study

2.6.1.1 BSC in higher education

Higher education institutions (HEIs) play a major role in providing formal education, research quality, and engagement with society. This formal education can support students in attaining academic degrees and professional certifications. Further, the success of universities has a favourable impact on society's economic development by providing thorough and accessible high-quality education and high-impact research. Consequently, it is expected that HEIs construct strong partnerships with business and industry stakeholders. Moreover, as they are required to adjust to political, economic,

social, and technical forces, HEIs must adapt to continuing trends and advancements in their macro and micro settings. Thus, it is suggested that adopting private sector management practices could lead to considerable advances in HE performance.

The BSC is one of the most widely used practices in for-profit organisations, and has also gained popularity in non-profit organisations, such as the HE sector, to measure and improve performance. Financial, customer (student), internal processes, and organisational capacity perspectives of the BSC should be aligned with the defined vision and mission, allowing managers to track and adapt their strategies. Based on these perspectives, objectives are formulated and the appropriate measures are chosen to monitor and track improvements towards achieving strategic goals. This form of assessment can support the identification of detailed enhancements to organisational performance, which can influence external ratings such as placement in league tables, for instance the Times Higher Education (THE) and the QS world university rankings, thus increasing the global visibility of HEIs.

Camilleri (2021) investigated PM in HEIs through the lens of the BSC to evaluate its strengths and weaknesses in performance appraisal (PA). PA potentially affects employees in terms of job retention, salaries, and promotion. The main findings are that the PA tool can assist in better communication among academic employees and their leaders, and gives appraisees beneficial feedback that enhances their motivation, morale, and dedication. However, using PA in isolation from other performance policy improvements might not generate the desired results, and employees may come under avoidable pressure if they believe that serious decisions need to be made. Rompho (2004) developed a BSC and strategy map for a university by investigating its usage within universities, involving the stakeholders within the early design stage, and examining the understanding of the designed BSC within the management staff. They found that 22 institutions used the BSC: one in Canada, two in the United Kingdom (UK), two in Australia, and 17 in the United States (US). The main extracted objectives for HEIs from the BSC approach are summarised in Table 2.5 below.

Table 2.5: Main objectives for HEIs from a BSC perspective

Perspective	**Objectives**
Customer	Quality of graduates, quality of research, and quality of academic service to the community
Internal process	Quality of learning support, quality of academic staff, and quality of the learning process
Learning and growth	Quality of the quality assurance system, quality of planning, and quality of staff development
Financial	Cost focus, revenue focus, and training and development focus.

2.7 Technology and Performance Measurement

Kueng et al. (2001) emphasise the role of technology to support PM. It began with an attempt to define the PMS. Bititci et al. (1997) stated that, “At the heart of the performance management process (i.e. the process by which the company manages its performance), there is an information system which enables the closed loop deployment and feedback system. This information system is the PMS, which should integrate all relevant information from relevant systems” (see Figure 2.9). Kueng et al. (2001) suggest two cycles of PMS, which are creation and use of the system, as shown in Figure 2.10.

Table 2.6 summarises research contributions regarding the role of technology to support the implementation of a PMS.

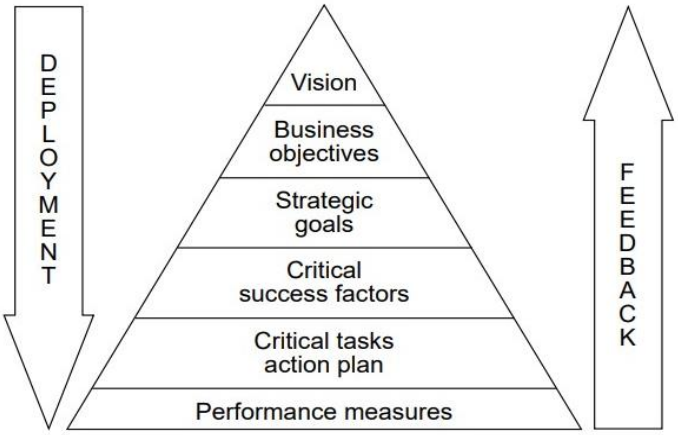

Figure 2.9: Closed loop deployment and feedback system for the performance management process (Bititci et al., 1997)

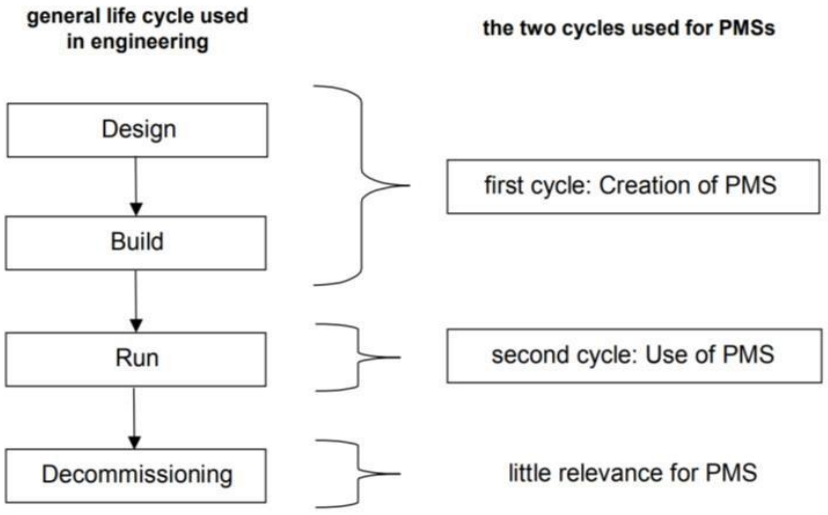

Figure 2.10: The four common phases in engineering (Kueng et al., 2001)

Table 2.6: Summary of research contributions on the role and impact of technology in PMS implementation, adapted from Vallurupalli and Bose (2018)

Paper	Major contribution	Sector	Methodology
Bititci et al. (1997)	Recognised and positioned IT as a critical component of PMS.	Industry	The audit method (data collection using workbook, integrity audit, and deployment audit)
Kueng et al. (2001)	Discussed how the existing shortcomings in the design of a PMS could be bridged using IT.	Industry	Survey data gathered from 8 Swiss companies
Bose (2006)	Discussed how data systems related to performance measurement may be effectively managed.	Companies	Research literature
Creamer and Freund (2010)	Proposed a framework for using business analytics in performance measurement.	Companies	Forecasting approaches: logistic regression and boosting
Sidorova et al. (2016)	Discussed the relevance of social media in performance measurement.	Companies	Case study of 8 companies

Bourne et al. (2000) highlight the importance of 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) indicate that measures should be dynamic, not static, to stay relevant to any potential changes, as shown in Figure 2.11. Bourne et al. (2002) identify two main drivers of successful implementation as top management support and perceived benefits. Further, both the commitment of the operative level and the tool being appropriate for the organisation's requirements are identified as key factors of a successful implementation of measurement systems (Jääskeläinen and Sillanpää, 2013). De Waal (2003) states that the use stage is the most important stage to ensure success of PMS and how it can be affected by the behavioural factors. Table 2.7 summarises the research contributions on the topic of organisational challenges associated with implementation of an IT-based PMS.

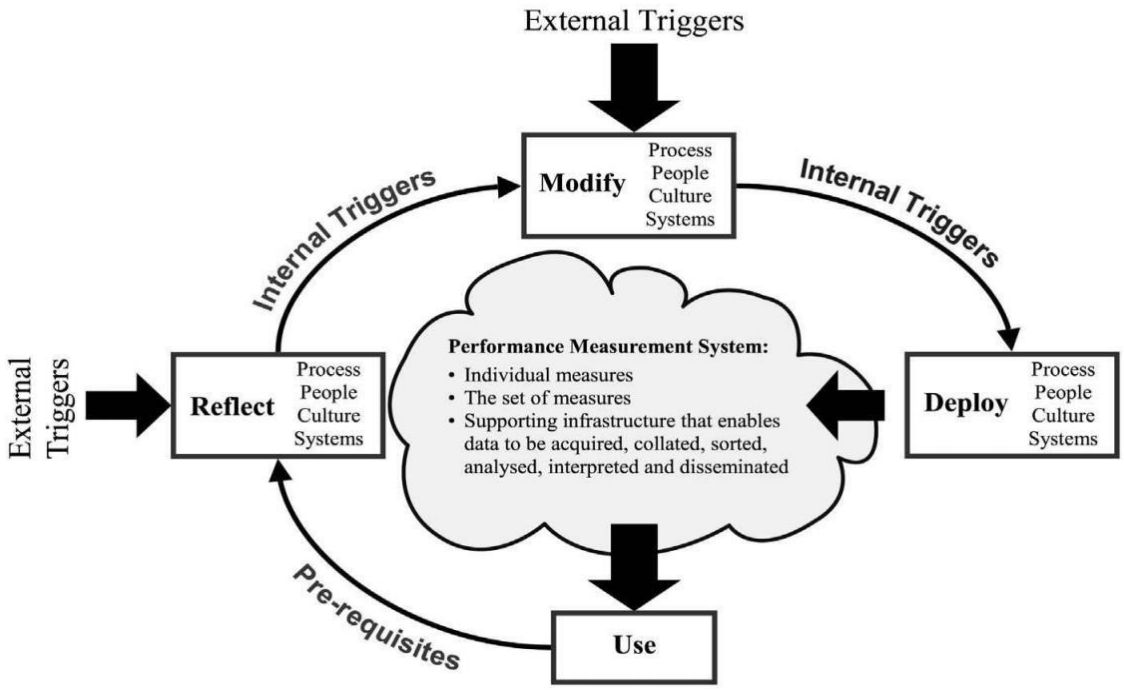

Figure 2.11: Framework of factors affecting the evolution of performance measurement systems (Kennerley and Neely, 2002)

Table 2.7: Summary of research contributions on organisational challenges associated with implementation of an IT-based PMS, adapted from Vallurupalli and Bose (2018)

Research	Major contribution	Sector	Methodology
Bourne et al. (2000)	Observed that change in performance measurement activities might lead to redistribution of power in a firm and attract resistance from some employees.	Manufacturing companies	Case study with three UK companies over two-year period.
Kennerley and Neely (2002)	Highlighted the importance of organisation's readiness for change in adoption and use of a PMS.	Companies	Case study (semi-structured interviews with 25 managers from 7 organisations).
Bourne et al. (2002)	Identified two factors likely to play an important role in the implementation of a PMS: perceived benefits of the system, and top management support.	Companies	Case study of 10 companies (semi-structured interviews with directors and managers).

Holloway et al. (2009)	Discussed how top management may help in mitigating the risk of failure in implementation of a PMS.	Not specified	Survey sent to 31 experts. Factor analysis
Jääskeläinen and Sillanpää (2013)	Suggested that commitment at the operative level is critical for effective implementation of a PMS.	Public organisations	Interviews
Marchand and Raymond (2008)	Suggested that IS literature can be useful in studying PM and proposed a framework for user acceptance of PMS.	Not specified	Research

2.7.1 Analytics in higher education (HE)

There is increasing awareness of the significance of data analytics in HE. This may be due to changing conditions, and for reasons such as: the increased competitive pressures of competition and quality assurance expectations, financial constraints, greater student diversity, and the continued need to have stakeholder involvement to understand related issues (Siemens et al., 2013). Universities must attempt to deal with huge requirements for change and issues related to quality and income generation (Taylor and Baines, 2012). Further, over the past decade, the number of students attending university has increased dramatically (Siemens et al., 2013). However, there is a lack of understanding of the successful adoption of analytics, and strategic insight into analytics is not as well understood in HE as in other sectors such as business, government, and healthcare (Siemens et al., 2013). It is stated that by Siemens et al. that “The education system to date has largely failed to make this transition from data accessible to analytics informed” (Siemens et al., 2013). Figure 2.12 illustrates the role of analytics in driving action.

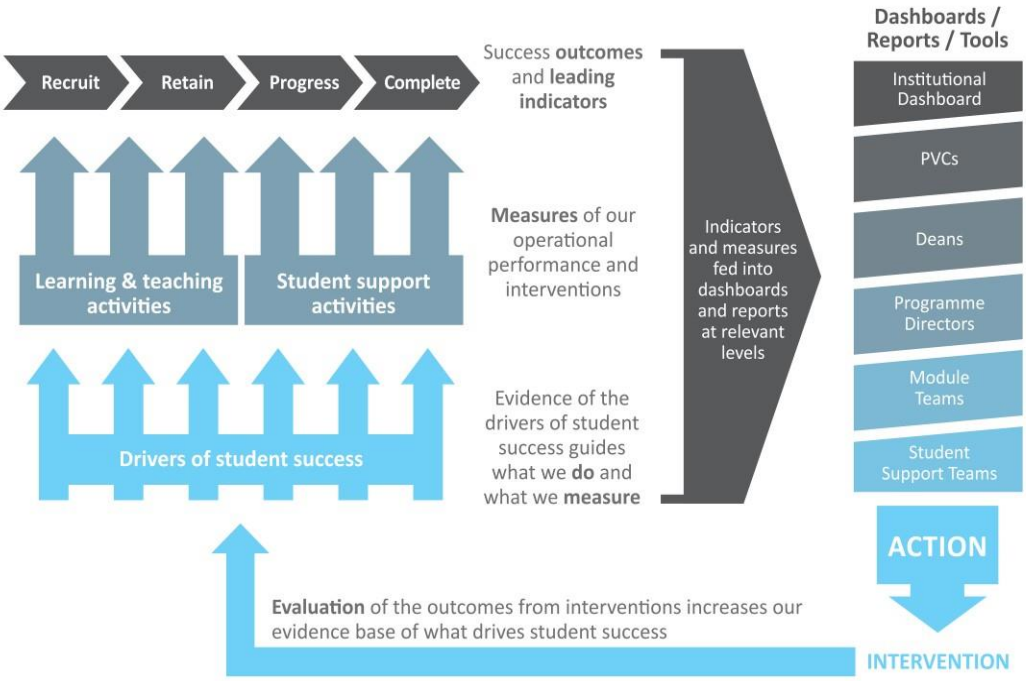

Figure 2.12: Analytics drives action to increase success (Siemens et al., 2013)

As a result, it is crucial to establish a common language of analytics in HE, based on what we mean by analytics, what type of analytics we need, and what technologies are involved, as Van Barneveld et al. (2012) argue. Analytics could be applied to various levels, either institution, department, or learner, depending upon the goals and objectives of the analytics. There are several types of analytics in HE, such as academic analytics, learning analytics, predictive analytics, and action analytics, as illustrated in Figure 2.13 and Figure 2.14. Table 2.8 below shows some proposed definitions of various types of analytics and their level of focus (Van Barneveld et al., 2012).

Table 2.8: Some definitions of analytics (Van Barneveld et al., 2012)

Term	Definitions	Level of focus
Analytics	"An overarching concept that is defined as data-driven decision-making."	All levels
	"[The] processes of data assessment and analysis that enable us to measure, improve, and compare the performance of individuals, programs, departments, institutions or enterprises, groups of organisations, and/or entire industries."	All levels

Business analytics	"The whole category is just using data and analysis to understand and manage your business more effectively, as opposed to simply capturing your customer's address or keeping track of your employees' vacation balances, that transactional kind of stuff."	Institution (enterprise)
Academic analytics	"[A] process for providing [higher education institutions] with the data necessary to respond to the reportage and challenges facing contemporary universities."	Institution Department
	"A process for providing higher education institutions with the data necessary to support operational and financial decision-making." (Adapted from Goldstein and Katz)	Institution
Learning analytics	"The use of analytic techniques to help target instructional, curricular, and support resources to support the achievement of specific learning goals." (Adapted from Bach)	Department Learner
	"[To] enable teachers and schools to tailor educational opportunities to each student's level of need and ability."	Learner
	"[The] collection and analysis of usage data associated with student learning; [to] observe and understand learning behaviours in order to enable appropriate intervention."	Learner
Predictive analytics	"An area of statistical analysis that deals with extracting information using various technologies to uncover relationships and patterns within large volumes of data that can be used to predict behaviour and events."	All levels

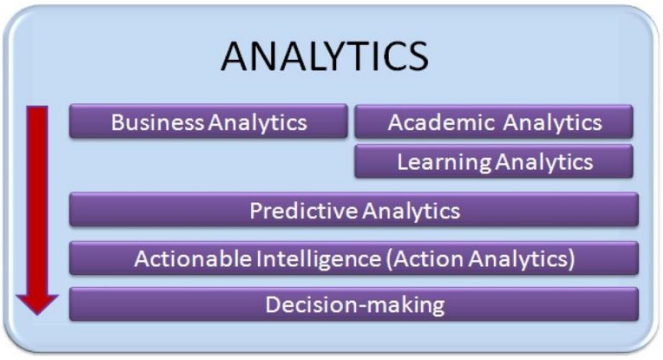

Figure 2.13: Conceptual framework of analytics in business and HE (Van Barneveld et al., 2012)

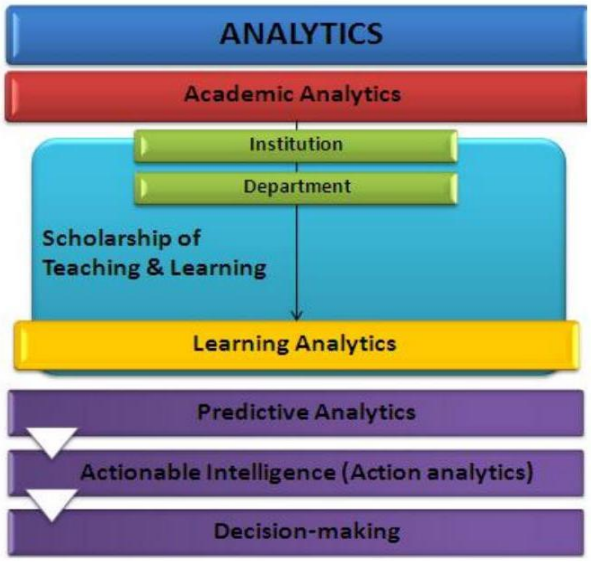

Figure 2.14: Analytics in HE (Van Barneveld et al., 2012)

From the definitions presented in Table 2.8, the various kinds of analytics are associated with different levels within an organisation. It is crucial to understand what kind of analytics are required and to specify what level of the organisation they are aimed at. In this study we concentrate on institution- and department-related levels, which are represented by the term 'academic analytics', to support PM in HE.

2.7.2 Performance measurement and business intelligence in higher education

Recently, universities have become more cautious towards performance measurement due to increased stress on employees by demands for accountability (Taylor and Baines, 2012). One of the most popular tools to support PM, used widely within both for-profit and non-profit organisations, is

the BSC. In the HE sector some universities have already adopted this approach; for example, Glasgow Caledonian University, Napier University, University of California, and Ohio State University (Cheowsuwan, 2016). However, Taylor and Baines (2012) indicate that a small number of UK universities use a BSC, possibly because of resistance by some staff to using business world techniques. However, others are open to developing corporate quality, effectiveness, and accountability measures (Taylor and Baines, 2012).

The majority of studies in this area discuss aspects of the DB as a tool to support students with their learning, such as for feedback, brainstorming, performance tracking, and teacher awareness in group activities, as summarised in Table 2.9. Boosalis et al. (2016) used the Dataset publishing language and Google's public data explorer with DB to analyse data on student learning outcomes, in an attempt to keep them meaningful at various levels of the organisation. Furthermore, a number of studies investigated the implementation of DB to support performance in HE. For example, Denwattana and Saengsai (2016) successfully proposed the use of the Thailand HE DB to support the nursing college of the public health ministry.

Overall, the factors influencing the successful adoption of DB in the HE sector are poorly understood, as are frameworks to support the production and visualisation of effective metrics. This limitation should be investigated and further researched.

Table 2.9: Research paper studies in the context of HE

Research study	Major contribution	Sector	Methodology
Siemens et al. (2013)	Investigating learning analytics opportunities and data requirements that are unique to education sector.	HE	Case study of 10 HE institutions
Van Barneveld et al. (2012)	Highlighted the importance of establishing a common language of analytics in HE.	HE	Review
Cheowsuwan (2016)	Application and implementation of BSC in HE.	HE	Case study of the School of Information and Communication Technology
Guitart and Conesa (2015)	Adopting BI to build DB for teachers by applying analytical techniques on Virtual Learning Environments (VLE)	HE	Stem

Taylor and Baines (2012)	Providing an insight and identifying key issues of applying BSC.	HE	Case study (interviews with senior managers in four UK universities that applied BSC)
Pantazos and Vatrapu (2016)	Design, development and evaluation of teaching DB.	HE	Evaluated with 6 university teachers using biometric usability and eye-tracking technology.
Tarigan et al. (2017)	Finding out performance discrepancy among academic and non-academic staff based on BSC.	HE	T-test
Bakhtina et al. (2015)	Assessment of administrative personnel in HE.	HE	Delfi method, SWOT analysis, brainstorm.
Teixeira and Misaghi (2013)	Benefits of BI tool in an educational landscape.	Private educational institutions	Case study (interview with a manager and 2 system analysts in the IT department).
Adriansyah et al. (2013)	Implementation of human resources management information system.	HE	Case study

2.8 Developing the Framework

Mukherjee and D'Souza (2003) investigated the critical success factors of implementing DW. They explored the factors via a dual approach that compared success factors with factors that lead to failure, and examined embedding them in the phased logic of DW implementation. Factors that lead to failure are classified into two main groups: technical and organisational. Technical factors are data-driven or resource-limitation issues. An example of a data-driven problem is data access, where line and IT managers argue about who should operate the database. In contrast, organisational factors, such as organisational politics, a lack of business objectives, a lack of user involvement, and the absence of an executive sponsor, have been demonstrated to negatively affect the implementation of DW.

BI solutions are employed as an expansion of Enterprise Resource Planning (ERP) systems by combining, processing, and analysing substantial volumes of transactional data produced by the ERP. Hawking and Sellitto (2010) investigated the critical success factors for BI in a setting with ERP systems by conducting qualitative methodology and content analysis of presentations by industry practitioners who implemented and used the system. The sample of presentations for content analysis totalled 69 related to SAP's events and 9,868 presentations. It was found that the majority of the most frequent factors were management support, user participation, and team skills, which were noted in earlier literature and applied to both BI and ERP systems. The content analysis revealed that the industry presentations reflected a practitioner's perspective.

Bischoff et al. (2015) constructed a conceptual model of continuous use of BI and applied a mixed methods approach to explore and confirm the model. They employed partial least squares (PLS) and structural equation modelling (SEM) to test the model and validate existing or new relations between the factors, as presented in Figure 2.15. Their investigation of the particular context of BI systems is motivated by the characteristics of BI, such as the long-term ROI, the variety of their use cases, and inventive rather than regular use. This study offers two contributions. First, in the particular context of BI systems, this study verifies existing constructs and relationships, such as perceived utility, perceived ease of use, trust, and information quality characteristics, that have already been predicted for the ongoing use of IS in general. Further, this study introduces either new constructs or new relations, such as the impact of the organisation, coverage of user needs, user support, influence of peers, and governance constructions.

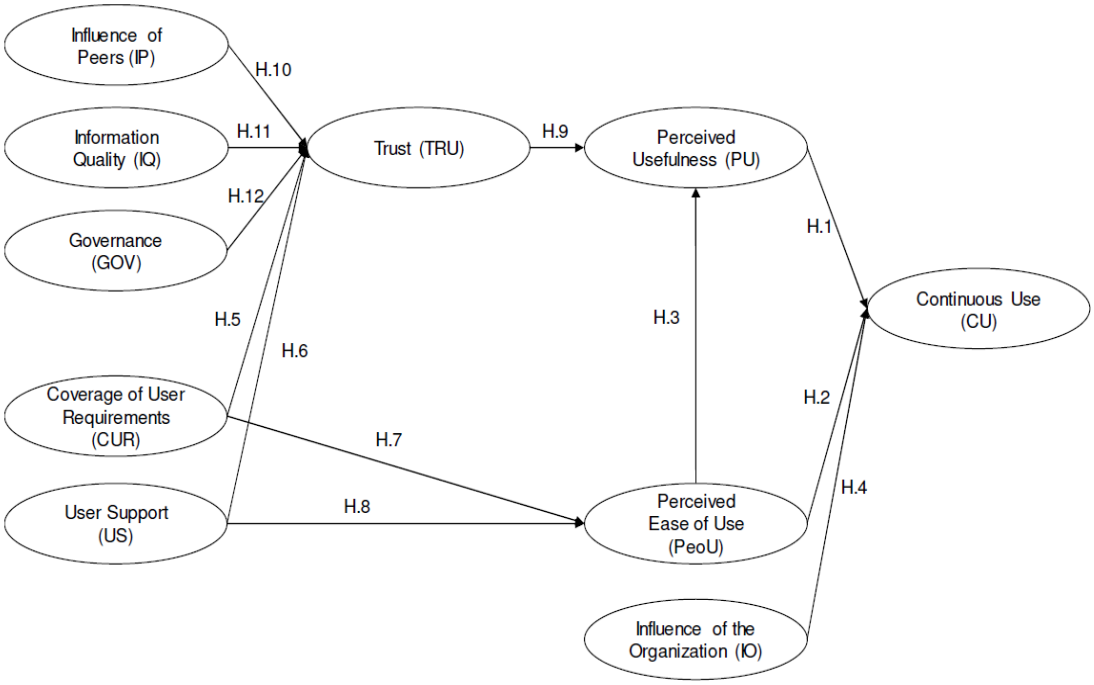

Figure 2.15: Model of continuous use of BI (Bischoff et al., 2015)

Gaardboe and Svarre (2018) conducted a systematic literature review by applying a building block search strategy. They critically evaluated 43 studies published between 2008 and 2017 to extract an overview of the Critical Success Factors (CSF) of BI. The task characteristics are examined first, then the structure, user, and technological elements. In contrast to non-distinct CSFs, which were factors discovered in fewer than nine articles, distinct CSFs were detected in at least nine papers. Four additional CSFs were identified: organisational structure; organisational culture; development of competencies; and strategy and vision.

Pauwels et al. (2009) describe what DB are, how to create them, and what motivates people to use them. The term DB derives from car dashboards, which display important vehicle metrics that the driver should be aware of. Integration is a crucial DB feature designed to improve understanding of data and the processes that bridge the gap between internal and external reporting, and which share the same viewpoints. DB support the consistency of measures for monitoring performance, planning goals and strategies, and communicating with stakeholders. A framework for the successful adoption of DB is presented in Figure 2.16.

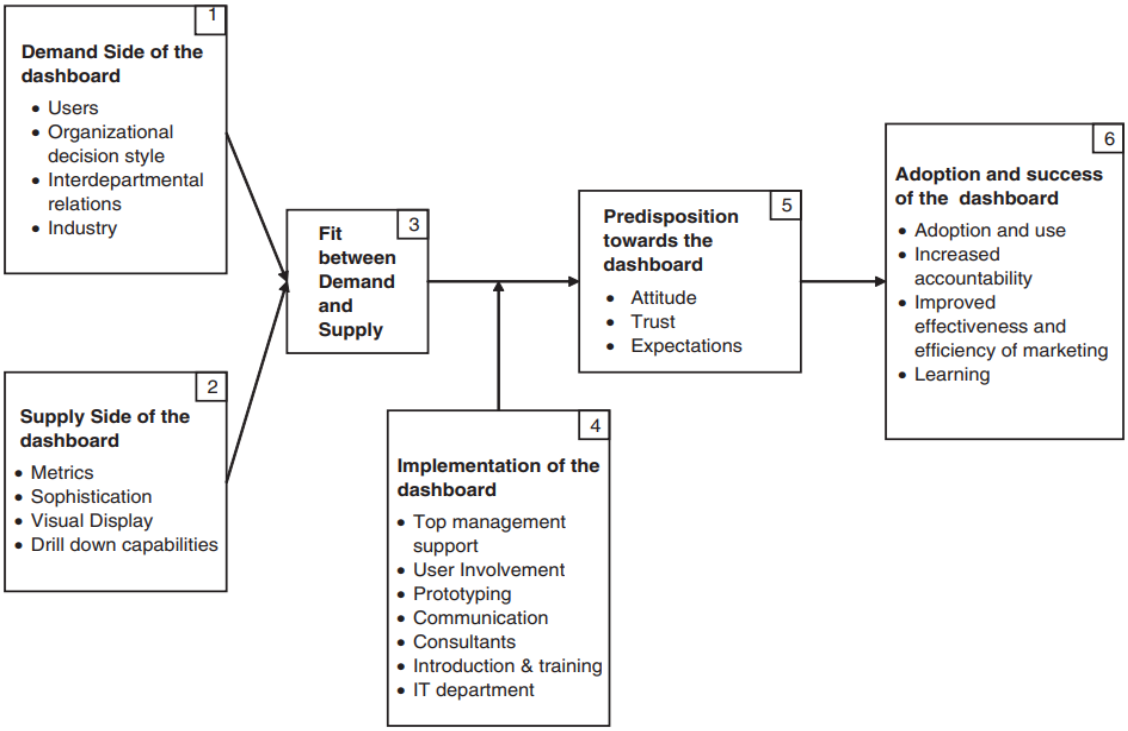

Figure 2.16: Framework for the successful adoption of dashboards (Pauwels et al. 2009)

Wixom and Watson (2001) conducted an empirical study to investigate the impact of factors related to data warehouse implementation. The literature on IT deployment, infrastructure, DW, and success was examined to find relevant influencing factors. This was followed by survey information gathered from 126 conference registrants of The Data Warehousing Institute (TDWI). The initial model was generated and then confirmed by structured interviews with 10 DW experts, as shown in Figure 2.17. The three variables of DW performance considered in the study model were data quality, system

quality, and perceived net benefits. Success with organisational difficulties, project issues, and technological challenges were the three areas of warehouse implementation success that were found.

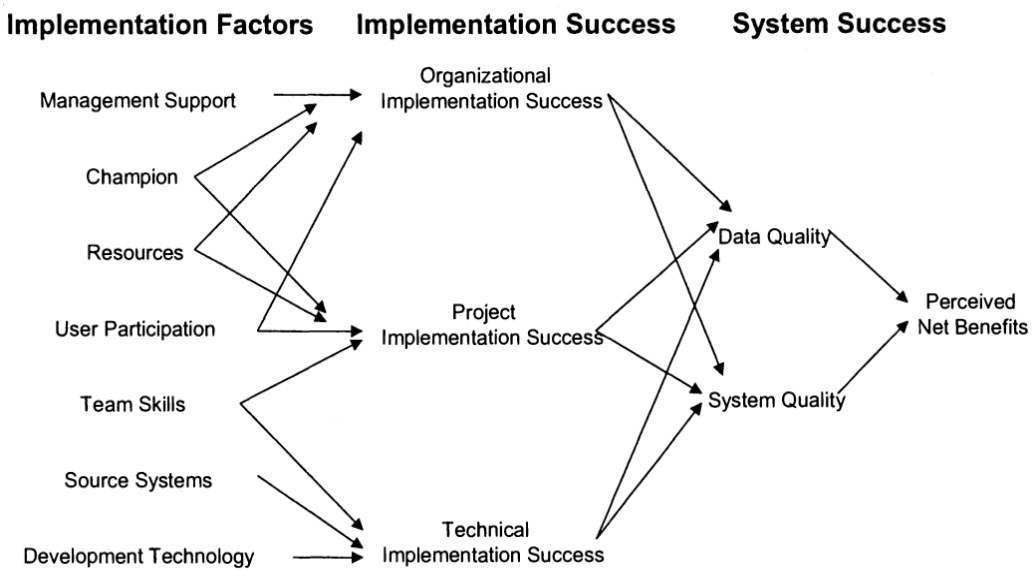

Figure 2.17: Model of data warehousing success (Wixom and Watson 2001)

Pinto and Slevin (1989) demonstrated 10 critical success factors as guidelines for project managers to support the monitoring and assessment of projects. They suggested that these factors should not be fixed at all stages of the project life, but instead should be prioritised within each stage. Figure 2.18 illustrates the factors at each stage. The first assessment of a project's necessity and goals is part of the conceptual stage. For the purpose of achieving these objectives, a more formal set of plans is created, then the execution phase of the project is when the 'real' work is completed. In the termination stage, several final tasks must be carried out after the project is finished, including the

release of resources, the transfer of the project to the clients, and the reassignment of project workers.

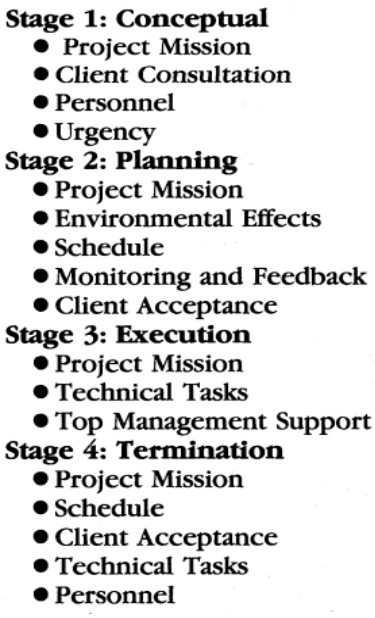

Figure 2.18: Critical success factors at each project stage, in order of importance (Pinto and Slevin 1989)

Delone and McLean (2003) produced their model based on process and causal consideration of information systems (IS) success factors. They constructed a comprehensive study of previous research associated with IS success to generate their model, which was then updated ten years later, based on a large amount of citation research and their validated results. Hypotheses regarding the nature of these causal relationships such as more use, more user satisfaction, and positive net benefits are associated with a high-quality system and should be made within the context of a study. Figure 2.19 shows Delone and McLean's updated model.

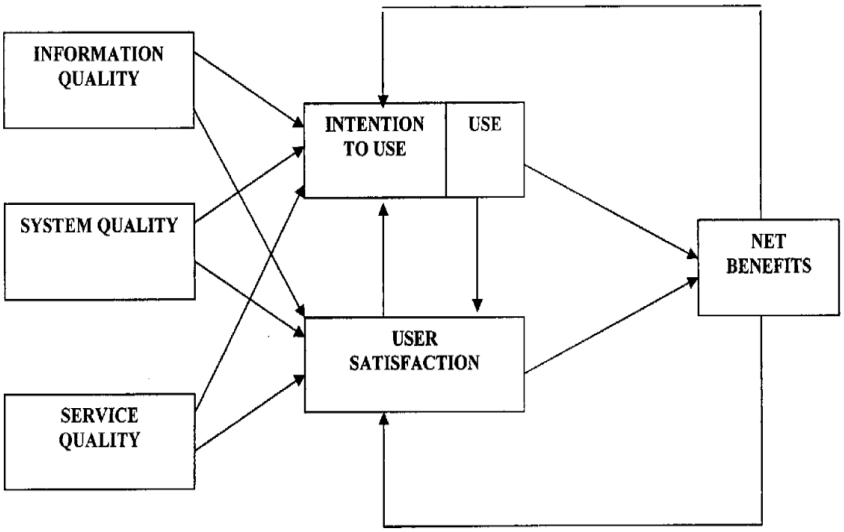

Figure 2.19: Updated Delone and McLean information systems success model (Delone and McLean 2003)

Emam (2013) designed a framework for the critical success factors of BI. These are classified on the basis on the four dimensions of organisation, process, technology, and quality, as seen in Figure 2.20.

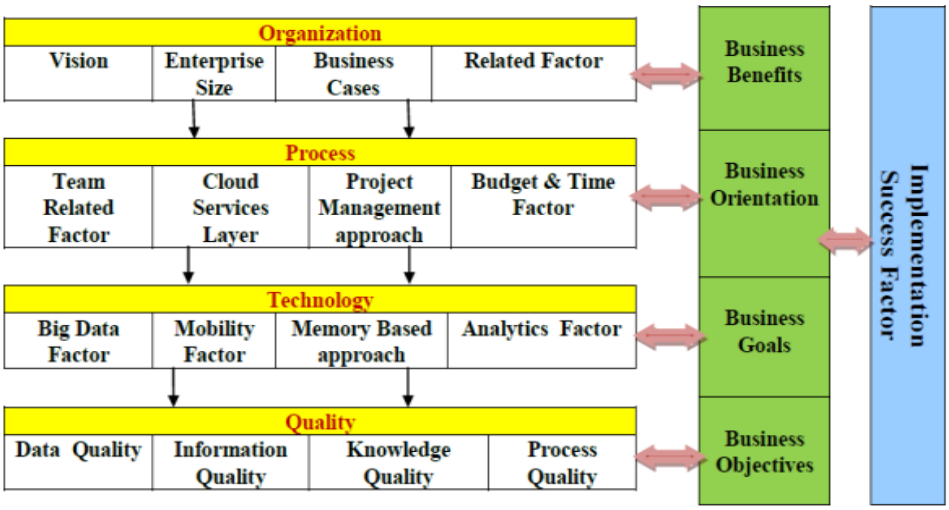

Figure 2.20: Business intelligence critical success factors (Emam 2013)

Table 2.10 illustrates the success factors presented in the literature review. Table 2.11 presents these factors and maps them to the perspectives of the BSC to generate the first version of the framework, as seen in Figure 2.21.

Table 2.10: BI success factors

Factors	Research papers								
	Gaardboe and Svarre (2018)	Bischoff et al. (2015)	Emam (2013)	Hawking and Sellitto (2010)	Pauwels et al. (2009)	Delone and McLean (2003)	Mukherjee and D'Souza (2003)	Wixom and Watson (2001)	Pinto and Slevin (1989)
Management support	✓	✓		✓	✓		✓	✓	✓
Management process	✓								
Project management	✓								
Proper infrastructure and data quality			✓	✓			✓	✓	
Governance	✓	✓		✓					
System quality	✓	✓				✓		✓	
Information and output quality	✓	✓	✓			✓			
External support (consultants)									✓
Monitoring and feedback									✓
Training and competency development	✓			✓	✓				
Net benefits	✓	✓				✓		✓	
User involvement		✓		✓	✓		✓	✓	
Task compatibility	✓								

Factors	Research papers								
	Gaardboe and Svarre (2018)	Bischoff et al. (2015)	Emam (2013)	Hawking and Sellitto (2010)	Pauwels et al. (2009)	Delone and McLean (2003)	Mukherjee and D'Souza (2003)	Wixom and Watson (2001)	Pinto and Slevin (1989)
User's technology experience	✓								
User satisfaction	✓					✓			
User expectations	✓				✓				
Adequate budgetary resources			✓					✓	
Proper planning/scoping of project				✓					
Define business objectives and goals							✓		✓
Clear vision and strategy	✓		✓						✓

Table 2.11: Mapping the factors of BSC perspectives

Perspectives and their factors	Definition	Source
Vision and strategy		
Defined business objectives and goals	Establish goals and needs	Mukherjee and D'Souza (2003)
Clear vision and strategy	Create sound overall vision and its strategy	Gaardboe and Svarre (2018)
Customer perspective	"To achieve our vision, how should we appear to our customers?"	
User and stakeholder involvement	User involvement "occurs when users are assigned project roles and tasks, which leads to a better communication of their needs and helps ensure that the system is implemented successfully"	Wixom and Watson (2001)
Task compatibility	This supports the relevance of task-technology fit (TTF), which suggests that efficiency is high when a technology is compatible with a user's tasks	Gaardboe and Svarre (2018)
User's technology experience	Users are skilled with the technology	Gaardboe and Svarre (2018)
User expectations	For example, "if users have unrealistic or implausible expectations of a BI system, or if the implementation of a BI system fails, they will resist using it"	Gaardboe and Svarre (2018)
User and stakeholder satisfaction	The reaction of the user towards the output of a system	Delone and Mclean (1992)
Internal process perspective	"To satisfy our shareholders and customers, what business process must we excel at?"	
Management support	Management support is "widespread sponsorship for a project across the management team"	Wixom and Watson (2001)
Management processes	Refers to strategy implementation, which can be defined as the politics and procedure management processes (e.g., culture, change processes, bureaucracy) used in an organisation to support BI users	Gaardboe and Svarre (2018)
Project management	"Relates to processes established to identify, develop and implement BI including ongoing operations and maintenance. Project management is more operational than management support and includes coordinating, scheduling, scope and monitoring	Gaardboe and Svarre (2018)

	activities, as well as resources related to project objectives"	
Proper infrastructure and data quality	The quality of data that are provided by source infrastructure. There may be a relationship between infrastructure and data quality. Sound data quality can be ensured through efficient data management and access to data sources.	Wixom and Watson (2001)
Governance	"The construct reflects the existence of specific governance processes for developing and operating the BI system and the degree to which the governance processes are followed and enforced." "Governance includes the people, committees and processes that ensure that BI meets organisational goals. For example, at its highest level, governance ensures that the BI and business strategies are aligned. It should prioritise projects and make the required resources available. At lower levels, it should ensure that there are consistent data definitions"	Bischoff et al. (2015) Wixom and Watson (2001)
System quality	"Measures of the Information Processing system itself". Further, "The desired characteristics of the system itself which produces the information" such as the flexibility and ease of use	Delone and McLean (1992)
Learning and growth perspective	"To achieve our vision, how will we sustain our ability to change and improve?"	
Information and output quality	"Measures of information system output: the quality of information that the system produces"	Delone and Mclean 1992)
Training and competency development	"Training to strengthen a manager's belief in the system, Furthermore, to help users become familiar with the system."	Gaardboe and Svarre (2018)
Net benefits	The benefits of a system as perceived by an organisation. This includes individual and organisational impact.	Delone and Mclean (1992) Delone and McLean (2003)

	Individual impact: is the influence which the information product has on management decision Organisational impact: the effect of the information product on organisational performance	
Monitoring and feedback:	"Timely provision of comprehensive control information"	Pinto and Slevin (1989)
External support (consultants):	Receiving support from outside the organisation	Little and Gibson (2003)
Financial perspective	"To succeed financially, how should we appear to our shareholders?"	
Adequate budgetary resources:	Measure the economic aspect of the project.	Xu and Hwang (2007)
Proper planning/scooping of project:	Proper planning and execution of the implementation schedule	Hawking and Sellitto (2010)

2.9 Summary

This chapter presents the general academic background to the field, along with related studies. As this research study is complex and multidimensional, an overview of concepts has been given to establish a general understanding of different dimensions related to the topic, such as BI, DB, BSC, GQM, and PM.

PMSs have been broadly discussed, taking into consideration various related aspects such as metrics, technology, and organisational challenges. This is aligned with the popular and commonly adopted approach of the BSC that began within for-profit organisations and later spread to non-profits, and suggests the application of a balanced and multidimensional collection of measures. This includes the HE sector combining other technologies, such as BI, and highlighting the importance of analytics and DB to support data-driven decision-making and PM.

Even though awareness of data-driven decision-making and PM is continually growing within the HE sector, there is a marked lack of research into the successful application and usage of such tools compared to that for for-profit organisations, and even non-profit organisations such as the health sector. Table 2.12 summarises some of the research gaps highlighted in this literature review.

Table 2.12: Research gaps identified from the literature review

Themes	Research gaps
Misalignment	• Misalignment between measures and targets may hinder the use of DB (Allio, 2012; Abdul Rahman et al., 2017). • Data visualisation needs to be aligned with a purpose or intention (Echeverria et al., 2018). There is no clear way of showing whether one particular decision method is correct and produces a better outcome than another, or whether it is better than no method (Letier et al., 2014). • There are very few studies on the impact of DB on learning, and indicators cannot be useful if they are not trusted by users (Schwendimann et al., 2017). • Many organisations are not aware of how or whether the measures used to support decision-making are related to their goals (Trinkenreich et al., 2017).
Design	• Lack of usability testing of the design of the DB (Echeverria et al., 2018). • The choice of data to be visualised might not correspond with what learners and teachers are looking for, and even if the visualisation is interpreted correctly, learners and teachers might fail to understand how to adapt their behaviour (Echeverria et al., 2018). • Further research in data presentation and communication using DS is recommended (Kosara and Mackinlay, 2013). • Data are meaningless without explanations, so annotations are required yet have not been evaluated (Elias and Bezerianos, 2012). • Uncertainty tends to be hidden when providing information to learners about their learning in most visualisations, as some design techniques, such as using performance categories like low, medium, and high are applied, without fully addressing uncertainty (Epp and Bull, 2015). • There is a lack of useful information in DB, as well as little understanding of the kind of information that various stakeholders and users need to see, and how it should be presented (Schwendimann et al., 2017).
Quality	• Poor data quality, due to too much information that affects reliability analysis, and lack of awareness of data value (Gitzel et al., 2015). • Systems that render relevant data automatically are important (Koopman et al., 2011). • Huge numbers of alternative solutions that are difficult to explore manually and lack of integrated tools to support decision analysis under uncertainty conditions (Busari, 2017). • Using analytical tools on inaccurate data generates inaccurate information, which affects decision-making: large volume of data versus little analytical culture (Haupt et al., 2015). • Possible creation of large number of metrics by applying GQM (Berander and Jonsson, 2006).

As a result, the framework presented in Figure 2.21 shows the framework of success factors of BI and DB in alignment with BSC perspectives.

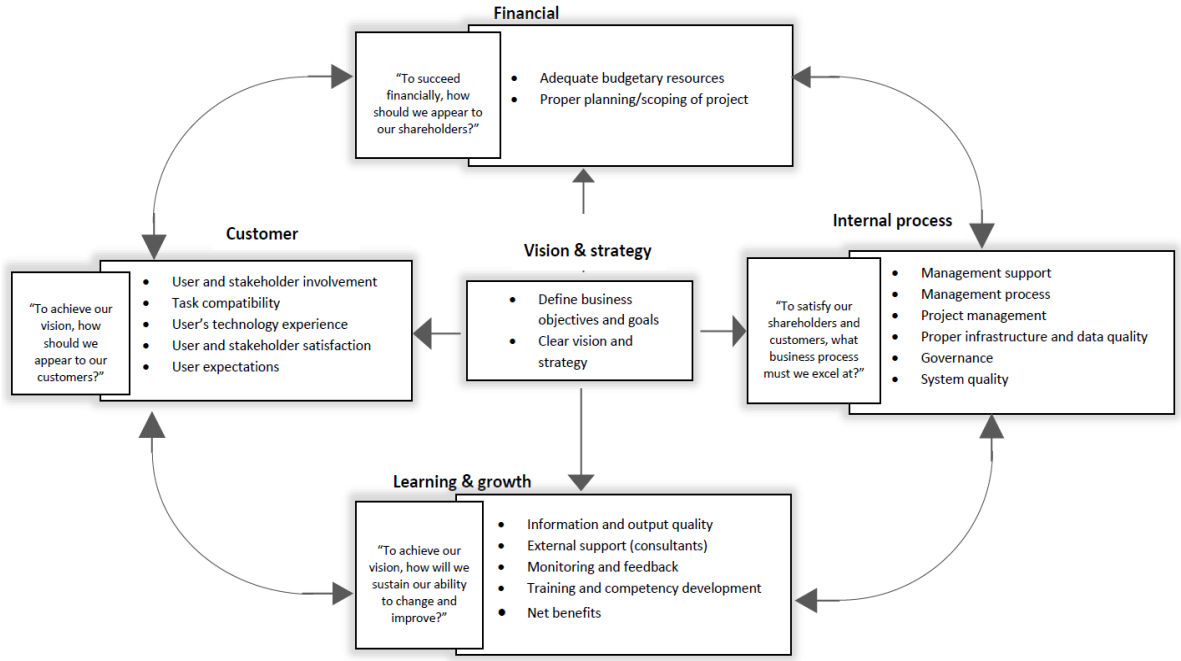

Figure 2.21: The proposed framework of the success factors

Chapter 3 Research Methodology

3.1 Introduction

This chapter describes the methodology and research design used to conduct this research. It begins with a brief presentation of the research orientation and approach. Then, it describes the present study research design, such as its various data collection and analysis instruments. The final part deals with ethical considerations, the trustworthiness of this research, and my role as the sole researcher.

3.2 Research Questions

This research aims to answer the following questions:

RQ1: *How might the balanced scorecard (BSC) approach be adapted to measure the successful usage of Business Intelligence (BI) and Dashboards (DB) to support Performance Measurement (PM) in higher education?*

1.1 What are the financially related factors to ensure the successful application of BI and DBs to support PM in HE?

1.2 What are the customer-related factors to ensure the successful application of BI and DBs to support PM in HE?

1.3 What are the factors related to the learning and growth perspectives to ensure the successful application of BI and DBs to support PM in HE?

1.4 What are the factors related to the internal process perspective to ensure the successful application of BI and DBs to support PM in HE?

RQ2: *Depending on the confirmed framework, how might the confirmed factors be measured and evaluated?*

2.1 What is the appropriate set of measures to reflect the presented factors?

As BI and DB use technologies to support analytics and evidence-based decisions and performance measures, visualising the appropriate data and information relevant to success is crucial. Investigating the factors that underlie success and measuring them by combining two approaches, BSC and GQM, should improve data-driven decisions and performance. Consequently, RQs have been formulated to explore and confirm the factors that lead to measuring them.

3.3 Research Approach

The research paradigms that are commonly adopted by researchers to verify their studies tend to be either positivist or interpretivist. While the interpretivist are focused on interpreting the different meanings of data, the positivist are based on numerical quantifications and testing of hypotheses (Creswell, 2014). These two paradigms are the foundation for three main research approaches: quantitative; qualitative; and mixed methods.

First, the quantitative approach is based on positivist justifications for knowledge advancement, such as cause and effect or correlation, and it applies strategies such as experiments and surveys to generate statistical data (Creswell, 2017). Second, the qualitative approach is founded in knowledge assertions based on constructive viewpoints, such as narratives, grounded theory, and case studies, by collecting open-ended data with the purpose of developing themes from the data (Creswell, 2017). Researchers adopt qualitative methods to gain insights, discovery, and interpretation of a problem or a phenomenon (Noor, 2008). The most common methods of qualitative research are participant observation, in-depth interviews, and focus groups (Mack, 2005). Finally, a mixed methodology approach is consequence-oriented, and requires the simultaneous or sequential collection of data that involves both numeric and textual information (Creswell, 2017). Researchers taking this approach adopt methodologies that include collecting, analysing, and interpreting qualitative and quantitative data in a single study (Leech and Onwuegbuzie, 2009).

In this study the researcher used a mixed or hybrid methodology approach, for various reasons. First, to yield more valid findings the structure of my research requires two phases. While the first phase requires a qualitative research approach, the second phase requires a quantitative approach. Second, the research objectives aim both at exploring the framework of using BI and DBS in the HE sector and testing the validity of this framework. Third, this research uses features of both quantitative and qualitative approaches, as explained in Table 3.1. It uses features of the case study to deeply understand how BI and DBs is adopted in three HE cases, following the framework developed in this study.

Case studies can create effective communication between researchers and participants by analysing participants' stories to obtain good understanding of an event (Baxter and Jack, 2008). They depend on the type of questions, which are commonly 'how' or 'why' questions, involve less control from the researcher over the events, and/or study new phenomena within real-life contexts. Finally, the type of research questions asking "what" and "how" requires the use of both qualitative and quantitative approaches to obtain triangulated and complementary insights into the researched phenomenon (Mack, 2005).

Table 3.1: Comparison of quantitative and qualitative research approaches (Mack, 2005)

Themes	Quantitative	Qualitative
General framework	Seek to confirm hypotheses about phenomena	Seek to explore phenomena
	Instruments elicit and classify replies to queries in a stricter manner.	Instruments use more flexible, iterative styles of eliciting, and categorise responses to questions.
	Use highly structured methods such as questionnaires, surveys, and structured observation.	Use semi-structured methods such as in-depth interviews, focus groups, and participant observation.
Analytical objectives	To quantify variation	To describe variation
	To predict causal relationships.	To describe and explain relationships.
	To describe characteristics of a population	To describe individual experiences To describe group norms
Question format	Closed-ended	Open-ended
Data format	Numerical (obtained by assigning numerical values to responses)	Textual (obtained from audiotapes, videotapes, and field notes)
Flexibility in study design	Study design is stable from beginning to end	Some aspects of the study are flexible (for example, the addition, exclusion, or wording of particular interview questions)
	Participant responses do not influence or determine how, and which questions researchers ask next	Participant responses affect how, and which questions researchers ask next
	Study design is subject to statistical assumptions and conditions	Study design is iterative, that is, data collection and research questions are adjusted according to what is learned

3.4 Research Design

In order to explore the factors related to successful adoption of BI and DB in HE, the researcher followed a set of stages. First, to generate the first copy of the proposed framework, the researcher started by looking at the literature review and analysing the factors identified by previous research

in a variety of contexts. This was followed by examining the proposed factors using semi-structured interviews with the 12 experts, who were an assortment of decision-makers, consultants, and planning and strategy members within the HE sector, to produce the second copy of the proposed framework. In this third phase, the questionnaire was designed and distributed to confirm (or refute) the findings of the previous two phases.

All these three stages were named as the sequential triangulation phase of this research, as in the following diagram (Figure 3.1). The aim of this triangulation stage is to validate the proposed framework using both qualitative and quantitative data collection instruments; that is, the use of secondary data in the literature review chapter, expert interviews, and the questionnaires.

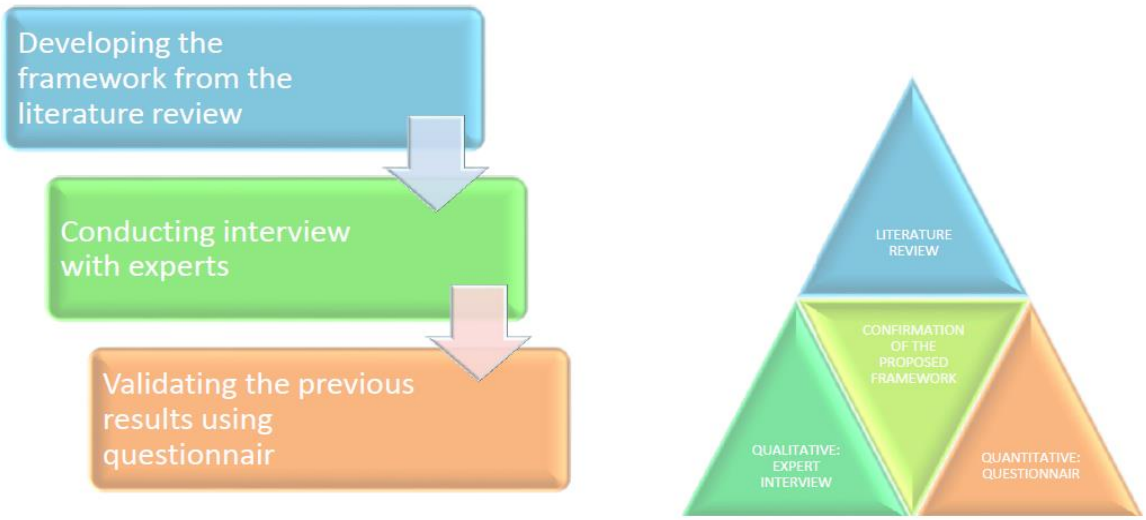

Figure 3.1: Triangulation to validate the proposed framework

After the triangulation stage of this research, case studies were conducted to get deeper insights from the participants into the effectiveness of the proposed framework and what metrics require further modification. All the qualitative data were analysed using thematic analysis, while quantitative data were analysed using descriptive statistics and SPSS hypothesis testing tests. Therefore, this section is divided into three phases to demonstrate the two parts of the sequential triangulation research stage and a final part to showcase the process of conducting, planning, and analysing the case studies.

3.4.1 Phase One: Expert interviews

After identifying the success factors in the literature secondary data, semi-structured interviews were conducted with a number of experts in the field of HE to validate, modify, and refine the factors in the original framework. The interviews consisted of both open- and closed-ended questions. The closed-ended questions involved rating the proposed factors, while the open-ended

questions were intended to give the experts a chance to explain the reasons for their choices. This enabled the researcher to identify, confirm, and refine the proposed factors involved in the current usage of PMSs. The open-ended questions were also used to discover new factors affecting BI success.

3.4.1.1 Identifying experts

In order to discover and validate the factors of the proposed framework related to successful usage of BI and DB to promote PM within HE organisations, this study conducted semi-structured interviews with 12 experts. The concept of data saturation is used in this research, which indicates that the number of participants is increased until the dataset reaches redundancy or no new data are being collected. Consequently, the researcher can conjecture that there is an adequate number of participants (Marshall et., 2013). Moreover, the sample of experts was chosen from three distinct categories according to role: decision-makers, strategy and planning members, and consultants. The strategy and planning members were employees who worked to develop strategies relating to organisational PM, while the consultants had been involved in consultation processes with the HE sector.

As this study seeks to understand and promote better organisational PM in the HE sector, the researcher decided to narrow the focus from the university-wide level to a faculty-based level to enable better access to decision-makers. The target decision-makers were a head of school and a dean or vice-dean of a faculty.

3.4.1.2 Sampling technique for the interviews

It is important to determine the appropriate sample size for interviews. Entire populations cannot be studied, for reasons such as feasibility and cost restrictions, so choosing a representative sample is crucial (Bhattacherjee, 2012). The sampling process involves choosing a population; that is, “all people or items (unit of analysis) with the characteristics that one wishes to study”, and a sampling frame, which is “an accessible section of the target population”. A sample is then chosen from the sampling frame (Bhattacherjee, 2012).

In qualitative studies, sampling techniques are generally non-random and non-probability, such as convenience, quota, and expert sampling (Bhattacherjee, 2012). In this study, an expert sampling technique was applied, “where respondents are chosen in a non-random manner based on their expertise on the phenomenon being studied” (Bhattacherjee, 2012). Furthermore, the convenience method was used, considering convenient access to participants.

3.4.1.3 Interview design

The interview was designed to collect both qualitative and quantitative data using a semi-structured approach that included open- and closed-ended questions. The qualitative data were gathered using open-ended questions designed to investigate the factors presented in the proposed framework and to elicit participants' opinions on the validity of the factors and the perspectives they belonged to.

The quantitative data were obtained from the closed-ended questions, which were designed to gather participants' ratings for each of the factors on a five-point Likert scale. The Likert scale consisted of numbered responses from 1 to 5, where 1 represented strongly disagree, 2: disagree, 3: neutral, 4: agree, and 5: strongly agree. One advantage of the five-point scale is the ease of reading the whole list to the interviewee, compared to the more time-consuming seven-point scale. Better reliability and validity are obtained with a five-point scale than fewer scale points (Dawes, 2008).

3.4.1.4 Interview procedures

At the beginning of the study, communication was established with the sample of experts via email or WhatsApp messages inviting them to participate. Once the invitation had been accepted, participants were sent the consent form, the proposed framework, and information about the study. Suitable times, dates, and preferred interview medium (phone, face-to-face, or email) were arranged.

Most of the interviews were conducted via phone, and a few were conducted face-to-face. Only two of the interviews (Expert-10-CON and Expert-11-VICE-DEAN) were accomplished via email and messages. These participants received the interview questions and the list of definitions, then wrote down their answers. This method of interviewing was necessary because of time limitations during the Ramadan period. All the interviewees were asked to sign the consent form, then the framework was discussed and the questions were asked. They were informed at the beginning that the interview was expected to last an hour. All the interviews were conducted in English and there were no translation issues that might affect the result.

3.4.1.5 Thematic data analysis

The themes are coded for the questions provided in the interviews; a deductive approach is applied, following six steps to conduct a thematic analysis, as suggested by Braun and Clark (2006) and Cruzes and Dyba (2011).

- Familiarising oneself with his/her data. The researcher made herself familiar with the data by transcribing, reading, and re-reading the data
- The researcher used NVivo to generate the themes that mapped to the interview questions. Figure 3.2 is an example.
- The codes were generated and mapped to the themes as presented in Figure 3.3
- Reviewing and checking the mapped codes to the themes, and to the entire data set as illustrated in Figure 3.4
- Defining and generating the overall story, and finally producing the report of the analysis.

In the first step, I transcribed the audio data verbatim into text; in the second step I read and re-read the text to identify initial codes and themes based on the proposed framework and interview questions, using the nodes function of NVivo. In the third and fourth steps, I skimmed through the text again and reviewed the initial themes to come up with final potential themes. In the fifth and final step, I named the final themes and wrote the analysis report.

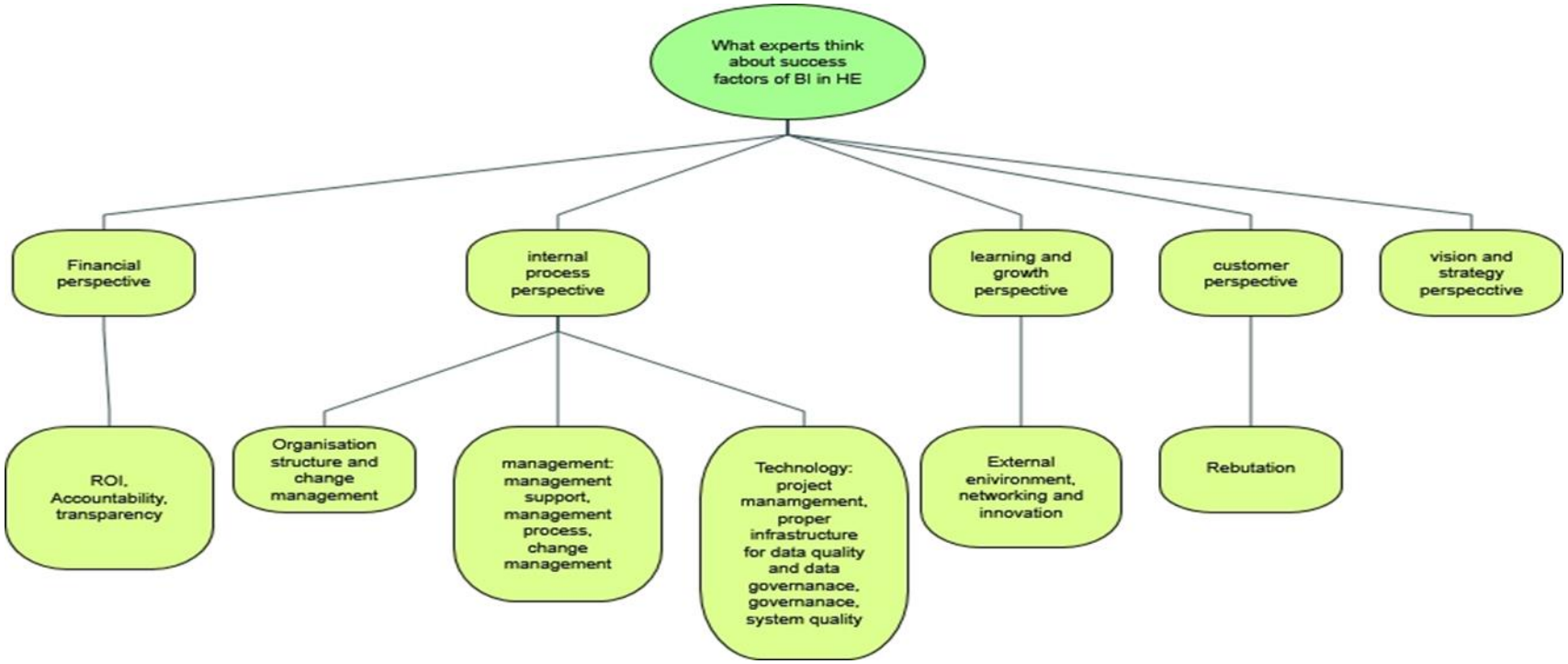

Figure 3.2: Using NVivo to generate themes

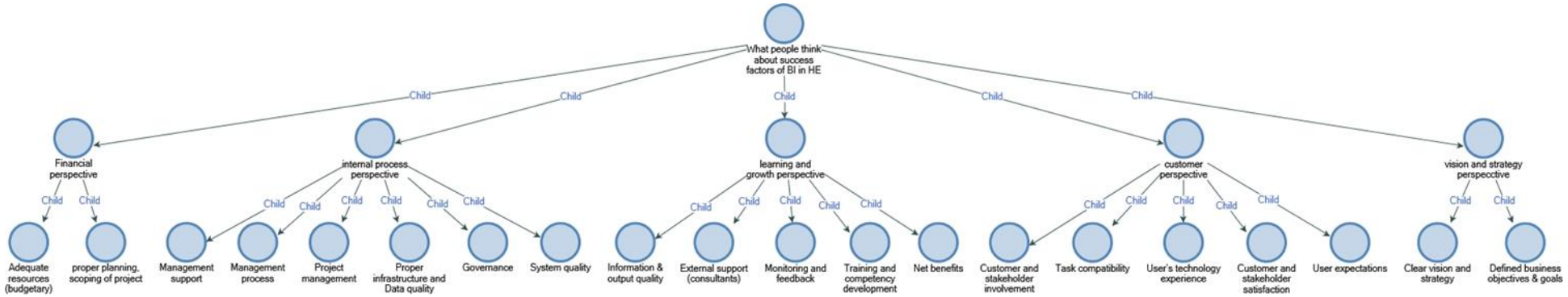

Figure 3.3: Mapping codes into the themes

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Reference 1 - 0.11% Coverage

very important

<Files\\Interviews\\INTV-03-DEAN> - § 1 reference coded [3.27% Coverage]

Reference 1 - 3.27% Coverage

it is very important to have adequate financial resources for many reasons. For example, you will put the project in risk if failed to cover its cost. While enough resources will support and increase, even the innovation and being expand.

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Reference 1 - 1.47% Coverage

Regarding 'budgetary resources' strongly agree. Because if there is good budget so we can invest in a good infrastructure, good technology, good consultation.

Figure 3.4: Reviewing and checking the mapped codes and themes

3.4.2 Phase Two: Questionnaire

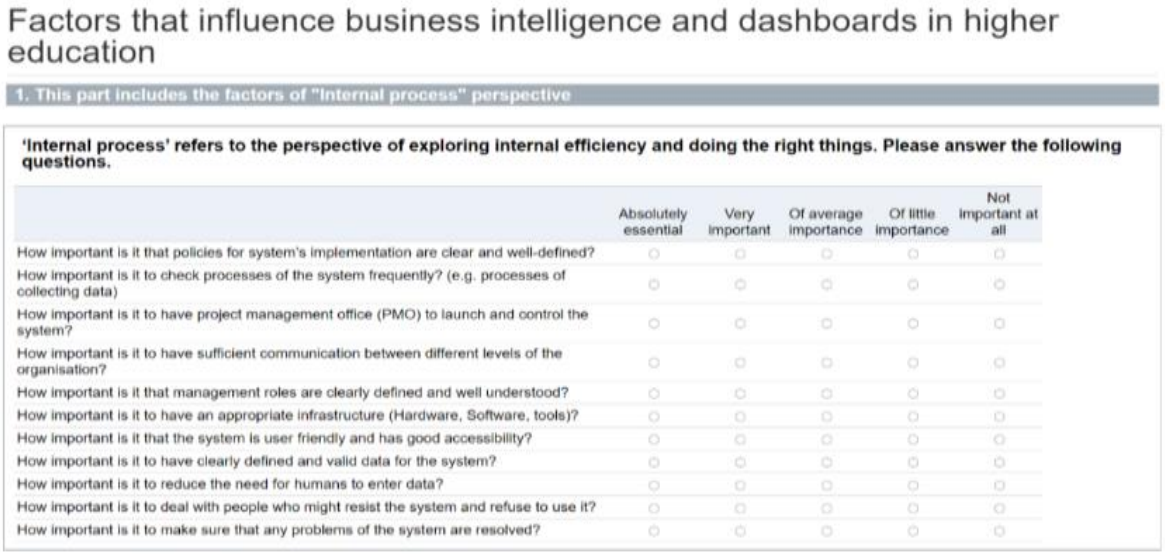
In this study, online questionnaires were distributed to a larger sample of participants to validate the factors that had been established by the interview process.

3.4.2.1 Questionnaire components and procedures

The questionnaire was first piloted with 20 individuals in order to improve the instrument. Based on the feedback and the comments, an improved final version of the questions was generated. It includes two main sections. The first section contains 35 closed-ended questions, with answers based on a Likert scale with the following options: absolutely essential; very important; of average importance; of little importance; and not important at all. The second section consists of open-ended questions to gain an insight of participants' opinions and suggestions.

Figure 3.5 shows the published survey. The questionnaire was designed and generated using the iSurvey tool and distributed by contacting participants via the email address given in their profile or on the organisation's website. The emails contained 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 to complete the survey, if they had not already done so.

The chosen method of sampling was the convenience sampling technique, and the target participants were individuals whose major responsibilities included strategic or operational decisions, as well as those engaged in developing or designing BI systems or DB. Achieving the required response level was challenging, as although around a thousand people attempted the questionnaire over a period of more than three months, only 37 completed the survey in full, as seen in Figure 3.6.



Factors that influence business intelligence and dashboards in higher education

1. This part includes the factors of "Internal process" perspective

'Internal process' refers to the perspective of exploring internal efficiency and doing the right things. Please answer the following questions.

	Absolutely essential	Very important	Of average importance	Of little importance	Not important at all
How important is it that policies for system's implementation are clear and well-defined?	○	○	○	○	○
How important is it to check processes of the system frequently? (e.g. processes of collecting data)	○	○	○	○	○
How important is it to have project management office (PMO) to launch and control the system?	○	○	○	○	○
How important is it to have sufficient communication between different levels of the organisation?	○	○	○	○	○
How important is it that management roles are clearly defined and well understood?	○	○	○	○	○
How important is it to have an appropriate infrastructure (Hardware, Software, tools)?	○	○	○	○	○
How important is it that the system is user friendly and has good accessibility?	○	○	○	○	○
How important is it to have clearly defined and valid data for the system?	○	○	○	○	○
How important is it to reduce the need for humans to enter data?	○	○	○	○	○
How important is it to deal with people who might resist the system and refuse to use it?	○	○	○	○	○
How important is it to make sure that any problems of the system are resolved?	○	○	○	○	○

Figure 3.5: Preview of the published questionnaire

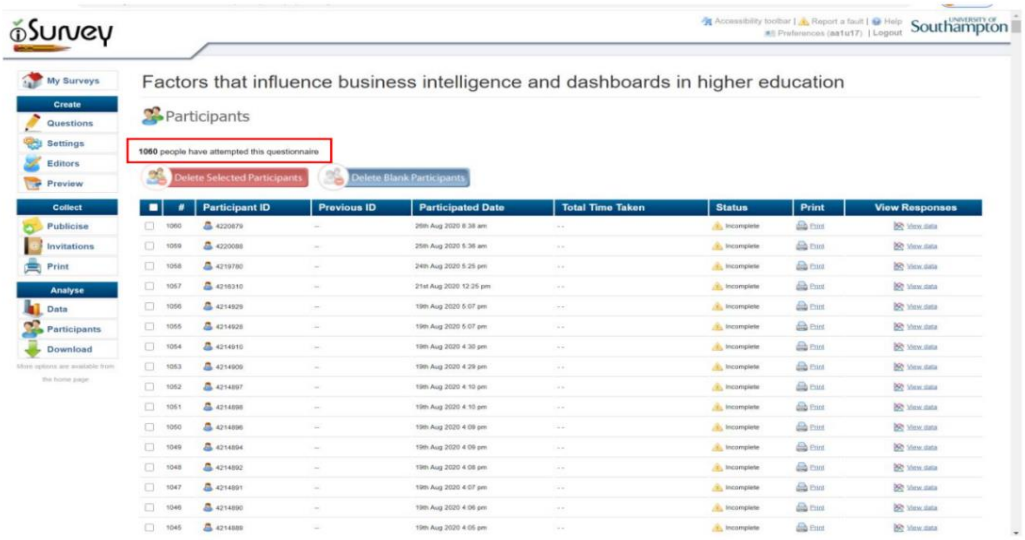


Figure 3.6: Participants who attempted the survey

The researcher sought to identify the reason why so few completed the questionnaire. One possible reason is that it took too long to complete. This was unlikely as the majority accomplished the survey within 10 minutes. Another reason could be that participants might have decided that they were not suitably qualified to fill in the survey, and this seems to have been the most likely reason. This could have been because the concepts of BI and DB are not yet commonly understood in the HE sector.

The researcher then found further potential participants by contacting two non-profit organisations that support HEIs and research in subjects including BI. In this way the required number of participants was reached.

3.4.2.2 SPSS data analysis

The questionnaire was analysed using SPSS software, and the one-tailed t test was used to examine the significance of the proposed factors. The one-sample t-test was used to analyse the results of the quantitative data to compare the mean μ of the population with a hypothesised value of μ0 = 3, which is the mean value of five-point Likert Scale. The hypotheses for testing each factor are as follows:

- H0: If the mean rating of the proposed factor μ < 3, the factor is not significant
- H1: If the mean rating of the proposed factor μ >= 3, the factor is significant. The Bonferroni correction is used to test the significant of the questionnaires' statements.

Applying the Bonferroni correction meant that any observed p-value less than the corrected p-value α/n = 0.05/35= 0.001 was declared to be statistically significant.

3.4.3 Phase Three: Case studies

In this study, a case study is defined as an empirical inquiry for exploring the effectiveness of using DB and BI in improving measurement and performance in the HE sector. Its aims are to gain a deeper understanding of the explored phenomenon within its real context and expose various perspectives from three case studies (Runeson, et al., 2012). In this thesis, the case study is the final round of data collection after conducting triangulation mixed methods to identify and confirm the factors of effective use of BI and DB to improve organisations' performance. This case study phase of my research intends to answer the following questions:

RQ2: What are the appropriate metrics that measure the success of using BI and DB?

- RQ2.1: How does the higher education (HE) sector measure and improve their performance?
- RQ2.2: What is the role of business intelligence (BI) and dashboards (DB) to support performance measurement (PM) of HE organisations?
- RQ2.3: What are the appropriate metrics to measure the effectiveness of using this technology?
- RQ2.4: What are the barriers to and opportunities in applying this technology?

The main goal of the case study is to measure these factors and understand some related aspects by highlighting the role of BI and DB in the HE sector, together with the associated barriers and opportunities. This goal can be met by considering the following objectives of the case study:

- Understanding the measures and techniques that are already in place in current practice with BI and DB in HE

- Apply the GQM approach to measure previously confirmed factors
- Evaluating these measures
- Finding out and understanding the barriers to applying BI and DB effectively in HE
- Finding out and understanding the opportunities in applying BI and DB effectively in HE.

3.4.3.1 Sampling for the case studies

The case study is planned to be performed within HEIs that use DB to improve their performance. However, if DB are not applied within an organisation, using BI or the concept of analytics makes it a valid case for the study. Further, the unit of the analysis is either an institution, a faculty, or a department, as presented in Figure 3.7. However, the main concentration is a faculty or a department, because these are more manageable than a whole institution. Consequently, the convenience sampling method was chosen to select the case-study HEIs.

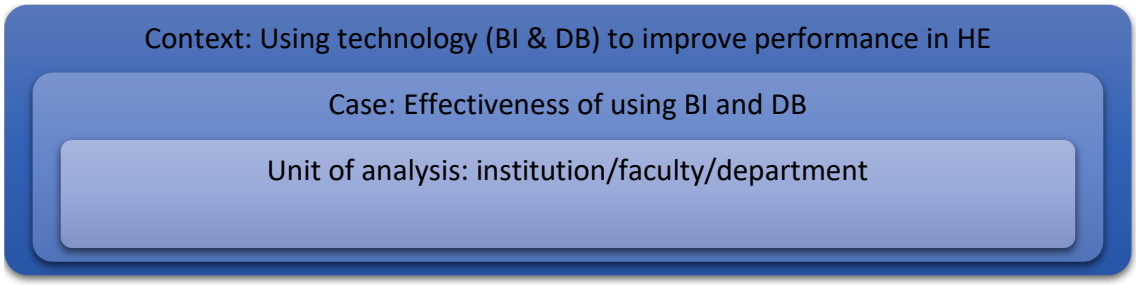


Figure 3.7: Units of analysis

In order to recruit participants from the various HEIs, three group websites/emails were used to distribute the call for participation to any Russell or non-Russell group institution: 1) academic, financial space; 2) UK universities@Jisc mail; and 3) business-intelligence@Jisc mail.

Only six participants from universities replied and consented to take part in the study. After the withdrawal of one participant for unspecified reasons, the remaining participants constituted two females and three males, and their roles in the HE institution vary. The three case studies (HEIs) are referred to by number (e.g., case study one).

The three participants from case study one comprise one male and two females, all working in a planning and strategy team. One of the female participants has a main role, which is head of data analytics and insight. The male participant from case study two is a deputy director of planning and strategy. The male from case study three has dual roles: chief of staff and director of strategic project, and vice-chancellor officer.

For confidentiality, a detailed account of the universities where the participants work is not provided. The following diagram (Figure 3.8) summarises the exclusion and inclusion criteria adopted to recruit and select both the units and cases for analysis.

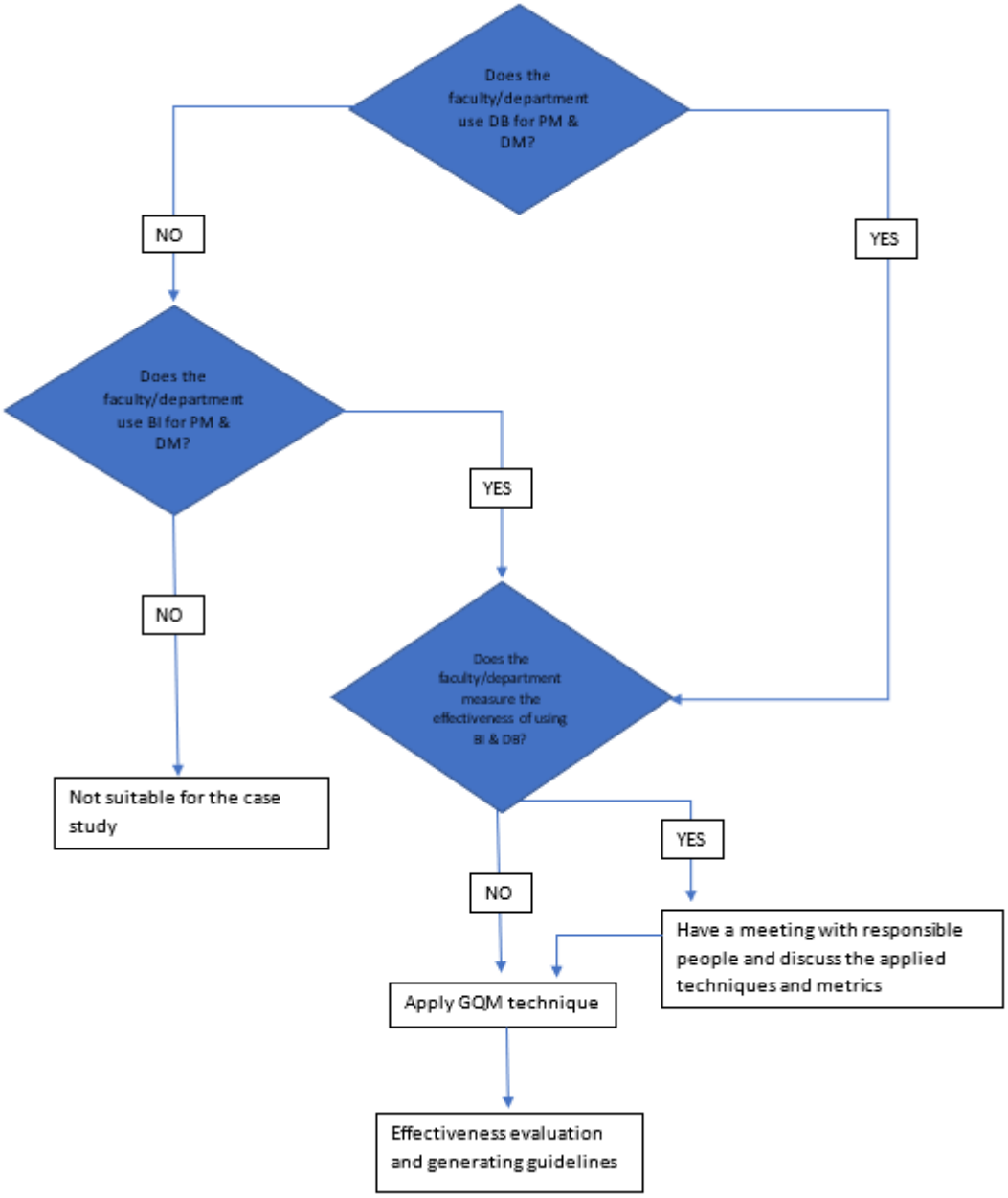


Figure 3.8 General process of the CS and inclusion, exclusion criteria

3.4.3.2 Planning and procedures of the case studies

After applying inclusion and exclusion criteria to select the suitable unit of analysis, it was planned to run the case study through three milestones. The first was to scan the environment and the current statutes; the aim was to understand the current status and techniques of measuring performance. Consequently, it includes two main parts, as presented in the following tables (Table 3.2 and

Table 3.3):

Table 3.2: First milestone (part 1)

RQ2.1: How does the higher education (HE) sector measure and improve their performance?			
Scanning the environment and current status **Part 1: General understanding of performance measurement within the organisation**			
The applied system	Data collection method/sampling method	Participants	Questions
DB or BI	Focus group if applicable, if not interviews with individuals/ Convenience sampling	Group/individuals of different roles/skills (people making decision: Vice-dean, Dean, or Head of school/ member of planning & strategy team/ member of the development team)	From your perspective, what does performance measurement in HE means?
			How important is it to measure performance in HE? • Why do you think it is important? • Which part or level of your organisation do you think the performance measurement is most important? why?
			Do you measure performance at your organisation? • How do you measure performance? • How does your institution/faculty measure their performance?
			How many managerial levels that constitute the organisation? • What is the main structure of your organisation? Is it horizontal, vertical or something else?
			What is the role and responsibilities of each level? • How do individuals from different levels/roles communicate?
			What process is followed for promotion (from one position/role to another)? • How is the decision made?

Table 3.3: First milestone (part 2)

RQ2.2: What is the role of business intelligence (BI) and dashboards (DB) in supporting performance measurement of HE organisations?			
Scanning the environment and current status Part 2: General understanding of adopting technology to improve performance			
The applied system	Data collection/ sampling method	Participants	Questions
DB or BI	Focus group if applicable, if not interviews with individuals/ Convenience sampling	Group/individuals of different roles/skills (People making decision: Vice-dean, Dean, or Head of school/ member of planning & strategy team/ member of the development team)	How did you decide that you need BI or DB? • What were the processes (steps) you have taken to adopt BI or DB? • What measures are presented in the DB to track the performance? • How to you define/select the appropriate metrics? • How do you ensure the accuracy of data presented in the DB? • Do you review and refine the metrics to keep them updated? How aften and how? • Do you think that DB presented the information that you need? Why? • How did these measures been presented? Can you share screenshots?
			How does the organisation confirm the value of BI and DB systems?
			Did you find DB/BI helpful to your organisation to achieve the strategy? How
			Did you find DB/BI helpful to your department to achieve the strategy? How?
			Did DB/Bi help the department to be aligned with the organisation's strategy? How?

The second milestone is to refine and generate the appropriate metrics to measure the factors of effective use of BI and DB. The Goal Question Metrics (GQM) approach is to be adopted, as presented in the following tables (Table 3.4, Table 3.5 and Table 3.6):

Table 3.4: The second milestone (refining and generating metrics)

<table>
<tr><th colspan="4">RQ2.3: What are the appropriate metrics that measure the effectiveness of using BI and DB?</th></tr>
<tr><th colspan="4">Refining and Generating metrics</th></tr>
<tr><th>Applied system</th><th>Data collection/ sampling method</th><th>Participants</th><th>Questions</th></tr>
<tr><td rowspan="3">DB or BI</td><td rowspan="3">Focus group if applicable, if not interviews with individuals/ Convenience sampling</td><td rowspan="3">Group/individuals of different roles/skills (People making decision: Vice-dean, Dean, or Head of school/ member of planning & strategy team/ member of the development team)</td><td>Going through the following goals and objectives, could you please answer the subsequent questions:
• What do you think about the proposed description of these goals (Table 3.5)? Could you explain?
• What do you think of the proposed description of these objectives (Table 3.6)? Could you explain?</td></tr>
<tr><td>Applying the GQM approach, for each objective and its proposed questions, what do you think of the following?
• Does the question need to be refined? How?
• Do you suggest other questions?
• On scale of 3: high, middle, low; do you suggest prioritising of the proposed questions?</td></tr>
<tr><td>What do you think about the proposed metrics?
• Does these metrics need to be refined? How?
• Do you suggest other metrics?
• On scale of five: do you think these metrics match their assigned question(s)? Why?</td></tr>
</table>

Table 3.5: Description of the goals

Goals	**Description**
Goal-1: Vision and strategy	To assist and achieve the vision and strategy of the organisation.
Goal-2: Internal process	To meet user demands and improve current activities of the system.
Goal-3: User and stakeholder	To identify, manage and achieve user and stakeholder satisfaction.
Goal-4: Financial	To manage, utilise and support the financial resources.
Goal-5: Learning and growth	To increase innovation, learning, personal and organisational growth to assist skills and capability.

Table 3.6: Description of the objectives

Internal process perspective	
Management support	Management support is widespread sponsorship for the system across the different levels of management.
Change management	An approach to control change and help users to adopt change.
Management processes	Refers to strategy implementation, which can be defined as the politics, procedures, and processes (e.g., culture, change processes, bureaucracy) used in an organisation to support BI and DB users.
Proper infrastructure	The required hardware, software, and tools.
Data quality and data governance	The accuracy and timeliness of data that are provided by source infrastructure, and clear ownership of data.
Governance	Governance includes the people, committees, and processes through different levels of the organisation to ensure that BI and DB meets organisational goals, making decisions and keeping records of decision to ensure accountability.
System quality	The desired and achieved characteristics of the system.

Learning and growth perspective	
Information quality	The information being accurate, meaningful and up to date.
Training and competency development	Training to strengthen a manager's belief in the system. Furthermore, to help users become familiar with the system and use it effectively.
Net benefits	The benefits of a system as perceived by an organisation. This includes individual and organisational impact, which can be positively or negatively influenced by BI.
Monitoring and feedback	Monitoring the impact of data-based decisions and obtain feedback.
Internal consultation	Receiving advice and support from inside the organisation.
Financial perspective	
Adequate budgetary resources	Plan and manage the costs and economic aspects of the project.
Proper planning/scoping of project	Proper planning and execution of the implementation schedule.
Return on investment	Increasing income against expenditure.
Vision and strategy	
Defined business objectives and goals	Establish goals and needs.
Clear vision and strategy	Create clear overall vision and its strategy.
User and stakeholder perspective	
User and stakeholder involvement	Direct or indirect participation of users and stakeholder over different stages of the system.
User's experience	User's skills and competence.
User and stakeholder expectations	Understanding and managing realistic expectations.
User and stakeholder satisfaction	The reaction of the user and stakeholder towards the output of a system.

To answer the questions of the second milestone, a list of metrics is to be shared and discussed to evaluate, refine, and generate metrics. These metrics are classified on the basis of five main goals, which are internal process; learning and growth; user and stakeholder; financial; and vision and

strategy, as illustrated in the following tables (Table 3.7, Table 3.8, Table 3.9, Table 3.10, and Table 3.11):

Table 3.7: Questions and metrics of goal-1 (Vision and Strategy)

Code	Questions and Metrics	Metric Identifier	Source
Q1	**Does the institution follow a clear vision and strategy for applying and using the system (Dashboard/Business Intelligence)?**		
M1.1	The vision around the system (Dashboard/Business Intelligence) are clearly stated and understood.	Strongly agree/ Agree/ Neutral/ Disagree/ Strongly disagree.	
M1.2	The strategy around the system (Dashboard/Business Intelligence) are clearly stated and understood.	Strongly agree/ Agree/ Neutral/ Disagree/ Strongly disagree.	
Q2	**Does the institution state clear objectives for the system?**		
M2.1	The objectives around the system (Dashboard/Business Intelligence) are clearly stated and understood.	Strongly agree/ Agree/ Neutral/ Disagree/ Strongly disagree.	
M2.2	The requirements for using the system (Dashboard/Business Intelligence) are clearly stated and understood.	Strongly agree/ Agree/ Neutral/ Disagree/ Strongly disagree.	
Q3	**Is it clear that the vision and strategy of the system (Dashboard/Business Intelligence) aligned with the vision and strategy of the organisation?**		
M3.1	The institution tests the linkage of the system (Dashboard/Business Intelligence) with the actual strategy to ensure the alignment.	Strongly agree/ Agree/ Neutral/ Disagree/ Strongly disagree.	

Table 3.8: Questions and metrics of Goal-2 (Internal Processes)

Code	Questions and Metrics	Metric Identifier	Source
Q1	**Does management over different levels (e.g., Executives, Senior managers) provides support to apply and use the system (Dashboard (DB)/Business Intelligence (BI))?**		
M1.1	The institution keeps championing the use of the system (DB & BI).	Strongly agree/ Agree/ Neutral/ Disagree/ Strongly disagree.	
M1.2	The importance of the system (DB & BI) for the success of the institution is understood to users.	Strongly agree/ Agree/ Neutral/ Disagree/ Strongly disagree.	
M1.3	There is encouragement for regular use of the system (DB & BI) by many people for a variety of purposes.	Strongly agree/ Agree/ Neutral/	

		Disagree/ Strongly disagree.	
M1.4	The institution expects high level of participation in capturing and sharing intelligence.	Strongly agree/ Agree/ Neutral/ Disagree/ Strongly disagree.	
M1.5	The institution facilitates authorisation to access the system (DB & BI).	Strongly agree/ Agree/ Neutral/ Disagree/ Strongly disagree.	
M1.6	The institution Incentivises and rewards performance based on the system (DB & BI).	Strongly agree/ Agree/ Neutral/ Disagree/ Strongly disagree.	(Ramakrishnan et al., 2016)
Q2	**How to ensure data governance and the quality of data?**		
M2.1	There is a clear ownership of data.	Strongly agree/ Agree/ Neutral/ Disagree/ Strongly disagree.	
M2.2	There is a clear ownership of processes that generate the data.	Strongly agree/ Agree/ Neutral/ Disagree/ Strongly disagree.	
M2.3	There is a clear understanding of uses of the data.	Strongly agree/ Agree/ Neutral/ Disagree/ Strongly disagree.	
M2.4	The purpose of using the data is clear.	Strongly agree/ Agree/ Neutral/ Disagree/ Strongly disagree.	
M2.5	There is a clear understanding of who controls data.	Strongly agree/ Agree/ Neutral/ Disagree/ Strongly disagree.	
M2.6	There is a clear understanding of who produces data.	Strongly agree/ Agree/ Neutral/ Disagree/ Strongly disagree.	
M2.7	There is clear definition of data used to compose key ratios.	Strongly agree/ Agree/ Neutral/ Disagree/ Strongly disagree.	
M2.8	The institution has a single source its data.	Strongly agree/ Agree/ Neutral/	

		Disagree/ Strongly disagree.	
M2.9	The institution demonstrates periodic validation of data.	Strongly agree/ Agree/ Neutral/ Disagree/ Strongly disagree.	
Q3	**How is the quality of the system (DB & BI)?**		
M3.1	The system (DB & BI) is easy to use.	Strongly agree/ Agree/ Neutral/ Disagree/ Strongly disagree.	
M3.2	The system (DB & BI) loads quickly (has minimal downtime).	Strongly agree/ Agree/ Neutral/ Disagree/ Strongly disagree.	
M3.3	The system (DB & BI) is integrated appropriately with other sources.	Strongly agree/ Agree/ Neutral/ Disagree/ Strongly disagree.	
M3.4	The visual displays used in the system (DB & BI) are consistent and set within a context.	Strongly agree/ Agree/ Neutral/ Disagree/ Strongly disagree.	
M3.5	The system (DB & BI) creates interactive displays such as drill-downs.	Strongly agree/ Agree/ Neutral/ Disagree/ Strongly disagree.	
Q4	**Does the system (DB) have the appropriate infrastructure?**		
M4.1	The tool used to deliver the system is suitable.	Strongly agree/ Agree/ Neutral/ Disagree/ Strongly disagree.	
M4.2	Efficient data management and access to data sources are supported.	Strongly agree/ Agree/ Neutral/ Disagree/ Strongly disagree.	
M4.3	The required hardware, software, and computer network are provided.	Strongly agree/ Agree/ Neutral/ Disagree/ Strongly disagree.	
Q5	**Do the processes of applying and using the system (DB & BI) managed effectively?**		
M5.1	The institution has explicit processes to create a culture that reinforces the utility of the system (DB & BI).	Strongly agree/ Agree/ Neutral/	

		Disagree/ Strongly disagree.	
M5.2	The institution communicates the purpose and the processes of using the system (DB & BI) to multiple levels of staff.	Strongly agree/ Agree/ Neutral/ Disagree/ Strongly disagree.	
M5.3	The institution constitutes the fundamental processes for updating, presenting, modifying the system (DB & BI).	Strongly agree/ Agree/ Neutral/ Disagree/ Strongly disagree.	
M5.4	The institution has straightforward processes to deliver its strategic intent to users.	Strongly agree/ Agree/ Neutral/ Disagree/ Strongly disagree.	
M5.5	The institution establishes explicit politics for the system (DB & BI) production and usage.	Strongly agree/ Agree/ Neutral/ Disagree/ Strongly disagree.	
M5.6	The institution establishes explicit timetables for the system (DB & BI) production and usage.	Strongly agree/ Agree/ Neutral/ Disagree/ Strongly disagree.	
M5.7	The institution establishes explicit rules for the system (DB & BI) production and usage.	Strongly agree/ Agree/ Neutral/ Disagree/ Strongly disagree.	
M5.8	The institution has processes for converting information into plan of action.	Strongly agree/ Agree/ Neutral/ Disagree/ Strongly disagree.	(Ramakrishnan et al., 2016)
M5.9	The institution has processes for distributing intelligence throughout the organisation.	Strongly agree/ Agree/ Neutral/ Disagree/ Strongly disagree.	(Ramakrishnan et al., 2016)
M5.10	The institution has processes for sharing organisational intelligence with individual employees.	Strongly agree/ Agree/ Neutral/ Disagree/ Strongly disagree.	(Ramakrishnan et al., 2016)
M5.11	The institution has processes for absorbing intelligence from individual employees into organisational framework.	Strongly agree/ Agree/ Neutral/ Disagree/ Strongly disagree.	(Ramakrishnan et al., 2016)

Q6	**How does the organisation govern the system (DB & BI)?**		
M6.1	The structure of departments enables exchange and sharing of intelligence within the organisation.	Strongly agree/ Agree/ Neutral/ Disagree/ Strongly disagree.	(Ramakrishnan et al., 2016)
M6.2	The organisation facilitates sharing of information and collaboration across structural boundaries.	Strongly agree/ Agree/ Neutral/ Disagree/ Strongly disagree.	(Ramakrishnan et al., 2016)
M6.3	The institution has clear records and accountability for decisions about the system (DB & BI).	Strongly agree/ Agree/ Neutral/ Disagree/ Strongly disagree.	
M6.4	The institution has transparency to know when particular snapshots are taken, and what data is included and why.	Strongly agree/ Agree/ Neutral/ Disagree/ Strongly disagree.	
Q7	**How does the institution manage and control the change?**		
M7.1	The institution controls the change and adaptation of the system to changing environment and self-learning.	Strongly agree/ Agree/ Neutral/ Disagree/ Strongly disagree.	

Table 3.9: Questions and metrics of Goal-3 (User and Stakeholder)

Code	Questions and Metrics	Metric Identifier	Source
Q1	**How to improve satisfaction with the system (DB & BI)?**		
M1.1	The system (DB & BI) meets the user's needs and scope to influence.	Strongly agree/ Agree/ Neutral/ Disagree/ Strongly disagree.	
M1.2	The system (DB & BI) helps users in solving issues related to performance and decision-making.	Strongly agree/ Agree/ Neutral/ Disagree/ Strongly disagree.	
M1.3	The system (DB & BI) helps users to perceive the requirements of the organisation/department's performance and decision-making process.	Strongly agree/ Agree/ Neutral/ Disagree/ Strongly disagree.	
M1.4	The system (DB & BI) helps users to respond to enquiries about the organisation/department's performance and decision-making process.	Strongly agree/ Agree/ Neutral/ Disagree/ Strongly disagree.	

M1.5	The use of the system (DB & BI) has helped to meet the short-term goals of the department.	Strongly agree/ Agree/ Neutral/ Disagree/ Strongly disagree.	
M1.6	The use of the system (DB & BI) has helped to meet the long-term goals of the organisation.	Strongly agree/ Agree/ Neutral/ Disagree/ Strongly disagree.	
Q2	**How to ensure involvement of user and stakeholder?**		
M2.1	The use of the system (DB & BI) has increased engagement among users and staff.	Strongly agree/ Agree/ Neutral/ Disagree/ Strongly disagree.	(Ramakrishnan et al., 2016)
M2.2	The use of the system (DB & BI) has enabled administrators & key staff to engage in fact-based decision-making.	Strongly agree/ Agree/ Neutral/ Disagree/ Strongly disagree.	(Ramakrishnan et al., 2016)
M2.3	The use of the system (DB & BI) has enhanced approachability with our stakeholders.	Strongly agree/ Agree/ Neutral/ Disagree/ Strongly disagree.	(Ramakrishnan et al., 2016)
M2.4	The stakeholders have involved in metrics design and progress reports.	Strongly agree/ Agree/ Neutral/ Disagree/ Strongly disagree.	
Q3	**Does the system (DB & BI) satisfy the expectations of the user and stakeholder?**		
M3.1	The expectations of the user and senior management about the system (DB & BI) are realistic.	Strongly agree/ Agree/ Neutral/ Disagree/ Strongly disagree.	
M3.2	The expectations of the stakeholder about the system (DB & BI) are realistic.	Strongly agree/ Agree/ Neutral/ Disagree/ Strongly disagree.	
M3.3	The expectations of the user about the system (DB & BI) are managed.	Strongly agree/ Agree/ Neutral/ Disagree/ Strongly disagree.	
M3.4	The expectations of the stakeholder about the system (DB & BI) are managed.	Strongly agree/ Agree/ Neutral/ Disagree/ Strongly disagree.	

Q4	**How does the experience help the user?**		
M4.1	The user able to use their previous experience to recognise the new information.	Strongly agree/ Agree/ Neutral/ Disagree/ Strongly disagree.	
M4.2	The user able to use their previous experience to apply the information to create new opportunities.	Strongly agree/ Agree/ Neutral/ Disagree/ Strongly disagree.	
M4.3	The user able to use their previous experience to apply the information to create new capabilities.	Strongly agree/ Agree/ Neutral/ Disagree/ Strongly disagree.	

Table 3.10: Questions and metrics of Goal-4 (Financial)

Code	Questions and Metrics	Metric Identifier	Source
Q1	**How to ensure adequate budgetary resources?**		
M1.1	Using the system (DB & BI) facilitates financial sustainability (financial cost and financial return).	Strongly agree/ Agree/ Neutral/ Disagree/ Strongly disagree.	
M1.2	Using the system (DB & BI) has reduced the financial risk.	Strongly agree/ Agree/ Neutral/ Disagree/ Strongly disagree.	
M1.3	There is investment in a good infrastructure and technology.	Strongly agree/ Agree/ Neutral/ Disagree/ Strongly disagree.	
M1.4	There is adequate funding to support development, maintenance, and training of the system (DB & BI).	Strongly agree/ Agree/ Neutral/ Disagree/ Strongly disagree.	
Q2	**How to ensure proper planning of the budget?**		
M2.1	The institution has clear and scoped financial plan.	Strongly agree/ Agree/ Neutral/ Disagree/ Strongly disagree.	
Q3	**How to increase the financial return?**		
M3.1	Using the system (DB & BI) has increased the financial resources.	Strongly agree/ Agree/ Neutral/ Disagree/ Strongly disagree.	

M3.2	Using the system (DB & BI) will increase the future financial resources.	Strongly agree/ Agree/ Neutral/ Disagree/ Strongly disagree.	
M3.3	The organisation will take advantage of future opportunities to improve the financial return.	Strongly agree/ Agree/ Neutral/ Disagree/ Strongly disagree.	
M3.4	The organisation will take advantage of future opportunities to improve the financial return.	Strongly agree/ Agree/ Neutral/ Disagree/ Strongly disagree.	

Table 3.11: Questions and metrics of Goal-5 (Learning and Growth)

Code	Questions and Metrics	Metric Identifier	Source
Q1	**Does the system (DB & BI) assist information and output quality?**		
M1.1	The institution uses the system (DB & BI) to deliver meaningful information.	Strongly agree/ Agree/ Neutral/ Disagree/ Strongly disagree.	
M1.2	The institution uses the system (DB & BI) to deliver up-to-date information.	Strongly agree/ Agree/ Neutral/ Disagree/ Strongly disagree.	
M1.3	The institution uses the system (DB & BI) to extract knowledge from BI data to improve its decision-making.	Strongly agree/ Agree/ Neutral/ Disagree/ Strongly disagree.	
M1.4	The institution uses the system (DB & BI) to measure the outputs and impact of its work.	Strongly agree/ Agree/ Neutral/ Disagree/ Strongly disagree.	
Q2	**Does the institution consider training and competency development?**		
M2.1	The institution has an underlying value of training and learning around the system (DB & BI).	Strongly agree/ Agree/ Neutral/ Disagree/ Strongly disagree.	
M2.2	The institution considers training to strengthen managers belief in the system (DB & BI).	Strongly agree/ Agree/ Neutral/ Disagree/ Strongly disagree.	
M2.3	The institution considers training to help users to become familiar with the system (DB & BI).	Strongly agree/ Agree/ Neutral/	

		Disagree/ Strongly disagree.	
M2.4	The institution uses the system (DB & BI) to enable competency development.	Strongly agree/ Agree/ Neutral/ Disagree/ Strongly disagree.	
Q3	**Does the institution consider monitoring and feedback of the system (DB & BI)?**		
M3.1	The system (DB & BI) assists the institution to monitor the impact of their decisions.	Strongly agree/ Agree/ Neutral/ Disagree/ Strongly disagree.	
M3.2	The institution uses the system (DB & BI) to manage the feedback processes.	Strongly agree/ Agree/ Neutral/ Disagree/ Strongly disagree.	
M3.3	The institution uses the system (DB & BI) to improve the feedback processes.	Strongly agree/ Agree/ Neutral/ Disagree/ Strongly disagree.	
Q4	**Does the institution consider the internal consultation?**		
M4.1	The institution receives internal consultation to improve the system (DB & BI).	Strongly agree/ Agree/ Neutral/ Disagree/ Strongly disagree.	
M4.2	The institution receives internal consultation to enhance the use of the system (DB & BI).	Strongly agree/ Agree/ Neutral/ Disagree/ Strongly disagree.	
M4.3	The institution imposes the system (DB & BI) with internal consultation to track and manage indicators and performance targets.	Strongly agree/ Agree/ Neutral/ Disagree/ Strongly disagree.	
Q5	**Does the organisation perceive individual/organisational impact of the system (DB & BI)?**		
M5.1	The system (DB & BI) assists users with the quality of their decisions.	Strongly agree/ Agree/ Neutral/ Disagree/ Strongly disagree.	
M5.2	The system (DB & BI) assists users to create and try innovative ideas for their work.	Strongly agree/ Agree/ Neutral/ Disagree/ Strongly disagree.	
M5.3	The system (DB & BI) assists the organisation to improve its ranking.	Strongly agree/ Agree/ Neutral/	

		Disagree/ Strongly disagree.	
M5.4	The system (DB & BI) assists the institution to improve its social impact.	Strongly agree/ Agree/ Neutral/ Disagree/ Strongly disagree.	
M5.5	The system (DB & BI) assists the institution to improve its reputation.	Strongly agree/ Agree/ Neutral/ Disagree/ Strongly disagree.	

Finally, the third milestone is to explore the barriers of applying BI and DB effectively within the HE sector. Further, potential opportunities to apply this technology are to be discussed, as seen in the following table (Table 3.12):

Table 3.12: The third milestone (Barriers and Opportunities)

RQ2.4: What are the barriers to and opportunities for applying this technology?			
Challenges and Opportunities			
The applied system	**Data collection/ sampling method**	**Participants**	**Questions**
DB or BI	Focus group if applicable, if not interviews with individuals/ convenience sampling	Group/individuals of different roles/skills (people making decision: vice-dean, dean, or head of school/ member of planning & strategy team/ member of the development team)	Do you think that GQM is a good approach to measure the effectiveness of using the system (DB and BI)?
			What are the barriers that could face the HE for applying the system (BD and BI)?
			How these barriers can be overcome?
			What are the opportunities of applying the system (BI and DB) in HE?
			Do you have any recommendations for using the system (DB and BI) to support performance measurement and decision-making within HE?

3.4.3.3 Data collection tools and procedures

The main rationale for using interviews as a means of data collection is to obtain deeper insights into the explored phenomenon. They are complementary to the triangulated findings obtained from the first and second phases above (see 3.4.1 and 3.4.2). In this study, a focus group of at least two individuals with differing roles and tasks who use BI or DB is to be conducted. However, if a focus group is not applicable, the individuals are to be interviewed. After each meeting, the recorded conversations are to be transcribed and a draft report generated prior to the next meeting.

During the data collection phase, only a single focus group was conducted with the two participants from case study one. The remainder of the interviews turned into semi-structured interviews, because only a single participant was able to join the scheduled meeting. I decided on the semi-structured interview, as it provides the researcher with the flexibility to add or change the wording of the questions. All the interviews were video-recorded and conducted online using Microsoft Teams and in the English language. The recorded interviews were then transcribed and checked by a second coder.

3.4.3.4 Piloting the instrument

Piloting was conducted with five individuals to improve the clarity of the interview instrument and amend some questions. Three of the participants are researchers who have just accomplished their PhD or are in the very last stage of their PhD. One of the participants is a professor assistant at a university, and they participate in managerial tasks relating to quality assurance. The majority of their tasks are paper-based rather than technology-based assessments. The last participant has long experience in the HE sector, with a number of roles and activities relating to performance and DB.

Consequently, five versions of the instrument were generated, based on the comments of each participant.

3.4.3.5 Thematic data analysis

As explained in section 3.4.1.5, the six steps of Braun and Clarke (2006) were initially followed to code data, then reviewed to form final themes according to the proposed framework and generate new themes that come up from the data. As the researcher recorded the data using Microsoft Teams and English was the language of communication, transcriptions were generated automatically. However, the researcher went through all the data to check for any issues and missed words. Mind Meister software was used to help in managing and facilitating the coding of

the data. I applied the inductive approach for the case study, stating that the identified themes are linked to the collected data as a bottom-up approach, following the six steps suggested by Braun and Clark (2006) and Cruzes and Dyba (2011).

3.5 Ethical Considerations

A few ethical measurements were taken to ensure ethical practice in this study. Before conducting interviews, an ethical application form was submitted to the ERGO committee. The application was approved by the Ethics Committee of the University of Southampton (Ethics no. 47154, 55703, 66921). After that, the participants were given an information sheet to become familiar with the project and decide whether to participate. Only when the potential participants were fully aware of the study and had agreed to take part were they asked to sign the consent form. Participants were also made aware of their rights to quit the study and ask to have any of their information removed. When the participants had consented to participate, I started scheduling interviews according to their availability. In terms of confidentiality, I informed the participants that their real names and the universities where they worked would not be revealed. Codes were used to protect the confidentiality of my participants.

3.6 Trustworthiness and Validity

Credibility is the equivalent of internal validity in quantitative research. It means the truth of the findings. The credibility of this study can be seen through the use of triangulation. Triangulation is one of the most powerful approaches that can be applied to improve validity and supply a broader picture of the studied phenomenon. It is achieved through considering multiple perspectives and data sources. There are several forms of triangulation:

- Data source triangulation, which means collecting data from various sources or based on various occasions
- Observer triangulation, to include more than observer in the study
- Methodological triangulation, which integrates various kinds of data collection methods, such as combining qualitative and quantitative methods
- Theory triangulation, which applies several theories or viewpoints.

In this study, methodological triangulation and data source triangulation were used to improve the credibility and the validity of the findings. A detailed account of how the study conducted and continuous feedback received from the second coder and my supervisor ensured the confirmability and reliability of the findings.

3.7 Positionality and the Role of the Researcher

My role as a researcher in this study can be seen in terms of reflexivity (Creswell, 2014). In this study I used triangulation as a way of getting multiple perspectives around the same examined issue. This enabled me to balance my subjectivity. I also used an audit trail to check and recheck the findings using a second coder, and addressed the feedback accordingly. My supervisor commented on my findings and suggested amendments, where necessary. During the interview phase, I was more a listener and rarely intervened as the speaker. This allowed participants to provide their own viewpoints without being influenced by the researcher's assumptions. For the quantitative data, I checked the validity by using software to calculate the statistics.

3.8 Conclusion

This chapter introduced the research methodology of the current study. The research approach and the rationale for its selection were discussed and clarified. The research design, with a specific emphasis on data collection tools, procedures, and data analysis methods, was explained. A detailed account was provided of the sampling techniques and recruited participants.

In the next chapter, the findings of the sequential triangulation stage (expert interviews and questionnaire data) are presented and discussed.

Chapter 4 Results and Discussion of the Triangulation

4.1 Introduction

Looking at the literature review and having a holistic understanding of the various aspects related to BI, DB, and their success factors, a framework was proposed by mapping the factors to the perspectives of the BSC, as presented at the end of Chapter 2. In this chapter, interviews were conducted to validate the proposed framework with 12 experts to identify any other factors or modify the presented factors, or the mapping of the factors to the perspectives. Consequently, the second phase of triangulation was applied, and the second version of the framework generated as presented in Figure 4.1. Finally, the last phase the triangulation was applied, using quantitative techniques to confirm and approve the final version of the framework (Figure 4.2).

This chapter presents the results of the thematic analysis of the interview data. I applied a deductive approach using sets of codes based on the framework presented in Figure 2.21 at the end of Chapter 2. The results generated are discussed to validate the proposed framework. Experts were interviewed to rate the proposed factors and identify any not mentioned in the framework.

The first section presents the results of the interviews. The interview data were processed using the qualitative management software, NVivo. In the second section the findings are discussed and the confirmed framework is introduced. At the end of this chapter a quantitative part is provided to present the last angle of the triangulation methodology: to confirm and approve the final version of the framework.

4.2 Results of the Interviews

This section presents the results of the interviews with experts. As mentioned in the methodology chapter, the qualitative data were generated from semi-structured interviews with 12 experts from multiple organisations. The main purposes of the interviews were to examine and identify the factors of successful application (usage) of BI and DB to support PM in HE.

4.2.1 Demographic information

There were 12 experts in total from six organisations. Ten were from HE non-profit organisations, one from a for-profit organisation, who worked as a consultant with an HE organisation, and one from a government non-profit organisation. The 12 experts were classified according to their role within their organisations: planning and strategy (3); consultants (3); and decision-makers (6). Two were also consultants, as seen in Table 4.1. Planning and strategy members were coded as P&S, consultants as CON, and decision-makers as DEAN or VICE-DEAN. Participants with the dual roles of decision-maker and consultant were coded as CON-VICE-DEAN: for example, Expert-01-P&S signifies Participant 1, a planning and strategy member.

Table 4.1: Demographic information of the study participants

Experts	Experience	Level	Role	country
Expert-01-P&S	More than 5	All levels	Planning & strategy	United Kingdom
Expert-2-CON-VICE-DEAN	More than 5 years	Strategic	Consultant & decision-maker	Saudi Arabia
Expert-03-DEAN	5 years	All levels	Decision-maker	Saudi Arabia
Expert-04-CON	More than 5	All levels	Consultant	Egypt
Expert-05-CON	More than 5	All levels	Consultant	Saudi Arabia
Expert-06-VICE-DEAN	More than 5	**	Decision-maker	Saudi Arabia
Expert-07-P&S	More than 5	**	Planning & strategy	Saudi Arabia
Expert-08-P&S	2 years	All levels	Planning & strategy	Saudi Arabia
Expert-09-CON-VICE-DEAN	More than 5 years	Strategic	Consultant & decision-maker	Saudi Arabia
Expert-10-CON	5 years	Strategic	Consultant	Saudi Arabia
Expert-11-VICE-DEAN	More than 5	All levels	Decision-maker	Saudi Arabia
Expert-12-VICE-DEAN	More than 5	Strategic	Decision-maker	Saudi Arabia

4.2.2 Qualitative data results

4.2.2.1 Vision and strategy perspective

- **Clear vison and strategy**

Table 4.2: Ratings for clear vision and strategy

Expert	Clear vision and strategy
Expert-01-P&S	Strongly agree
Expert-2-CON-VICE-DEAN	Strongly agree
Expert-03-DEAN	Agree
Expert-04-CON	Strongly agree
Expert-05-CON	Neutral
Expert-06-VICE-DEAN	Strongly agree
Expert-07-P&S	Strongly agree

Expert-08-P&S	Strongly agree
Expert-09-CON-VICE-DEAN	Strongly agree
Expert-10-CON	Strongly agree
Expert-11-VICE-DEAN	Strongly agree
Expert-12-VICE-DEAN	Strongly agree

Expert-03-DEAN stated: "The organisation should have a clear vision", and **Expert-05-CON** explained, "I cannot have BI if I do not have vision and strategy. Does BI support or serve the vision and strategy? Yes, it will, however, more important that it will support objectives and goals. Consequently, achieving objectives and goals is more important than vision and strategy. The most important thing that goals and objectives are clear". **Expert-06-VICE-DEAN** stated that "Your vision is your dreams (where you want to be), while mission is about where you are now and how you will reach achieve your vision (dream). So, in this perspective I think it is important to have clear vision and clear mission as well".

In addition, **Expert-09-CON-VICE-DEAN** believed that "It is important that each university has its own vision", and he argued, "Universities here in 'X_1: country' say that their vision is 'research, community service and teaching'. All of them, the 40 universities. But this should not be the case". He supported his opinion with an example, saying, "We do not support research. Research is only done to get promotions but not to be related to serve the community such as our lifestyle, our consuming, etc. that will help even the government with making decisions". Furthermore, he suggested that:

> if each university understood their circumstances and opportunities, like X University is located near the sea and Hajj, so it has to take this into consideration. Also, X University should take being in a petroleum location into consideration and build its vision based on this. Each university copies the other, they do not have their own vision and strategy to achieve this vision. For example, X University says our vision is to be number one in the world for Gulf marine biology and to build the strategy based on this.

Expert-10-VICE-DEAN stated, "Without vision and strategy, I think the services will fail". **Expert-11-VICE-DEAN** confirmed, "Clear vision and strategy help the project team to work coherently and efficiently to achieve the desired goals and objectives". **Expert-12-VICE-DEAN** commented, "This is the most difficult thing, and it is very important. Vision must be very clear. The problem is that they just write down nice words". She argued, "So far, it is a challenge to have this vision as a real vision. I think this could be because strategic planning concept in universities is very weak. We are different to business organisations". This statement was supported with an example: "When Sabic, which is a profit organisation, says our vision is to become the number one petrochemicals organisation, they understand what they mean, and they know how to measure it: like number of exports and imports". Then she added:

> In our universities, they might say our vision is 'to be pioneers...', but they have no idea how to measure this. Each word must have a strategy to achieve it and measure it. It is very big challenge, and even the training regarding this is very weak. Moreover, I think it depends on the leader of the university. If they adopt a strategic approach this will influence the whole organisation.

- **Defined business objectives and goals**

Table 4.3: Ratings for defined business objectives and goals

Expert	Defined business objectives and goals
Expert-01-P&S	Strongly agree
Expert-2-CON-VICE-DEAN	Strongly agree
Expert-03-DEAN	Strongly agree
Expert-04-CON	Strongly agree
Expert-05-CON	Strongly agree
Expert-06-VICE-DEAN	Strongly agree
Expert-07-P&S	Strongly agree
Expert-08-P&S	Strongly agree
Expert-09-CON-VICE-DEAN	Strongly agree
Expert-10-CON	Strongly agree
Expert-11-VICE-DEAN	Strongly agree
Expert-12-VICE-DEAN	Strongly agree

Expert-01-P&S stated that:

> I think, you start something, but when you don't know what you want to be at the end, it's impossible to get there. If you don't know where you're going, how can you ever get there? Especially in HE. I think you've got to know what you're aiming for because there are so many pressures on our time at the moment because of resources. I think we've got to really know how to spend resources wisely. That's money and time. We've got to focus on what makes us able to make it worthwhile. In terms of the university's strategic plan, I think that's pretty clear. But in terms of the BI plan, I think it's maybe not so clear.

She asked, "This interview is confidential, right?" and continued, "This is maybe not policy at the moment. To do this as a team, it would be helpful for us to know what we should be doing". **Expert-03-DEAN** confirmed, "It is very important for us to support the four illustrated perspectives". In addition, **Expert-04-CON** believed, "Defining clearly what the project is as well as its goals, outcomes, and vision is very important. Otherwise, the project will fail. So, defining objectives and goals at the beginning is crucial. Therefore, we can measure later whether or not the project is achieving what we need". Then he explained:

Goals are a group of KPIs (the initial KPIs), which are presented in DB, for example, customer satisfaction. Another example is that the KPIs help to see whether some lecturers are overloaded compared to others. So, based on these KPIs and DB we can understand whether we are meeting the goals that were generated at the beginning of the project.

Expert-06-VICE-DEAN strongly agreed with this factor and distinguished between goals and objectives, saying, "I think goals are the purpose, while objectives are the way to achieve that purpose. So, usually, each goal is supported by some objectives". **Expert-09-CON-VICE-DEAN** explained, **"**Strategy derives from vision, then objectives and goals derive from strategy". **Expert-11-VICE-DEAN** confirmed, "Well-defined objectives and goals may help in focused approaches at each step from planning to execution and evaluation of the projects". However, **Expert-12-VICE-DEAN** was of the opinion that "Sometimes they make plans that are impossible or difficult to achieve".

4.2.2.2 Internal process perspective

- **Management support**

Table 4.4: Ratings for management support

Experts	Management support
Expert-01-P&S	Strongly agree
Expert-2-CON-VICE-DEAN	Strongly agree
Expert-03-DEAN	Strongly agree
Expert-04-CON	Strongly agree
Expert-05-CON	Strongly agree
Expert-06-VICE-DEAN	Strongly agree
Expert-07-P&S	Strongly agree
Expert-08-P&S	Strongly agree
Expert-09-CON-VICE-DEAN	Strongly agree
Expert-10-CON	Strongly agree
Expert-11-VICE-DEAN	Agree
Expert-12-VICE-DEAN	Strongly agree

Expert-2-CON-VICE-DEAN expressed her agreement with this factor, and added, "Planning is usually done top-down, while implementation is bottom-up, so if the top management support the concept of BI and performance measurement, they will say go ahead". **Expert-03-DEAN** and **Expert-06-VICE-DEAN** mentioned the role of management support to assist the internal process. The former said, "Without having support from the management, internal process is really difficult" and the latter, "To support the internal process I have to have management support". **Expert-04-CON** emphasised**, "**People won't use the project, or their usage will be limited, if the top management won't support

the project". **Expert-07-P&S** highlighted, "There is no point in having a vision and a strategy if you do not have management support". **Expert-08-P&S** explained, "If we are managed by a dean who is supportive and believes in the quality system, then we have an effective management process, and more attention is going to be paid to quality. In contrast, if the dean is not interested in quality, there is no commitment from employees".

Expert-09-CON-VICE-DEAN said, "It is very important, but we still have people who do not believe in business intelligence. Here in 'X_1: country' we adopt the hierarchy system, top management then middle management and lower management. So, if top management believe in it, this means other levels will also believe in it, but if top management don't support it, all that the lower levels can do is to try to get them to understand and approve it. It does become challenging if lower and middle management believe in BI, but the top management don't". **Expert-12-VICE-DEAN** emphasised, "We cannot do anything without management support," and went on to explain, "Management support is meant to empower people and to support them with the appropriate environment, as well as to help solve problems. Management deals with emergencies, implement plans and applies them in phases, and create detailed plans for detailed requirements".

- **Management process**

Table 4.5: Ratings for management process

Experts	Management process
Expert-01-P&S	Agree
Expert-2-CON-VICE-DEAN	Strongly agree
Expert-03-DEAN	Neutral
Expert-04-CON	Agree
Expert-05-CON	Agree
Expert-06-VICE-DEAN	Strongly agree
Expert-07-P&S	Strongly agree
Expert-08-P&S	Agree
Expert-09-CON-VICE-DEAN	Agree
Expert-10-CON	Agree
Expert-11-VICE-DEAN	Strongly agree
Expert-12-VICE-DEAN	Strongly agree

Expert-2-CON-VICE-DEAN said:

> Universities tend not to write clear policies: they depend on the HE system, for example. The policies need details, but no one writes these policies except for a few universities, and even if they write them, they do not implement and use them. Now, we've started to ask them to make

> sure they have policies and procedures that follow the template of their KPIs… but universities tend not to have policies, they often manage and control by custom or tradition.

In addition to this, **Expert-04-CON** explained, "If management process is not clear from the beginning, this makes the situation difficult and blocks the success of the project". **Expert-07-P&S** stated, "It is important to have management process to achieve success. It is important to have policies and procedures to manage the process and to ensure that we will reach our goals within the appropriate time and to ensure efficiency".

Expert-09-CON-VICE-DEAN expressed the opinion that management process is recognised as lacking:

> Unfortunately, here in 'X_1: country', management process is not improving and developing the way it should. We have a top-down approach, but not a bottom-up approach. For example, we wait for the decisions to come from deans, deans wait for them to come from vice-deans, vice-deans wait for decisions from the executives of the university, and executives wait for decisions from the ministry of education. Therefore, the hierarchy is still developing and is only top-down; we still do not have bottom-up decisions, so management process is still not mature enough.

He suggested that this could be improved by "replacing those we call gatekeepers, who still believe in the old traditional approach with the new generation. The lower and top management cannot be changed if we still have those gatekeepers". **Expert-11-VICE-DEAN** confirmed, "Well-defined and clear management processes guarantee success of the projects". **Expert-12-VICE-DEAN** added:

> Management support and management process are two sides of the same coin. Sometimes there is failure because of the complexity of the process. Sometimes you find individuals following a specific process and when you ask them why they're doing it like that, they say 'We don't know, it's always been done this way, sometimes these processes are very complex and there's no need to question them'. Then when you ask them whether it would be a problem if we removed that process, there's no answer, and this is very big issue. Processes are not checked frequently.

- **Project management**

Table 4.6: Ratings for project management

Experts	Project management
Expert-01-P&S	Agree
Expert-2-CON-VICE-DEAN	Strongly agree
Expert-03-DEAN	Agree
Expert-04-CON	Strongly agree
Expert-05-CON	Agree
Expert-06-VICE-DEAN	Agree
Expert-07-P&S	Agree
Expert-08-P&S	Neutral
Expert-09-CON-VICE-DEAN	Strongly agree
Expert-10-CON	Strongly agree
Expert-11-VICE-DEAN	Strongly agree
Expert-12-VICE-DEAN	Strongly agree

Expert-01-P&S was in agreement with the factor of project management, and explained:

> I think someone has to have an overview and an ownership, and again this is from experience when X_2 (the adopted system) was implemented. Like I say, a few people decided on the product in a bottom-up sort of way and didn't launch proper project management, so efficiency became a bit more difficult. It's more like having a group of people who are each looking at it from their own angle, rather than having someone at the top viewing the whole project, saying this is where we are going, and this is what individual people are going to do.

Expert-04-CON complained, “How can you carry out a project without project management? This applies to any project, not just BI projects”. **Expert-06-VICE-DEAN** commented:

> I think project management in most HE organisations is weak. There are good initiatives, but there is a problem with the project follow-up and there are no supportive feasibility studies done before commencing the project. We don’t have these things in place, even though they are important, and even if we do have them, they’re only on paper with no substance behind them. We have no adequate project management office (PMO). Based on what I know, the PMO just fill out forms. But the question is, do they really manage the project?

Expert-07-P&S agreed, “Yes, I think it is important to have a good understanding of the project and the expected results so that we know if it’s worth supporting financially”.

Expert-09-CON-VICE-DEAN strongly agreed with the necessity for project management:

It is a very important factor. However, unfortunately we don't yet have this way of thinking, I mean, having a project manager, facilities, and resources. We still have a traditional way of thinking, and sometimes colleagues don't even try to act as decision-makers and instead they carry on thinking as decision receivers, just receiving the decisions from the top, and applying them, and rarely trying to be creative. So, we still don't have any real application of the concept of project management, including risk management.

Expert-11-VICE-DEAN believed that project management "is the key to success". **Expert-12-VICE-DEAN** said, "To be honest, it is a big problem. They don't have the required experience. In my experience, many projects fail because they don't know how to carry out project management".

- **Governance**

Table 4.7: Ratings for governance

Experts	Governance
Expert-01-P&S	Agree
Expert-2-CON-VICE-DEAN	Strongly agree
Expert-03-DEAN	Agree
Expert-04-CON	Neutral
Expert-05-CON	Agree
Expert-06-VICE-DEAN	Strongly agree
Expert-07-P&S	Agree
Expert-08-P&S	Agree
Expert-09-CON-VICE-DEAN	Strongly agree
Expert-10-CON	Strongly agree
Expert-11-VICE-DEAN	Agree
Expert-12-VICE-DEAN	Neutral

Expert-01-P&S stated, "I think the tricky thing around governance is sometimes it can be seen as a bit of a block. Sometimes things get lost within the layers of governance, but good governance, when it works, is super important" and, interestingly, added, "In terms of governance, people who overlook it might be academics and may not really very interested in BI. They are only really interested in their research and in the university as a whole, but getting people who are sufficiently interested in BI and support it can be a bit difficult". They suggested, "What we've tried to do is to build relationships with people to show them how it will help them".

Expert-06-VICE-DEAN stated, "I can tell you why internal process governance is important. For example, we are working currently on improving planning and structuring procedures. In structuring, it is important to understand where different management positions should be placed to support governance". **Expert-07-P&S** singled out an important aspect of governance:

> By the way, regarding structure, we need to ask whether governance in HE is more vertical or horizontal. Does it have many layers or not? Does it apply central or independent strategy? These are crucial issues that are neither right nor wrong, but it's important to consider them. Each organisation has its unique size, priorities and lots of other aspects. It's not easy to say whether this or that model can help, because there is a kind of flexibility.

Furthermore, **Expert-08-P&S** said, "I think there is increased awareness. Members are more active. The tasks assigned to each administrative member are clear".

Expert-09-CON-VICE-DEAN claimed:

> We still have the same traditional structure, i.e. vice-dean, then dean, then head of school. We still have the same governance model that was established decades ago, and I don't think that will change smoothly. Nowadays, we as universities tend to be more commercialised organisations. We have a board of trustees or a board of directors, so I think if we have this new system and new governance, things will improve. Our governance model needs to improve to reach the point where everyone believes in data-driven decisions. If we have a systematic and dynamic governance model, this will help.

Expert-11-VICE-DEAN expressed the belief that good governance "helps and directs project managers to execute projects smoothly and successfully".

- **System quality**

Table 4.8: Ratings for system quality

Experts	System Quality
Expert-01-P&S	Neutral
Expert-2-CON-VICE-DEAN	Strongly agree
Expert-03-DEAN	Agree
Expert-04-CON	Strongly agree
Expert-05-CON	Agree
Expert-06-VICE-DEAN	Agree
Expert-07-P&S	Agree
Expert-08-P&S	Strongly agree
Expert-09-CON-VICE-DEAN	Agree
Expert-10-CON	Strongly agree
Expert-11-VICE-DEAN	Strongly agree
Expert-12-VICE-DEAN	Strongly agree

Expert-2-CON-VICE-DEAN stated that "Regular maintenance and support is very important to sustain the system". **Expert-03-DEAN** explained, "It is very important to get whatever I need and have good access". **Expert-04-CON** pointed out, "It's very important to have ease of access and capability".

Expert-08-P&S explained, "Having X_2 (the adopted system) has helped, but the problem is that it isn't user friendly. The data entry isn't user friendly, and I think it requires a lot of effort".

In addition, **Expert-09-CON-VICE-DEAN** said,

> We have some universities and organisations that use BSC but, unfortunately, it is still more for show than for real use. And people don't like to have their work related to quality. Unfortunately, the quality we have is not systematic and there are lots of forms to fill out and work that has to be done, so it becomes an extreme load rather than being beneficial. We need a simple system that can determine specific goals to ensure quality, what is usually called quality assurance. So, we need simple, clear quality assurance.

He added:

> Regarding X_2 (the adopted system), it is supposed to include a decision system, but so far it is only an automated quality assurance system. It is very complicated, to the point where people have started to hate it. Its usability is low and its interface or data migration have not been considered carefully enough.

In addition to this, an interesting point was made by **Expert-12-VICE-DEAN:** "Having a user-friendly system is very important, as it's useful for monitoring and extracting reports. So, while on a faculty level it might be easy enough to work without a system, on a university level it becomes very difficult". Further explanation was added:

> It is good to have an electronic system that analyses the data and illustrates the colours that specify specific problems, needs, successes, and so on. The decision-support system that we have only supports you with data, but it doesn't support the strategic plan, which includes plans, goals, and performance measurements.

- **Proper infrastructure and data quality**

Table 4.9: Ratings for proper infrastructure and data quality

Expert	Proper infrastructure and data quality
Expert-01-P&S	Strongly agree
Expert-2-CON-VICE-DEAN	Agree
Expert-03-DEAN	Agree
Expert-04-CON	Agree
Expert-05-CON	Strongly agree
Expert-06-VICE-DEAN	Agree
Expert-07-P&S	Agree
Expert-08-P&S	Agree
Expert-09-CON-VICE-DEAN	Agree

Expert-10-CON	Strongly agree
Expert-11-VICE-DEAN	Strongly agree
Expert-12-VICE-DEAN	Strongly agree

Expert-2-CON-VICE-DEAN was concerned about data validity, saying:

> This what I think the problem of validity of data is at the moment, I agree that it is important, but the fact is that data is not real… I think (I don't have real evidence) that the organisation provides us with something not real, just to show that they do their job. You know, sometimes there is an administrative unit that doesn't fill in its forms, and then all of the data is ruined.

Asked how the situation could be improved, the expert suggested:

> For example, in BSC there's usually someone who collects data and someone else who double-checks its validity and its quality, which is very important. For example, the data might indicate that the satisfaction rate is 80%, but the top management doesn't have time to check the validity of this percentage. However, the survey might not actually have been done or, if it was done, it might not have been analysed, so there should always be someone who asks for the evidence and checks the validity of data. Sometimes the data is misleading. People sometimes just provide the data, and they know that no one will check their sources.

Expert-08-P&S was in agreement with this: "It should be the case that if someone submits data, someone else should check it. Sometimes lecturers don't take their course portfolio seriously — sometimes they submit data only so that they will receive financial support, and often there's no one to check whether or not their data is valid".

Expert-2-CON-VICE-DEAN gave further explanation about the problem of time limitations, which have a negative impact on data quality:

> For example, when an organisation tries to implement a system, it's important to present our requirements to the company in a timely manner so that they understand the project. So, they might ask me to sort out a system within six months, and they give me all the permissions, budget, and so on. However, in reality, more like a year is required to create a contract with the company that will execute the system. The systems companies are not always that skilled, so we have to have a huge number of meetings to make them understand how the processes are run within the university, and this is the problem. Things need time, and some managers leave it to the last minute to avoid being accountable, then they just give false numbers.

Further explanation was added by **Expert-04-CON**:

> It should be all about proper data quality and data governance, because, as we say about data, 'garbage in, garbage out'. If we measured the quality of the data before moving it into data storage and presenting it on a DB, the data received and generated would be useful. Data governance is about specifying the kind of data and the sources, as well as which data should stay in and which should be thrown out.

Then, interestingly, he said, "Can HE institutions be successful without data quality and governance? I would say yes, because in HE they know their data very well and I think they have reliable data".

Expert-07-P&S confirmed this, saying:

> Yes, having good data is essential, because if I haven't got good data, the work I do is meaningless. HE is built on data, so it is essential. Based on my experience there can be problems with conflicting data. For example, I might receive more than one number regarding the same data, for example, I ask how many students are there in X, and then I receive several different figures. Therefore, I think the problem could be because of the lack of clarity of what data is required. For example, I should ask, how many students are registered in X? I have to be as clear as possible. As I said, there can be conflict and confusion about what the data represents, and we need to have a very definite description of what data is required, and the data we receive back should also be clearly defined, so we know exactly what it describes and what the source of the data is.

In addition, along similar lines, **Expert-09-CON-VICE-DEAN** stated:

> I am sorry to say that data quality is very weak in our organisations. They don't believe in data or in data-driven decisions. They don't make their decisions based on the data that they have and instead they build their decisions based on the financial aspects or the attitude of the top management. Rarely are our decisions built around the data.

He added:

> Their way of making decisions is, for example, asking whether they have adequate budget to implement the project, or, if the top level is happy about it, they'll just ask them to implement it. Sense of data is still immature in X_2 (adopted system); however, since the vision of X_1 (country) and related aspects such as KPIs and benchmarks have been more embedded into our management, there has been a slight improvement in attitudes towards the importance of data, although it is still very basic.

This expert suggested:

> Data sources are still not reliable, but the way it is collected should be clear. We must be clear about our data storage and validation. For example, we might ask what the average student age is, or what the criteria is for accepting new students at the university. The answer could be based on their age, or their grade. But the question is why did we make the decision based on this? So, we do not have validator.

The expert confirmed, "Improving employees' sense of the importance of data is crucial", and suggested, "We need specialised departments for data collection, storage, and analysis, and emphasise that unless your decision is data based, it should be ignored, or at least questioned". **Expert-12-VICE-DEAN** pointed out**:**

> Without data quality, you cannot do anything. For example, this decision support centre really did help us. If I want to make any decision, I have to have adequate and valid data in the system which can be accessed easily. Without these data, it's like making a decision in the dark. It is important to have valid, updated and accessible data. Before, you might have needed 10 days to get the data you wanted, now in seconds you get what you need.

4.2.2.3 Financial perspective

- **Adequate budgetary resources**

Table 4.10: Ratings for adequate budgetary resources

Expert	Adequate budgetary resources
Expert-01-P&S	Strongly agree
Expert-2-CON-VICE-DEAN	Strongly agree
Expert-03-DEAN	Strongly agree
Expert-04-CON	Strongly agree
Expert-05-CON	Strongly agree
Expert-06-VICE-DEAN	Strongly agree
Expert-07-P&S	Strongly agree
Expert-08-P&S	Strongly agree
Expert-09-CON-VICE-DEAN	Agree
Expert-10-CON	Neutral
Expert-11-VICE-DEAN	Agree
Expert-12-Vice-Dean	Strongly agree

Expert-2-CON-VICE-DEAN stated:

> What happens is that the organisation buys the system then trains employees how to use it, and usually the contract is a year. Then the next year, the university doesn't have the money to pay the company, so maintenance gets stopped and the company doesn't support us any

longer. Then the employees change and the new ones don't know how to use it, so the system doesn't get used any more. So, the system maintenance should continue for at least twenty years to get the required benefits.

Expert-03-DEAN said, "It is very important to have adequate financial resources for many reasons. For example, you will put the project at risk if it fails to cover costs, whereas adequate resources will support the system and increase innovation and expansion". In addition, **Expert-04-CON** said, "If there is a decent budget we can invest in good infrastructure, good technology, and good consultation". **Expert-06-VICE-DEAN** confirmed, "Yes, this is part of the current X_1 (country) vision in both HE and other organisations". **Expert-07-P&S** added, "Yes. Also, financial sustainability and how to generate money to support your processes". **Expert-08-P&S** stated**,** "Very important. We have this, but we are not independent. We follow the university budget".

Expert-09-CON-VICE-DEAN explained that "We only have the government to support us. We are fully supported by government, and this can be affected by different aspects like the economic conditions of the country. We do not have any other resources." and said "they don't even know their budget at the beginning of the year. The university suggests a budget, then the government accepts it or rejects it". **Expert-11-Vice-Dean** stated: "Adequate resources are vital, but are less important than strategic planning. With proper planning, prioritising and time scheduling, we can achieve goals and targets even if the sources are not adequate". **Expert-12-VICE-DEAN** said: "It is very important. We cannot do anything without having budget".

- **Proper planning and scoping of projects**

Table 4.11: Ratings for proper planning and scoping of projects

Expert	Proper planning and scoping of projects
Expert-01-P&S	Agree
Expert-2-CON-VICE-DEAN	Agree
Expert-03-DEAN	Agree
Expert-04-CON	Agree
Expert-05-CON	Agree
Expert-06-VICE-DEAN	Agree
Expert-07-P&S	Agree
Expert-08-P&S	Agree
Expert-09-CON-VICE-DEAN	Agree
Expert-10-CON	Strongly agree
Expert-11-VICE-DEAN	Strongly agree
Expert-12-VICE-DEAN	Strongly agree

Expert-03-DEAN responded**:** "Yes, it is important to have scoping for any project. If there is no clear plan, it will be wasting the resources". **Expert-04-CON** stated:

> Defining the scope from the beginning is important because, based on this scoping, I can work out whether the project will succeed and whether it supports the stated goals and objectives. If the project's expectations are not scoped and specified from the beginning and if these expectations increase as the project develops, we will never finish the project and will never be satisfied with its output.

Expert-07-P&S said: "It will help you to make the most out of your project". **Expert-10-CON** explained**:** "It is very important for our organisation to focus on its success by relying on proper planning and scoping of projects because we arrange the budget for projects in the first stage".

Expert-11-VICE-DEAN stated: "Proper planning and scoping of projects saves human and financial resources as well as time. It ensures clarity of vision, mission, goals and objectives at all levels, which leads to success of the project". **Expert-12-VICE-DEAN** explained:

> Planning and scoping are very important, especially with the current changes towards being autonomous. It is important to emphasise at this stage what the financial benefits are as well as the expected returns. Having this culture is very important, and it is clearly missing in our universities. Questions like 'What are the expenditures?' and 'What are the returns?' are very important now. They've never thought about this before. It is one of the biggest challenges. My outcomes are human, not money; we do not receive money from students. We are more towards consuming, and our product is not measured by money.

4.2.2.4 Learning and growth perspective

- **Information and output quality**

Table 4.12: Ratings for information and output quality

Expert	Information and output quality
Expert-01-P&S	Strongly agree
Expert-2-CON-VICE-DEAN	Agree
Expert-03-DEAN	Strongly agree
Expert-04-CON	Strongly agree
Expert-05-CON	Strongly agree
Expert-06-VICE-DEAN	Agree
Expert-07-P&S	Strongly agree
Expert-08-P&S	Neutral
Expert-09-CON-VICE-DEAN	Agree
Expert-10-CON	Strongly agree

Expert-11-VICE-DEAN	Strongly agree
Expert-12-VICE-DEAN	Agree

Expert-01-P&S explained:

> If you want people to buy into something, the data has to be fit for purpose, the tool has to be fit for purpose. Otherwise, they will not use it. They will find something else; they will stick to using a spreadsheet. They will export the data out, and never mind the dashboard you spent hours designing, and they'll put it into a spreadsheet and do it their own way. If it is not fit for purpose, then you're wasting everyone's time.

Expert-03-DEAN stated**:** "Information quality is fundamental to support the growth of the organisation". **Expert-04-CON** explained: **"**Yes, it is important because it will support satisfaction and increase trust, so they will keep using the tool".

Expert-06-VICE-DEAN:

> I thought data in the internal process is what I have inside the organisation, while information and output is the data that we have from outside the organisation: like, for example, how many students have graduated and how many of them have a job. I think to support learning and growth you need information from outside the organisation to improve consistency. So it is more about your product than information that you have inside the organisation.

Expert-07-P&S stated**:** "Information is a bit confusing, but analysis is clearer. I have to learn where I stand now, so I can grow". **Expert-08-P&S** explained: "I think we use information to improve, but our improvement is slow". **Expert-12-VICE-DEAN** stated**:** "it is important, but I think it belongs to the internal process perspective and it could be in learning and growth as well".

- **Monitoring and feedback**

Table 4.13: Ratings for monitoring and feedback

Expert	Monitoring and feedback
Expert-01-P&S	Agree
Expert-2-CON-VICE-DEAN	Strongly agree
Expert-03-DEAN	Agree
Expert-04-CON	Agree
Expert-05-CON	Strongly agree
Expert-06-VICE-DEAN	Strongly agree
Expert-07-P&S	Strongly agree
Expert-08-P&S	Strongly agree

Expert-09-CON-VICE-DEAN	Strongly agree
Expert-10-CON	Strongly agree
Expert-11-VICE-DEAN	Strongly agree
Expert-12-VICE-DEAN	Strongly agree

Expert-01-P&S stated:

> We've really struggled to get feedback. Like I said, we send things out and people use them, we know they use them and we can see that. But like I said before, getting people to engage and give us useful feedback is tricky because they are all super-busy. They report to people doing interesting things and they don't have time in the day to spend with us to tell us what they like and don't like. You know, that's fully understandable, but we would like to do it better.

Expert-2-CON-VICE-DEAN stated: It's very important. I take their opinion on the curriculum and the process and learning outcomes, I mean evaluating the services (not being part of the internal process but learning and growth)". **Expert-04-CON** said: "Monitoring is the part of the system that tells me about the user, while feedback is the part where the user tells me how they experience the system. By receiving feedback, I can understand how they use the system and their commitment to it, and how it's useful". **Expert-08-P&S** said:

> This helped with discovering new ideas with the students so they can give me ideas which support improvements. We keep in touch with the graduates even though communication is weak after graduation, and unfortunately, there is lack of support for feedback. The problem that I noticed in most schools is that they do not have sufficient contact with graduates or employers.

Expert-09-CON-VICE-DEAN stated:

> Feedback here in X_1 (country) is still not applied sufficiently. We just make so many decisions every year, but rarely do we ask what the impact is of the decisions that have been made, or whether there is a clear mechanism for collecting feedback. We don't seem to have a clear strategy regarding feedback, even though it is very important. The only way we collect feedback is via surveys but, unfortunately, these questionnaires are not taken seriously and students just fill them out as a task that needs to be finished, without giving much thought or expression to their real opinions.

They confirmed "If we have good monitoring of our decisions and receive feedback from individuals, we will be able to edit, change or mange our decisions more effectively". **Expert-11-VICE-DEAN** added: "It is important for corrective and preventive measures". **Expert-12-VICE-DEAN** agreed: "Very

important. It is important that we share feedback as well as the results of each stage of planning. We can then try to identify the problems that need to be solved".

- **Training and competency development**

Table 4.14: Ratings for training and competency development

Expert	Training and competency development
Expert-01-P&S	Agree
Expert-2-CON-VICE-DEAN	Strongly agree
Expert-03-DEAN	Agree
Expert-04-CON	Strongly agree
Expert-05-CON	Agree
Expert-06-VICE-DEAN	Strongly agree
Expert-07-P&S	Agree
Expert-08-P&S	Strongly agree
Expert-09-CON-VICE-DEAN	Strongly agree
Expert-10-CON	Strongly agree
Expert-11-VICE-DEAN	Agree
Expert-12-VICE-DEAN	Strongly agree

Expert-01-P&S said, "It should be pretty intuitive to people. So there's something about publicity and something about training for individual dashboards. Well, I think it changes over the life cycle of a thing". **Expert-2-CON-VICE-DEAN** explained the importance of training and how this can save resources: "This is important because it will stop wasting resources. If I employ someone and pay them, but don't train them, I don't get the required benefit. We believe that when we train employees, they can be very good support". Then she said, "In the past, the organisation tried to avoid paying for training, and this was an obstacle. But now they have to train them". **Expert-07-P&S** confirmed, "Training is very important and I think, yes, it is part of growth".

Expert-08-P&S stated, "In our organisation, if they have a new technology, they run training sessions, which is good. So, for example, to learn how to use X_2 (adopted system) and the BSC in the applied science school, I went through a four-stage training programme". **Expert-09-CON-VICE-DEAN** explained, "People won't be able to work as effectively without training. They might resist doing things if they don't understand the processes, and they need to understand that their work tasks have been built on appropriate decisions". **Expert-11-VICE-DEAN** pointed out, "It's very important to compensate for lack of skills and competency when assigning tasks". **Expert-12-VICE-DEAN** interestingly said, "It's very important. Without training, your strategy will not succeed. It is important for all members at all levels to understand the different concepts".

- **Net benefits**

Table 4.15: Ratings for net benefits

Expert	Net benefits
Expert-01-P&S	Strongly agree
Expert-2-CON-VICE-DEAN	Agree
Expert-03-DEAN	Agree
Expert-04-CON	Strongly agree
Expert-05-CON	Agree
Expert-06-VICE-DEAN	Strongly agree
Expert-07-P&S	Agree
Expert-08-P&S	Agree
Expert-09-CON-VICE-DEAN	Agree
Expert-10-CON	Strongly agree
Expert-11-VICE-DEAN	Agree
Expert-12-VICE-DEAN	Agree

Expert-01-P&S stated, "Yes, definitely, especially at the moment. We cannot be seen to be wasting time and money on something has no benefit to people". **Expert-03-DEAN** says, "It is very important to be creating a positive impact as much as possible". In addition, **Expert-04-CON** added, "The user might spend a long time on the system, so it is important to measure the benefits of the system to the user. It is important at all levels, individual and organisational". **Expert-06-VICE-DEAN** stated, "I do not think the individual is part of this phase. It is about the product and the outcomes for the organisation, such as the financial outcome"; then she added:

> I liked the phrase 'net benefits', because 'net' is important, for example, asking not simply, 'How many students have graduated?' but 'How many students have graduated and got a job?'. So, 'net' is a good word to represent the benefits that I have specified and want to gain.

Expert-07-P&S provided another example of net benefits, asking, "How many students have graduated and gained very important positions within organisations?" and adding, "'Net benefits' is about the real outcomes, returns, and benefits of the organisation. As we said in project management, it is important to specify the returns of the project, the ROI, and so this is related here". **Expert-09-CON-VICE-DEAN** explained, "The total benefits are important, for sure. But it is still early to get to the point of understanding the importance and the impact of their decisions and ensure sustainability".

Expert-11-VICE-DEAN confirmed, "This is an indicator of successful planning, execution and achievement of the goals and targets". **Expert-12-VICE-DEAN** was in agreement with this factor, even though she was not sure how it could be measured:

The question is how you are going to measure it. It is not easy to measure the net benefit. From my experience, I am not aware of a way to measure it. In general, I don't like things that are too complicated to achieve. As long as we have simple measurable factors, people will apply them and vice versa. Think about it, anyway. Is the net benefit going to be measured based on the ranking of the university, for example?

- **External support (consultants)**

Table 4.16: Ratings for external support (consultants)

Expert	External support (consultants)
Expert-01-P&S	Neutral
Expert-2-CON-VICE-DEAN	Agree
Expert-03-DEAN	Neutral
Expert-04-CON	Agree
Expert-05-CON	Strongly agree
Expert-06-VICE-DEAN	Agree
Expert-07-P&S	Agree
Expert-08-P&S	Strongly agree
Expert-09-CON-VICE-DEAN	Agree
Expert-10-CON	Strongly agree
Expert-11-VICE-DEAN	Agree
Expert-12-VICE-DEAN	Agree

Expert-01-P&S stated:

For our purposes we use them occasionally — they were used quite a lot in the setup, I think a key use for consultants is more in addressing some of the service issues. In our team, we use them either when something is key and we just need a bit of help with it, or if we have some money in the pot and we have a particular project we want to do as a standalone. So with that, we might send the project to the consultants and get them to look at it and see how we can best fit it to our own purposes. But they're not the be-all and end-all.

They added, "I think that because we are part of a big organisation, we are less dependent on external consultants than if we were a smaller concern. We have quite a lot of people who have those skills, and so we maybe have a bit more access to that kind of support.

Expert-2-CON-VICE-DEAN: "They are like an outside lens that can watch you and tell you what the problems are". **Expert-03-DEAN:** "In general in HE, lecturers and HE members are highly educated and experienced… so the use of consultants is more prestigious than demanded". **Expert-04-CON** said: "Sometimes you need consultants from outside the organisation and sometimes not. In HE, I think it should be external and internal consultation. Because in HE they have competencies that can support

without need for external input". **Expert-06-VICE-DEAN** suggested: "Make it consultation without mentioning external or internal, so the organisation can decide what they need". **Expert-07-P&S** said: "I think it depends on the organisation. Young organisations are different from strong, well-established organisations that have their own qualified members and experts. If the organisation depends on external support, I do not think you should be there. Internal support, yes, definitely".

Expert-09-CON-VICE-DEAN stated**:** "I think it is good to have both external and internal support. External support can give a view that cannot be provided by internal. For example, when I provide a consultation for another organisation, I can avoid courtesy and such social restrictions and be critical comfortably". **Expert-11-VICE-DEAN:** "External support at each phase of the project planning and execution may save unseen problems and project failures". **Expert-12-VICE-DEAN** stated**:**

> If we do not have the appropriate experience internally, then we need to have external support. Because some concepts are not understood by even top-level members, we need to have experts from outside the organisation. But dealing with an internal consultant who is already familiar with the situation and the people is better.

4.2.2.5 Customer perspective

- **Customer and stakeholder involvement**

Table 4.17: Ratings for user and stakeholder involvement

Expert	Customer and stakeholder involvement
Expert-01-P&S	Agree
Expert-2-CON-VICE-DEAN	Strongly agree
Expert-03-DEAN	Strongly agree
Expert-04-CON	Strongly agree
Expert-05-CON	Strongly agree
Expert-06-VICE-DEAN	Strongly agree
Expert-07-P&S	Strongly agree
Expert-08-P&S	Strongly agree
Expert-09-CON-VICE-DEAN	Strongly agree
Expert-10-CON	Strongly agree
Expert-11-VICE-DEAN	Strongly agree
Expert-12-VICE-DEAN	Strongly agree

Expert-2-CON-VICE-DEAN said, "This is very important. I carefully consider the opinions of users and stakeholders about the curriculum as well as the process and learning outcomes; I mean, I evaluate the services (not being part of the internal process)". Another point singled out by **Expert-03-DEAN** was that "Stakeholders and customers have to be part of the project to believe in it and for it to be doable".

Expert-04-CON explained:

> The customer is also a stakeholder with specific targets that might have been derived from the internal process. So, the involvement and awareness of the user is very important because in the end, we want the user to use the system and be part of the development of the system. It's not just about written procedures, like this has been done and that has been done, which make it becomes static and insufficient.

Expert-06-VICE-DEAN agreed, "Users and stakeholders have to be involved in all processes, starting from the vision and strategy procedures and across all other processes. If they are not involved from the beginning, how can I plan and improve my procedures to provide good service for them without involving them?"

Expert-08-P&S added, "Very important. The involvement is not only for instructors but also for students". **Expert-09-CON-VICE-DEAN** elaborated:

> We are still passive users. Lecturers are considered employees of government, so they do their work for X hours and receive their salary. They're not involved in decision-making and they only care about their salary and their timetable. They don't attach themselves to the organisation and are not an active part of the organisation.

This was followed by agreement from **Expert-10-CON** who said, **"**I strongly agree. In order to provide accurate information and good services, you have to involve your customer and stakeholder in this business". **Expert-11-VICE-DEAN** was of the opinion that "Involvement of stakeholders is crucial for optimum output and quality of the projects. Stakeholders' involvement ensures shared vision, which results in joint efforts to achieve the targets". **Expert-12-VICE-DEAN** stated, "This can be achieved by training, and by people being involved in all phases of the plan. When they are part of the plan, they will be more motivated to see the success of the plan".

- **Customer and stakeholder satisfaction**

Table 4.18: Ratings for customer and stakeholder satisfaction

Expert	Customer and stakeholder satisfaction
Expert-01-P&S	Agree
Expert-2-CON-VICE-DEAN	Strongly agree
Expert-03-DEAN	Agree
Expert-04-CON	Agree
Expert-05-CON	Agree
Expert-06-VICE-DEAN	Strongly agree
Expert-07-P&S	Strongly agree

Expert-08-P&S	Agree
Expert-09-CON-VICE-DEAN	Agree
Expert-10-CON	Agree
Expert-11-VICE-DEAN	Strongly agree
Expert-12-Vice-Dean	Strongly agree

Expert-2-CON-VICE-DEAN and **Expert-04-CON** confirmed, "If they are satisfied, they will use it" and "If they are happy, they will use it, which will make the project successful", respectively. However, **Expert-03-DEAN** pointed out, "It is good that customers are satisfied, but I cannot give it 5 because they do not have to be satisfied about all the KPIs. So their satisfaction is good but not a priority".

Expert-09-CON-VICE-DEAN put forth the argument that "We still do not understand what satisfaction means. You might ask, are you satisfied with this technology? They think the technology has to do everything", and added, "I think they have to improve their understanding of satisfaction", explaining, "But the question is what the limits of satisfaction should be. Should satisfaction be within a specific range, either partly or fully satisfied, for example?" **Expert-11-VICE-DEAN** confirmed, "Customer and stakeholder's satisfaction directly indicates the performance of projects, as well as their usefulness. It must be considered as one of the most direct and significant measure while evaluating projects".

- **Task compatibility**

Table 4.19: Ratings for task compatibility

Expert	**Task compatibility**
Expert-01-P&S	Agree
Expert-2-CON-VICE-DEAN	Agree
Expert-03-DEAN	Neutral
Expert-04-CON	Agree
Expert-05-CON	Disagree
Expert-06-VICE-DEAN	Neutral
Expert-07-P&S	Neutral
Expert-08-P&S	Neutral
Expert-09-CON-VICE-DEAN	Agree
Expert-10-CON	Strongly agree
Expert-11-VICE-DEAN	Agree
Expert-12-VICE-DEAN	Strongly agree

Expert-04-CON considered that "It is not necessary that the task is compatible with the stakeholders' abilities. It can be more difficult or less difficult. The user has to adapt to the tasks. So that's why I am not saying 'strongly agree', because tasks sometimes are challenging, so it is very important, but I don't strongly agree". **Expert-07-P&S** said, "I am not saying that task compatibility is not important, but it is very specific and there are other things which are more important than this".

Similarly, **Expert-06-VICE-DEAN** added, “I am not sure. Moreover, I do not think that it is a part of this perspective. I think it is just a service”. **Expert-11-VICE-DEAN** believed, “Task compatibility is crucial for execution of the projects. However, it may be fortified by additional training as well as through capacity building of the project manager and team members if needed”. **Expert-12-VICE-DEAN** said, “Yes, it’s very important. We have spent a very long time looking for systems that fit with our needs and tasks”.

- **User technology experience**

Table 4.20: Ratings for user technology experience

Expert	User technology experience
Expert-01-P&S	Agree
Expert-2-CON-VICE-DEAN	Agree
Expert-03-DEAN	Agree
Expert-04-CON	Disagree
Expert-05-CON	Agree
Expert-06-VICE-DEAN	Agree
Expert-07-P&S	Agree
Expert-08-P&S	Agree
Expert-09-CON-VICE-DEAN	Agree
Expert-10-CON	Disagree
Expert-11-VICE-DEAN	Agree
Expert-12-VICE-DEAN	Agree

Expert-01-P&S stated, “I think the BI tool is pretty intuitive, and it shouldn’t be particularly difficult to use”. However, **Expert-03-DEAN** said, “I don’t have any positive or negative reaction to this factor, because usually, managers and stakeholders are likely to be skilled. So, it is not very important”. This was followed by a similar point of view from **Expert-06-VICE-DEAN**, who suggested: “I think the word ’technology’ has to be removed and we should call it ‘user experience’ instead. Users have different kinds of experiences, not only technology. The word ‘technology’ makes it very specific. So you can make it general to include different kinds of experience”.

In addition to this, **Expert-04-CON** stated, “It is not necessary that the user has an experience in the technology we provide. The user does not have to have a background or experience in using BI systems or dashboards. If I only provide users with what they are familiar with, this means they aren’t learning or growing. So their experience does not have to be based on technology”. **Expert-12-VICE-DEAN** said, **“**Nowadays all people are skilled in technology use. You might have asked this question twenty years ago, but not now”. **Expert-11-VICE-DEAN** stated**,** “This is again very significant. User experience may help, or rather, augment, the design of efficient projects leading to optimum output and quality as well as enhanced customer satisfaction”.

- **User expectations**

Table 4.21: Ratings for user expectations

Expert	User expectations
Expert-01-P&S	Agree
Expert-2-CON-VICE-DEAN	Strongly agree
Expert-03-DEAN	Agree
Expert-04-CON	Strongly agree
Expert-05-CON	Agree
Expert-06-VICE-DEAN	Agree
Expert-07-P&S	Agree
Expert-08-P&S	Strongly agree
Expert-09-CON-VICE-DEAN	Agree
Expert-10-CON	Disagree
Expert-11-VICE-DEAN	Agree
Expert-12-VICE-DEAN	Disagree

Expert-03-DEAN commented, **"**If managers and stakeholders have good expectations, this will encourage them more. Bear in mind that expectations can be positive or negative. I am talking about positive expectations". **Expert-04-CON** explained:

> It is very important to manage user expectations while implementing projects, especially in the education sector. This is because HE depends more on research than on other things, and because of this, users can have unrealistic expectations. For example, they might produce forty pages of research based on theories that are not borne out in the real world. Therefore, they have very high expectations. So, it is very important for us to manage user expectations.

In addition to this, there was agreement from **Expert-06-VICE-DEAN**, who said:

> I need to know what users' expectations are in terms of growth and satisfaction. I think it is not only about user expectations though; stakeholders' expectations need to be factored in and it is important for them to be part of the learning and growth processes because they are part of planning to reach satisfaction. And we should talk either about expectations in general or about user and stakeholder expectations.

Expert-09-CON-VICE-DEAN added, "If you offer a BI management system to the head and say to them, 'This system will help you improve your work and your decisions will become data-driven', they don't understand that there is a range for errors. They think it must be 100% perfect. So, expectations have to be realistic". **Expert-11-VICE-DEAN** stated, "User expectations may be given prime importance in the planning and design phase, as they ensure the success of projects as well as the achievement of

targets". However, **Expert-12-VICE-DEAN** argued, "this factor is not important for me. I think the important thing is that they feel that the system is easy to use. I don't pay that much attention to their expectations if they feel the system is not complicated and easy to use. The latter is more important to me. I care about their satisfaction with the system".

4.3 Discussion of the Results

Each perspective included in the framework is reviewed below, and the findings related to the factors of these perspectives are discussed. This is to show the process of deciding which parts of the framework should be confirmed, which should be modified, which new factors emerge from the data, and which of these modifications and factors should be adopted in the model. Further outlined is whether these factors belong to the specified perspectives and what experts think about the proposed framework. In addition, some potential relationships between factors are identified, and the updated framework is illustrated.

4.3.1 Elements confirmed by experts

Within the following paragraphs the researcher presents the confirmed factors (summarised in

Table 4.22) and discusses some of the main points related to these factors.

Table 4.22: Factors confirmed by experts

Factors	Strongly agree	Agree	Neutral	Disagree	Strongly disagree
Vision and strategy perspective					
Clear vision and strategy	10	1	1	0	0
Defined business objectives and goals	12	0	0	0	0
Do factors belong to this perspective?	Yes		No		
	7		-		
Internal process perspective					
Management support	11	1	0	0	0
Management process	5	6	1	0	0
Project management	6	5	1	0	0
Governance	4	6	2	0	0
System quality	6	5	0	0	0
Proper infrastructure and data quality	5	7	0	0	0
Do factors belong to this perspective?	Yes		No		
	7		0		
Financial perspective					
Adequate budgetary resources	9	2	1	0	0
Proper planning and scoping of project	3	9	0	0	0
Do factors belong to this perspective?	Yes		No		
	6		0		
Learning and growth perspective					
Information and output quality	7	4	1	0	0
Monitoring and feedback	9	3	0	0	0
Training and competency development	7	5	0	0	0
Net benefits	4	8	0	0	0
External support (consultants)	3	8	1	0	0
Do factors belong to this perspective?	Yes		No		
	7		2		
Customer perspective					
User and stakeholder involvement	11	1	0	0	0
User and stakeholder satisfaction	5	7	0	0	0
Task compatibility	2	5	4	1	0
User's technology experience	0	10	0	2	0
User expectations	3	7	0	2	0
Do factors belong to this perspective?	Yes		No		
	4		1		

Regarding the vision and strategy perspective, all the experts but one confirmed all the factors. It can therefore be confirmed that it is essential to have clear vision and strategy within HE organisations. This emphasises the importance of defining and understanding the concepts embedded in the two

words, vision and strategy. **Expert-06-VICE-DEAN** addressed this point by defining vision as 'your dreams'. However, this definition could be ambiguous, as pointed out by **Expert-12-VICE-DEAN**, who said that dreams are the most difficult thing to express as meaningful and measurable statements yet that it is important to do so, otherwise they remain as vague and undefined imaginings. Dreams are more related to fancy, rather than being applicable to real life. Defining vision is more difficult for the HE sector, because it is not used to adopting strategic approaches to deal with the various aspects of vision, unlike for-profit organisations.

This idea was supported by **Expert-09-CON-VICE-DEAN**, who said that each HE organisation should have its own vision based on various aspects, such as location, instead of copying each other. This could increase understanding and belief in the vision and strategy of the organisation, which would have a positive effect on its achievement. Accordingly, goals and objectives should be declared. Interestingly, goals were described by **Expert-06-VICE-DEAN** as the purpose that is accomplished when the objectives are defined, while **Expert-04-CON** defined goals as groups of KPIs presented using DB that illustrate whether or not these goals are reached. This underlines the significance of this factor, bearing in mind that they should be 'doable', as **Expert-12-VICE-DEAN** pointed out. The experts all agreed with the factors identified as belonging to this perspective.

Moving on to the internal process perspective, there was general agreement with all the factors. However, there were some suggested modifications, which are discussed separately following this section. Clearly, management support was approved of as a crucial factor in the successful adoption of BI. This support needs top management to believe in data-driven PM and decision-making, otherwise the adoption of BI is too challenging and will fail. This is because the management plays a vital role in increasing awareness among employees and following up with them. Further, the management needs to empower employees with the appropriate environment, meeting the technological requirements and solving any problems that arise.

In addition to this factor, a management process is important to ensure clear and well-defined policies. For example, in X_1 (country), universities used not to have clear policies and instead managed their organisations traditionally. However, there is increasing emphasis on moving away from a traditional organisational philosophy and towards the implementation of clear policies. Consequently, 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 in successful adoption of BI. However, there is a lack of understanding of how to apply this concept within the HE sector. It is suggested that specialised people should be available who are experienced in project management, including risk management, proper planning and scoping of projects, and feasibility studies. It was clearly stated

that some projects indeed fail because of the absence of project management. 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. Within this perspective, the technological factors of system quality, ease of access, capability, and accessibility were confirmed. Proper infrastructure and data quality were also approved as essential factors.

In the learning and growth perspective, the majority of experts confirmed the factors, even though some amendments were proposed (discussed in the next section). Obviously, training can save and maintain resources such as time, money, and human resources; this was presented clearly in the example provided by **Expert-2-CON-VICE-DEAN** and supported by an example from **Expert-08-P&S** about receiving training over four stages to use the X_2 system. In addition, training would increase efficiency: first, by overcoming the lack of skills to assist accomplishment of tasks; second, by enabling better understanding and support of strategy by all members, at 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 how the decisions are made, which reduces resistance, as pointed out by **Expert-08-P&S** and **Expert-09-CON-VICE-DEAN**. It is crucial to evaluate services by collecting and receiving feedback. This includes understanding commitment and usage of the system and services provided, which would improve decisions and measures, and generate new ideas. However, the data showed that feedback systems were lacking in HE; that is, there were no clear mechanisms for collecting, receiving, or dealing with feedback. One reason for this was the lack of contact with graduate students. Another reason was that feedback is not taken seriously by students or lecturers, because they are not made aware of how their opinions affect HE services.

Interestingly, expert opinions on external support varied according to role. Decision-makers believed that, as the HE sector has competencies, consultation ought to be internal rather than external. For example, **Expert-03-DEAN** did not believe in external consultation, because it is expensive and unnecessarily prestigious, as well as useless, and could be replaced by internal consultation: “When we bring in a consultant and have a meeting, at the end of the meeting we find that we’ve gained nothing extra to what we already know”. He asserted that “They say or do things that we can do without their consultation, it is more expensive than supportive”. In other examples, **Expert-06-VICE-DEAN** and **Expert-12-VICE-DEAN** felt that it depended on the organisation itself. So, if the appropriate consultation could not be obtained internally, they would use an external consultant. Similarly, planning and strategy members had similar opinions to decision-makers: as **Expert-07-P&S** said, “If the organisation depends on external support, I do not think you should be there”, and “Internal

support, yes, definitely". **Expert-08-P&S** stated, "Each school has their own consultant who works on the strategic plan, gives ideas, and monitors quality. In the past, they were bringing external consultants, but now all of them are internal". **Expert-08-P&S** 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 so we can have better understanding. So, I think external support is important".

Expert-07-P&S excluded external partners or stakeholders who can support with consultation:

> It depends on what you mean by external support. For example, if I consider those stakeholders as partnerships to support me with consultation, let's say in university, I need to have a consultation from the business sector to help me to improve my product, which might be a student, for example. However, I do not think this is called consultation, I am not sure what it is called. So, to learn and grow I need to know my stakeholders, externally and internally.

On the other hand, the consultants and decision-makers who provide consultation do support both external and internal consultation. This is because external consultation can identify problems that are not noticed internally, and avoid politics and cultural boundaries/ **Expert-09-CON-VICE-DEAN** stated:

> 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 plays a role regarding my consultation. For example, I don't want to make the chairman of the committee dissatisfied, and so on. Especially since, as you know, our culture is based on social aspects**.**

Further, he tried to highlight that consultation might fail because:

> Consultants sometimes do not understand their role — are they part of making decisions or not? Are they facilitators to the decisions we make? Do they have the chance to approve or disapprove some decisions? Also, it is sometimes just for the sake of pride: yes, look, we have a consultant, like we have this person who is famous in his field or position as a consultant, based on his name.

Moving to the customer perspective, all the factors were confirmed by the experts. In rating task compatibility, four of the 12 were neutral and one disagreed. Consequently, this factor was removed from the model. User and stakeholder involvement should increase belief in a project and support

usage. Further, this involvement should enhance information accuracy and services, and increase motivation. Involvement should be over all processes and include a variety of actors, such as instructors, students, and stakeholders.

Satisfaction plays a major role in encouraging usage of the system. Moreover, it indicates the usefulness and performance of projects. However, satisfaction could be affected by expectations, as per the question raised by **Expert-09-CON-VICE-DEAN**: "What should the limit of satisfaction be? Should satisfaction be within a specific range: either partly or fully satisfied, for example?" and **Expert-07-P&S** commented, "I need to know whether the user's expectations grow and then reach satisfaction". Understanding and managing expectations should consolidate satisfaction. This would clarify misunderstandings in the statement of **Expert-12-VICE-DEAN**: "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 to me. I care about their satisfaction with the system".

4.4 Suggestions for Modifications of the Previously Presented Factors

4.4.1 Proper infrastructure and data quality

- Data quality and data governance
- Proper infrastructure.

Instead of illustrating proper infrastructure and data quality, some experts suggested either making them separate points, as two different factors, or paraphrasing the factor. **Expert-04-CON** proposed, "I do not know what the relationship is between data quality and infrastructure. I think of data quality and governance as one factor". **Expert-06-VICE-DEAN** suggested, "I think you mean data governance. For example, having tools like DB and 'who should see what'. The director of the university can see everything. There is difference between data governance and process governance". In addition, **Expert-07-P&S** said, "Data governance is related to values. If the organisation has a transparent strategy, this means more people can access data".

As a result, the factor of proper infrastructure and data quality was modified to become 'data quality and data governance'. Further, proper infrastructure is presented as an autonomous factor.

4.4.2 External support (consultants)

- Consultation and networking.

External support or consultants can be seen as an outside lens that can help organisations to discover how things could be done better and solve potential problems. Internal support was suggested, as well. This is because universities have competencies that can play a major role in providing support and consultations. Networking among universities and other organisations was proposed as a further beneficial form of consultation.

Consequently, this factor was modified to 'consultation', which emphasises both internal and external support, and 'networking'.

4.4.3 Technology experience of the user

- User experience.

It was suggested that the term technology experience is very limited and that it would be preferable to call it instead 'user experience'. Another relevant point is that people are much more familiar with technology now than twenty years ago. Therefore, this modification was adopted.

4.4.4 User expectations

- User and stakeholder expectations.

It was pointed out that the expectations of both users and stakeholders should be taken into consideration. Being informed about stakeholder expectations could improve the chances of success. Consequently, this modification was approved.

4.5 Identifying New Factors

4.5.1 Mission and values

Mission and values were identified to be a single factor that should belong to the vision and strategy perspective to promote satisfaction, transparency, and integrity. Values generated should affect other perspectives in a like manner. One of the reasons is that, if HE organisations are driven by their mission and values, they will be able to keep themselves on track when proceeding to their goals. Further, having mission and values would increase transparency, accountability, and reputation. Therefore, this factor was added to the proposed framework.

Expert-07-P&S believed that:

> It is important to add mission and values. Having and strengthening your values would support customer satisfaction. In addition, values would reflect the financial perspective regarding

transparency and integrity, and also reflect learning and growth, and internal process perspectives. Each value that is identified will reflect and support those perspectives.

Expert-2-CON-VICE-DEAN stated, “KPIs should not be our driver. We might try to reach these KPIs in non-logical ways, but the project has to be mission driven” and added, “Transparency and accountability are very important, and in X University they are known as flexibility and accountability”. Furthermore, **Expert-06-VICE-DEAN** commented:

> If the organisation has a transparent strategy, this means more people can access data. On the other hand, if the organisation is very closed about sharing data, and if it is very difficult to access data, this could be disaster that might lead to failure or resistance. Having more transparency means being more dynamic and able to change. In other words, nothing to be hidden except very specific ’secret‘ or private data.

4.5.2 Change management

This factor is identified as one that should be included within the ‘internal process’ perspective. It is mentioned both explicitly and implicitly by the experts. For example, some proposed that change management should be added as a separate factor, and they explained how it is different from management support. Others highlighted the problem of resistance. Accordingly, the researcher approved this factor and included it in the framework within the’ internal process’ perspective.

Expert-04-CON commented, “I think you need to add change management, which is different from management support. Management support is more about providing support for the project, while change management is about dealing with people who might resist the project and refuse to use it”. In addition, **Expert-07-P&S** talked about resistance:

> I don’t think it’s gender related, but I think it’s more related to culture. In other words, some individuals are open to other ideas, either male or female, and others not. In addition, I think it’s related to which generation the individual belongs to. Maybe men are more fearless than women. Women tend to accept instructions more than men do. Women are more disciplined and follow rules. This is in general, and not always the case, and there is no evidence — it’s just personal observation. But it could be just stereotyping.

Expert-06-VICE-DEAN added:

> Sometimes employers believe in the applied change, but this change could be negative. Therefore, employees may resist the change because they do not believe in it and do not think

> it is right. Not because they just resist change. In other words, they think their changes are right regardless of others' opinions.

Furthermore, the expert stated:

> I think it is different from management support. Therefore, at the beginning we said top management support processes while change management is different. Yes, management support is important to assist the change. However, change management includes the top management and all other individuals.

4.5.3 Automation

Automation has been mentioned as a factor that can promote success. The decision was made to add this factor to the 'internal process' perspective in the framework.

Expert-06-VICE-DEAN proposed the importance of automation as a factor that can support the internal process perspective: "I think automation is an important part of internal processes to speed up, improve and re-engineer processes". In addition to this, **Expert-07-P&S** believed that "Automation can help very much with reducing costs and saving time". Similarly, **Expert-12-VICE-DEAN**, while sharing their experience of using DSS, commented, "We became 'people soft', which means that we reduced the need for humans to enter data". They added, regarding the importance of a strategic plans system, "So far we've been using Excel, which I think is very difficult for tasks including collecting data, analysis, communication, and connecting the strategic plans of schools with those of the university". This illustrates the importance of automation.

4.5.4 Return on investment (ROI)

The experts emphasised the importance of having financial income in HE. Universities are non-profit organisations that provide services to a wide range of the community. As a result, having a financial return should improve the service. The decision was made to add this factor to the 'financial' perspective.

Expert-2-CON-VICE-DEAN suggested, "You can add financial sustainability — different income resources". In addition, **Expert-04-CON** commented on net benefits, "I think it should be changed to ROI," then added, "ROI has to be part of the 'financial' perspective, not the learning and growth. It is a very important part". **Expert-09-CON-VICE-DEAN** confirmed, "If we move towards being a commercial entity, this means we will have consultants from different sectors, such as businessmen, people specialising in finance and working with investments and ROI". **Expert-03-DEAN** proposed, "I

think net benefits is a factor more appropriate to finance than to learning and growth, or it should be in both". **Expert-07-P&S** stated, "And 'net benefits' is about the real outcomes, returns, and benefits of the organisation. As we said in project management, it is important to specify the returns of the project, the ROI, so this is related here".

Figure 4.1 presents the second version of the framework after being validated by the experts.

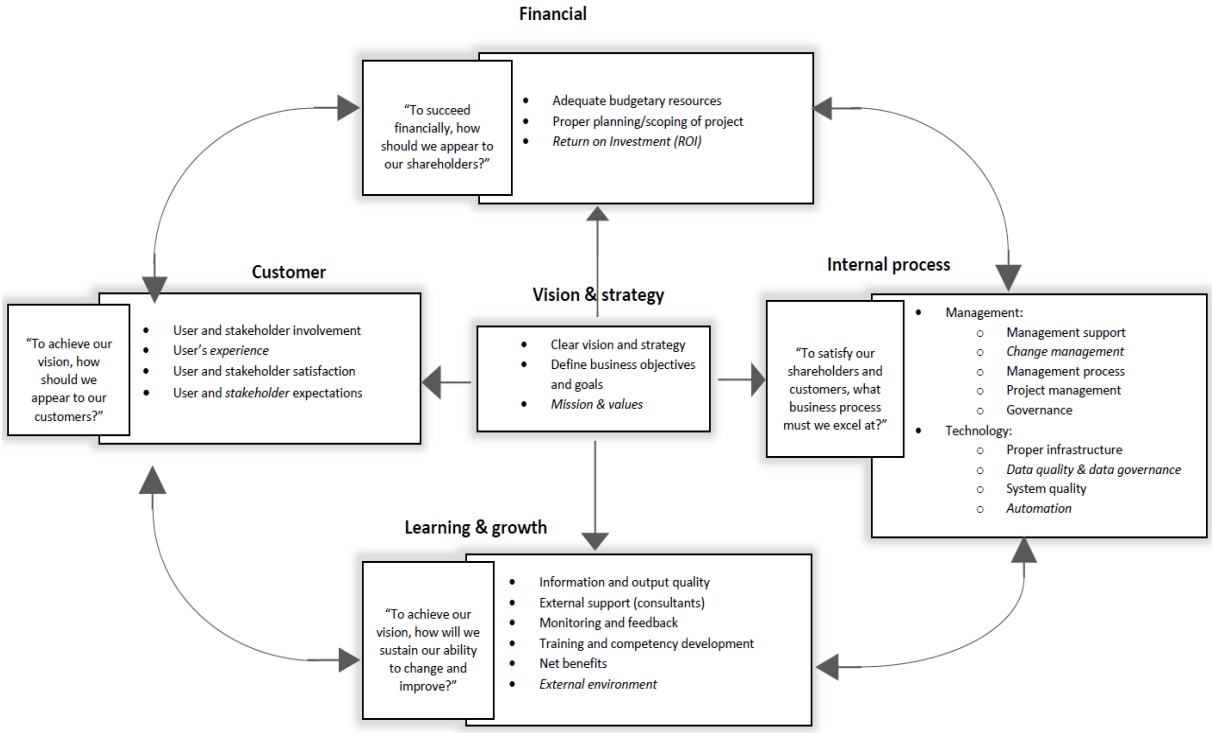


Figure 4.1: Pre-final version of the framework, as explored by study experts

4.6 Questionnaire to Confirm Results of Expert Interviews

The questionnaire was given to an alternative group of people to confirm and generate the final version of the framework. The details of the questionnaire design and the target participants are presented in Chapter 3, part 3.4.2. The next section shows how the framework has further changed based on the questionnaires.

Based on the frequency tables (see Appendix F), more than half the participants believed that the following factors are absolutely essential or very important: 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 on investment; clear vision; and define objectives and goals.

Using SPSS, Table 4.23 was generated by choosing to analyse the data using the one-sample t-test. The test value was set to 3.0, with a confidence interval percentage of 90%, because we wanted to apply the one-tailed t-test to put the entire 5% of our $\alpha = 0.05$ into each tail of the test, as illustrated in the tableTable 4.23. More detailed information is presented in Appendix F. Almost all the factors are statistically significant and should be included in the proposed framework.

The average rating of the factors is equal to or higher than the average hypothesised rate of 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 cross 0. However, the mean of the project management office, external consultation, and technology experience were frequency averages of 2.73, 2.65, and 2.76 respectively, which is less than the hypothesised value of 3.0. So according to H0, these factors are not statistically significant. Further, the p-value of $\alpha = 0.057, 0.001, 0.053$ are not less than the corrected p-value 0.001.

Finally, the results of automation, networking, defined mission and values, and experience illustrate that the means of all these factors are greater than 3.0, but p-value > 0.001, as can be seen in Table 4.23. 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) is larger than the sample of the qualitative part (12), the researcher decided to remove these factors from the framework.

Table 4.23: T-test results

Factor	Ref	Statement	Mean	P-value
Management Process	MP1	How important is it that policies for system implementation are clear and well-defined?	4.11	<0.001
	MP2	How important is it to check processes of the system frequently? (e.g. processes of collecting data)	3.97	<0.001
Project Management Office	PMO	How important is it to have a project management office (PMO) to launch and control the system?	2.73	0.057
Governance	GOV1	How important is it to have a communication between different levels of the organisation?	4.30	<0.001
	GOV2	How important is it that management roles are clearly defined and well understood?	3.92	<0.001
Proper infrastructure	PI	How important is it to have an appropriate infrastructure (hardware, software, tools)?	4.46	<0.001
System Quality	SQ	How important is it that the system is user friendly and has good accessibility?	4.35	<0.001
Data Quality & Data Governance	DQDG	How important is it to have clearly defined and valid data for the system?	4.49	<0.001
Automation	AUTO	How important is it to reduce the need for humans to enter data?	3.38	0.002
Change Management	CM	How important is it to deal with people who might resist the system and refuse to use it?	3.68	<0.001

Factor	Ref	Statement	Mean	P-value
Management Support	MS	How important is it to make sure that any problems of the system are resolved?	4.27	<0.001
External Consultation	EC	How important is it to have external consultation for the system?	2.65	0.001
Internal Consultation	IC	How important is it to have internal consultation for the system?	4.00	<0.001
Networking	NET	How important is it to have networking with other organisations for sharing ideas and overcoming obstacles?	3.30	0.007
Information and Output Quality	IQ	How important is it to learn from the information presented by the system?	4.24	<0.001
Monitoring	MON	How important is it to monitor the impact of the applied decisions?	4.03	<0.001
Net Benefits	NB1	How important is it to measure positive and negative impacts of the system on users?	3.68	<0.001
Net Benefits	NB2	How important is it to measure positive and negative impacts of the system on the organisation?	3.86	<0.001
Feedback	FEED	How important is it to collect feedback from users to improve the system?	3.95	<0.001
Training	TRA	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	UI	How important is it to involve users in all stages of introducing the system?	3.78	<0.001
Stakeholder Involvement	SI	How important is it to involve stakeholders to improve the system?	4.03	<0.001
Stakeholder Satisfaction	SS	How important is it to consider stakeholder satisfaction?	4.11	<0.001
User Satisfaction	US	How important is it to consider user satisfaction?	4.14	<0.001
User Expectations	UE	How important is it to manage user expectations of the system?	4.14	<0.001
Stakeholder Expectations	SE	How important is it to manage stakeholder expectations of the system?	4.08	<0.001
Experience	EXP	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	TEXP	How important is it that users need to have technological experience?	2.76	0.054
Budgetary Resources	BR	How important is it to have adequate budgetary resources to implement the system successfully?	4.46	<0.001
Financial Sustainability	FS	How important is it to ensure financial sustainability?	4.24	<0.001
Proper Scoping	PS	How important is it to scope the system carefully to avoid wasting resources?	4.00	<0.001
Return on Investment	ROI	How important is it that the system contribute to the financial performance of the university?	3.95	<0.001
Clear Vision	CV	How important is it to have a clear vision for the system?	4.11	<0.001
Define Objectives and Goals	DOG	How important is it to define objectives and goals of the system?	4.14	<0.001
Define Mission and Values	DMV	How important is it to define mission and values?	3.46	0.006

Regarding the open-ended questions, additional comments about the presented perspectives are invited in the first question. It was suggested that managing the expectations by senior management and involving stakeholders in some of the stages should be emphasised. It was also suggested that capability to forecast events would be beneficial. Communicating potential changes and ensuring transparency specifically while dealing with data and data provenance were also highlighted. In addition, it was felt that the system should have the capacity to deliver knowledge that could be used

by a variety of employees and for various purposes. Finally, it was suggested that the significance of these factors might vary, based on the maturity and role of the participants.

The second question investigated participants' opinions to discover whether other perspectives should be considered. It was proposed that the system chosen should be a DSS suitable for delivering the required functions and enabling easy access. Moreover, careful choice of the methodology to be applied to the system was considered essential. Additionally, it was proposed that increasing awareness of data literacy could be improved by having champions to optimise system usage as well as change management. Having single sources of data to avoid conflict and mistrust was highlighted, too. Finally, it was felt that realistic timeframes should be assigned to the completion of project tasks.

Figure 4.2 presents the final version of the framework, which was confirmed after applying the quantitative approach with an alternative group of participants.

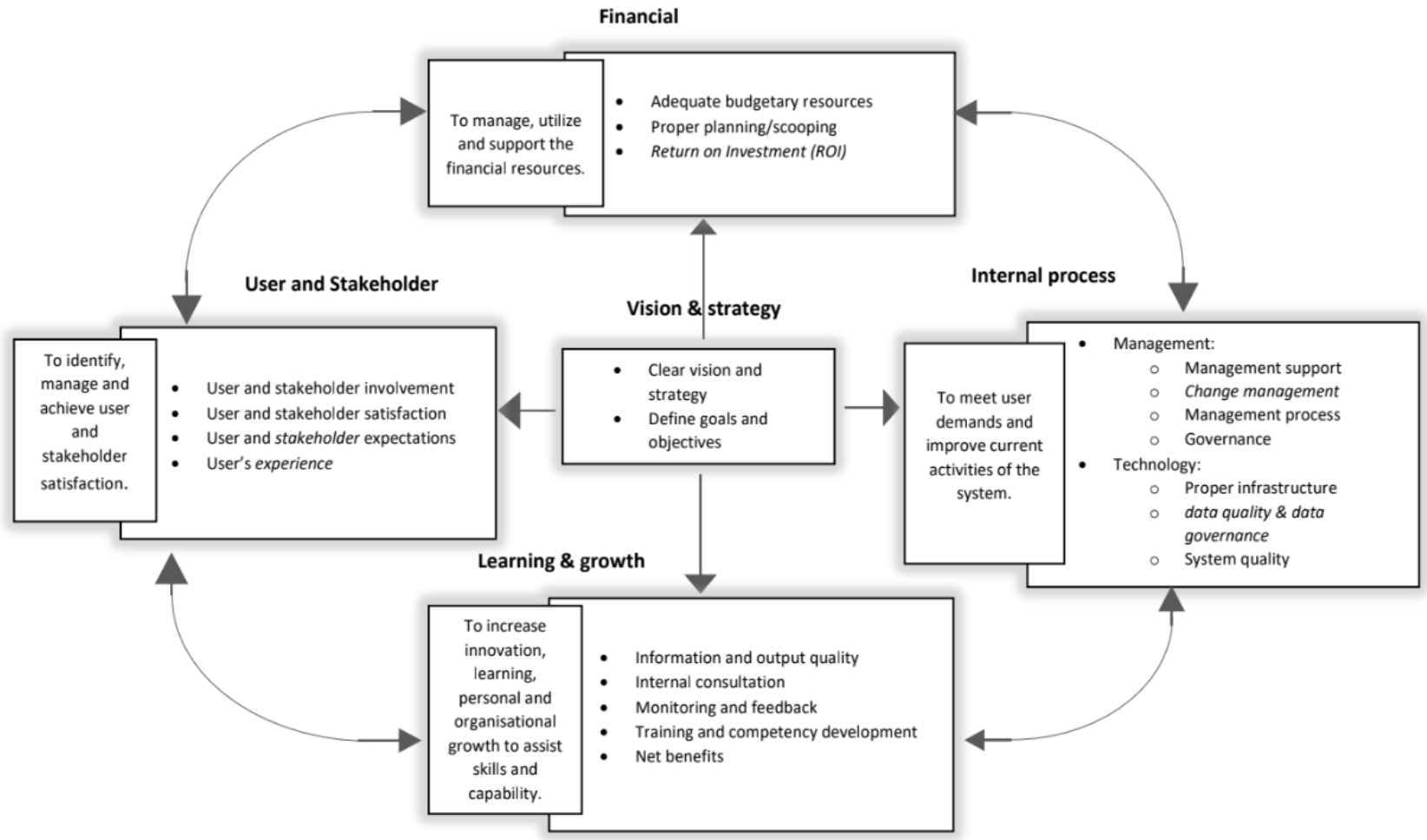


Figure 4.2: Confirmed and final version of the framework

4.7 Chapter Summary

This chapter describes how interviews were conducted to validate the proposed framework with 12 experts to identify any other factors or to modify the presented factors or the mapping of the factors with the perspectives. Consequently, the second phase of the triangulation was applied, and the second version of the framework was generated. Finally, the final phase of the triangulation was applied using quantitative techniques to confirm and approve the final version of the framework.

Chapter 5 Results, Analysis, and Discussion of the Case Studies

5.1 Introduction

Metrics were introduced using the GQM technique, which was applied to each factor of the confirmed framework in Figure 4.2. After that, the case study methodology was implemented to evaluate these metrics. This chapter presents the overall qualitative findings related to the three case studies. It explores how the participants from each case institution evaluated the metrics, scaled them, and recommended amendments or added comments for improvement.

Each case study is presented under its own heading (e.g., Case study one: University A). Under each section are subsections relating to the various questions and the evaluated metrics. The main findings are summarised at the end of the chapter. Consequently, the purpose of the case study is to evaluate the metrics that would support PM in HE. The instrument is not for the purpose of helping in decision-making, even though that could be achieved as future work based on this study.

5.2 Case Study One: University A

As mentioned in the methodology chapter, three participants (two females and one male) were interviewed in this case study. They provided their comments and views on the posed questions and metrics. However, because of the pandemic and time limitations, the first part was not answered. This is the question RQ2.1: How might the Higher Education (HE) sector measure and improve its performance? It was not answered by the participants recruited to this case study. As a result, the findings start with RQ2.2.

5.2.1 RQ2.2: What is the role of business intelligence (BI) and dashboards (DB) in supporting performance measurement of HE organisations?

In terms of how the three participants decided on the need for BI and DB, three themes were generated: 1) the significance of DB; 2) external pressures; and 3) internal monitoring. Overall, DB can be defined as a way to identify what resources are needed, make decisions related to progress and performance, and facilitate answering ad hoc queries. DB were also described by participants as helpful in diagnosing problems, figuring out solutions, checking “whether or not interventions have had an impact”, whether things are improving, and whether goals are achieved. Moreover, participants noted two main reasons for deciding whether to adopt BI and DB in the organisation:

so, “sometimes it's a bit of an external pressure. Sometimes it's internal monitoring and decision-making, and sometimes it's both, because sometimes you want to mount it internally because you've got something kind of going on externally, so yeah”.

In terms of external pressures, DB allow the reporting of data to prove the financial values and social roles of the organisation to the government. For example, employees recruited to the organisation receive an income and pay taxes, so DB provide data as a form of transparency to reassure the public and government that finances are legitimate and above board. Internal monitoring is also a factor in deciding whether BI or DB should be adopted by the institution. It was indicated that DB help to improve competitive position and can be used to rank organisations through measuring their performance and establishing whether goals have been achieved; that is, DB enable data-driven decision-making via data organisation and checking whether the institution has achieved its internal and competitive needs. Ad hoc queries can also be answered easily using DB data, such as to find out the numbers of enrolled students or how exam results compare across departments.

The main processes or steps followed to adopt BI or DB are identifying needs, checking data-publishing digital databases, and following up. Needs can be identified through building up conversations with people (face to face, emails) and researching to understand the kind of questions that require updated and clarified answers and those that need to be filed as dated. This would lead to improving data consistency and credibility, to understanding people’s needs, and to meeting their expectations so that literacy outcomes improve. Furthermore, it would help in structuring an up-to-date timeline of accessible and relevant data literacy for customers by using digital technologies and inter-team communications between stakeholders.

Literacy improvement also can happen through the standalone portfolio of DB and BI, such as self-service for the most common queries. Then, the stakeholder’s team can intervene if there are insufficient resources and limited time to check the data in the DB. This involves testing, measuring, and triangulating databases. After that, a bespoke basis for specific issues and self-service for frequently asked questions is made available for all customers. The digital database enables time-saving, dealing with more customers, and avoiding the high call volumes associated with a bespoke service. Finally, the follow-up stage requires checking of relevant data, such as whether customers’ needs are met and their questions answered.

Metrics are selected and defined on the basis of three categories: sector-led metrics, case-led metrics, and needs. Overall, a good metric is expressed as one driving towards the right behaviour and outcomes, it can monitor progress and is easily understood by customers, benchmarked, and sold in the market. An example of a sector-led metric, KPI, is looking at how it tracks and monitors

the progress and outcomes of the institutional strategy. In addition, a case-led metric depends on a set of benchmarks to measure the institution's instant performances and needs. Interestingly, these metrics usually tend to meet both the long- or short-term needs of the institution. However, there are financial issues, such as that some customers cannot buy it even if it keeps the institution on track and, if it is instant needs, the metric cannot be benchmarked.

In terms of ensuring the accuracy of the data presented in the DB, three themes were extracted: checking; comparison, and technology-based tools. First, sense-checking is undertaken with the sector-defined data to look for any changes, which mostly relies on experience. Further double-checking is conducted to spot issues with the database. Having DB is considered to be an advantage in pulling the data together and facilitating sense- and double-checking of the accuracy in the DW to make the database transparent.

In addition, some documented processes are a handy strategy to avoid any inaccuracy in the data. Alteryx is an example of the main technological tools that work to transform data into workflows. The workflows are then double-checked repeatedly to ensure the accuracy of the database. Moreover, error-checking report are run to flag any inaccuracy, missing data, or changes in the system with no obvious reason, so that the data processor team can avoid embarrassment. For example, data from sources systems such as the student record system and student admission system can undergo sense-checking, then comparison with previous data within the institution and triangulating with further data sources to make them reasonable. The judgment on the reasonable accuracy of data is made through digital processes such as Alteryx, because the accuracy of large-scale data cannot easily be achieved manually.

One of the three participants admitted that metrics are reviewed on the basis of their importance to the institution. Every five to 10 years is the point at which some metrics are reviewed to measure performance, examine the achieved goals, and monitor the (re)focus in the institution strategy. "Yes, it might be every five or 10 years we are doing a strategy review [..] to check if we kind of been meeting our goals out, if it's the emphasis still the same and you have that kind of question". When the emphasis is on cascading metrics, the review is conducted constantly without a fixed point in time to check better ways of measuring metrics "and also what may be the unintended side effects of certain metrics". For example, students' admission, access, and participation plan metrics are reviewed constantly to check performance, look at students' continuation and degree attainment, and how many students had a career by the end.

Consequently, the main issue is not to review all metrics on a regular basis, but to review metrics of high importance to the success of the institution's strategy. For example, the review plan is set, selecting metrics that require changes in measurement, and dividing the metrics into four stages,

then the data are sliced a hundred ways. It is emphasised that the few metrics chosen for review on the basis of both identified problems that require further improvement and the level of their importance to the institution's strategy. For example, for the access and participation plan, a year ago the university decided to change the strategy and adopt a new plan. However, the sector reviewed the goals set in the previous plan and made changes according to the required improvements.

Looking at the data presented in the DB, all the three participants stated that only baseline data are provided in the DB for people to think about and come up with more complex questions. It is compared with the Maslow's hierarchy of needs, in which a DB provides the basic information and needs of customers. The main reasons associated with a "basic needs" role of a DB is the chain and growing number of questions that people may come up with after receiving this basic information. The participants declared, "I expect questions to evolve, and that the more information you give to people, the more questions to arise. So a sign of success is if people start asking more complex questions".

In terms of BI or DB being helpful to achieve the organisation's strategy, all three participants confirmed that it is helpful in terms of facilitating the measurement and understanding the evolution of the strategy. Interestingly, this usage was helpful in ticking "where we want to be, and it was very clear, and you can kind of, say, have we hit it, or have we not hit it? Are we reaching out to required aim, are we not, so in that way it's been quite or really helpful?" Further, using BI or DB is useful for the executive group to circulate data for people to read and understand, so they become aware of the measured goals and contribute to their achievement and progress of the strategy. However, it is emphasised that certain data cannot freely be published, which may hinder the better progress of the strategy and its understanding from people.

Moreover, the use of the DB and BI was helpful to the department in two ways: to track the progress in performance; and to promote the institution as the first consultancy university in the X country. An example is the HEBCIS DB, used as knowledge exchange information looking at the enterprise side of an institution. This usage assisted in the alignment between its department and the whole organisation's strategy. The participant emphasised that the departmental DB provides more ready access to data to make better decisions in alignment with the organisation's strategy.

Having an action identified as a main element that confirms the value of either the system or the DB, particularly among the executives of the organisation – that is, receiving positive feedback from the vice-chancellor – is described as a way to increase a DB's value. Similarly, building up effective discussions around the data provided makes a DB more valuable. Participants said, for example, "If the university executive group is having really good strategic conversations of the back of it [data

provided], I would mark that as success". However, its DB is described as a set of coloured papers that contain the strategy's key information, rather than being truly interactive. It would be "like a couple of sheets like red, amber, green; but we call it a DB and we get fiat in terms of what the organisation likes".

5.2.2 RQ2.3 What are the appropriate metrics to measure the effectiveness of using BI and DB?

To answer this question, a description of the goals and objectives was shared with the three participants for them to become familiar with them and to make any comments. Table 5.1 summarises the findings, then the questions and metrics generated by these goals are evaluated.

Table 5.1: Description of goals and objectives

Goals and Objectives	Comments
Goal-1 (vision and strategy) and its objectives	• It is stated that their institution has a clear vision for their newly developed strategy, and it is in the process of making the actions underneath it. • The institution has a clear vision of how they want to represent that on a dashboard/Excel report. • The institution set goals to be achieved and make accessible for people to check whether their goals are achieved and how to update individuals on what is happening.
Goal-2 (internal process) and its objectives	• The interviewed participants mentioned that these goals remind them of the previous strategy iteration of balanced scorecard type methodology. • Even though they have plenty of data about internal processes, it was found to be one of the more difficult to be measured. • One reason for being not easy to measure is that they have not necessarily been used to measuring it. • An example they have is if they can measure the number of withdrawals and why students might withdraw. It is stated that data must exist, and departments know that someone dropped out, but the problem is about their data quality process of being able to measure it. • It is clarified that when they talk about internal processes, it is about reporting to support internal processes and making the existing data visible. • However, it is an issue; for example, they are building a CRM system and putting lots of data in there, but they have not thought about how to get out again.
Goal-3 (user and stakeholder) and its objectives	No comments added
Goal-4 (financial) and its objectives	No comments added
Goal-5 (learning and growth) and its objectives	No comments added

5.2.3 Evaluating the questions and their metrics:

By applying the GQM approach, the list of questions and their metrics has been reviewed with participants for evaluation purposes to refine, improve, or suggest other questions on the basis of their institution.

5.2.3.1 Goal 1: Vision and Strategy

- **Does the institution follow a clear vision and strategy for applying and using the system (Dashboard/Business Intelligence)?**
  - On the vision and strategy perspective, it was commented that the question required improvement. It was described as being an all-encompassing phrase that demands consideration of a specific level of granularity. This could be based at system level, in the case of the strategic plan.
  - M1.1: similarly, one participant stated that the question should clarify the level of granularity. For example, at a system level their answer would be no, while in terms of having a clear vision for what they want to have business intelligence do in the case of the strategic plan, the answer would be yes.
  - M1.2: participants suggested clarifying that it is about the DB enabling the strategy over the organisation, for example saying that the institution understands what it wants to achieve with the dashboard.

- **Does the institution state clear objectives for the system (Dashboard/Business Intelligence)?**
  - M2.1, M2.2: the participants agreed with both statements. However, they suggested articulating that it is about enabling the strategy.
  - It was mentioned that it is an issue that the metrics used are seldomly changed, which might effectively divert effort towards making a merely attractive dashboard, because data do not change often.

- **Is it clear that the vision and strategy of the system (Dashboard/Business Intelligence) is aligned with the vision and strategy of the organisation?**
    - One participant said, “I would read that as, Does the content of the dashboard reflect the strategy?”
    - It was stated that the DB that they are developing to monitor goals are very clearly aligned with the actual strategy, so there is a clear line of sight between them.
    - M3.1: the participants agreed with the point and stated, “There isn't necessarily a written document to say the vision and strategy for this KPI dashboard is this.

We may have it written down, saying the purpose of this dashboard is X, Y, and Z, but it's not phrased in the visional, strategy way".

5.2.3.2 Goal 2: Internal Process

- **Does management over different levels (e.g., executives, senior managers) provide support to apply and use the system (Dashboard/Business Intelligence)?**
  - One participant asked whether the support is championing and encouraging individuals to use the system or providing physical, practical support through generating content or sourcing data. She stated, "I think a lot of them will pay lip service to say, 'Oh yes, we really, really want this,' but when you ask them to actually help you generate content or to source the data or whatever, that is often where it becomes harder to get support".
  - M1.1, M1.2, M1.3, M1.4, M1.5, and M1.6: they agreed with these points and think that they make complete sense.
  - They suggested adding a point about whether a member of executives or senior management owns the results of the DB and has accountability for the DB's performance. They believe that the ownership of results and activity, which is different from the ownership of data, is important:

    So for example of, say, in our strategy, one of the key measures is student satisfaction. We're trying to push that a member of the University Executive Board (UEB) champ is accountable as a UEB accountability and that they will be the vice-president for education. So that way you are kind of making sure that championing process happens… it's making sure that activities take place that will improve his student experience.

- **How to ensure data governance and the quality of data?**
  - The participants believe that there is no ultimate truth, and that this should be accepted:

    I'm going to get on my usual hobby horse here, which often gets me sure, but I think it's a myth that there is an ultimate truth. Often in the data, and I think people have to sometimes accept that we choose to have some data be true and others not. For example, if there was a question about number of students, there are five, six, seven, or eight different ways to answer that question.

    Consequently, she believes that, for a DB, individuals should agree on which definition to use, then stick to it.
  - M2.1 to M2.9: participants approved these points, and like that they are splitting the ownership and the understanding: "I really like what you've done here".

- **How is the quality of the system (Dashboard/Business Intelligence)?**

- It was suggested that an important point to be considered is reaching out the required information quickly, “Taking the example of setting the student numbers, how quickly would it be for the VP education to find student numbers? How many clicks?”. The participants stated that they have many attractive DB, yet it is more about their ‘findability’.
- The participants discussed accessibility, as individuals might make colourful and splashy DB without being effective: “E: Don't get me started on pie charts. M: No, a pie chart is the devil. E: 3D pie charts as well. M: Yes, in both 3D pie charts”.
- Further, the participants mentioned documentation and transparency to improve the DB’s maintenance: “To have a data definition and whatever, but the more transparent they are, so that people can understand what they're looking at, the better”.

➢ **Does the system (Dashboard/Business Intelligence) have the appropriate infrastructure?**

- The three participants commented that, even though the question is important, it is a big one that might be difficult to answer.
- The three participants further mentioned that access management is an issue that they have to consider; that is, who should get access and how to ensure that they have access only to authorised data:

  The way in which we give people access to the dashboard? I can't remember if I saw a question about that. For example, we've had this conversation recently about financial data, that the university might want to share 10 of the 12 metrics with everybody, but there's two that's confidential that they want to manage access to.

- When the researcher asked if this was a barrier, the participants agreed and stated that it is political and could be a technical challenge.
- Further, this issue is related to cultural aspects and feeds into behaviours surrounding demands for transparency. However, some measures cannot be shared, which might cause people not to accept the system:

  So, if you tell people that there are there 10 metrics you can see but two you can’t, it doesn't help them buy into it. People focus on the two things they can't see, rather than the 10 things they can see. You know, you want to be transparent as well.

She added:

> But for me as a data provider, it's the most frustrating thing when people want to start looking at some bits selectively. Because I know that people are going to moan about it. They're going to get all funny about it and, at the end of the day, it's not me who's making those decisions, it's the managers, who don't get these access requests. Yeah, I think these are some challenges we face.

- **Are the processes of applying and using the system (DB & BI) managed effectively?**

  - It was commented by participants that there is no explicit process for using and applying the DB and BI system effectively at the institution. For example, before the pandemic, the institution attempted to adopt a kind of a culture for managing their transitioned system effectively. However, during the pandemic it was challenging to adopt a culture of managing all the data, as some can be accessed only by senior managers, such as the dean. Another reason is that financial and confidential data cannot be easily accessed by everyone.

    The participants gave suggestions for developing effective management of the data system. They suggested that the institution should define what they mean by a good culture for communicating the data, as well as how to organise a framework for the stakeholders, then obtaining and organising the feedback onto coloured scorecards.

  - In terms of culture, generally, there is a tendency to use the system. However, there are two elements that affect this culture, namely that individuals are either not interested or are apprehensive that data or information will get out of control. Consequently, there is a tendency to keep related aspects very tight while applying the processes. Moreover, it was mentioned that explicit processes are needed to find out who needs to use the system and whether it should be used within the university as a whole:

    > Because if they only want deans to use it, you know all they're doing that, but if they want the whole university to use it all, are they actually doing something about that, and I think the answer to that is quite often, no.

  Further, participants liked the points that describe the kind of culture needed. This needs to be measured to identify whether it is a transparent culture or a more central culture: "The problem is that: Is it a good culture or a bad culture?".

  - The problem with element M5.1 is that it supposes that there is a shared culture, while it should be about defining what culture is, so participants preferred M5.2. They explained that there is conflict between what individuals think and what they execute, "Because that's almost more telling Are you communicating it as a proxy for culture of what the culture is?". In addition, participants found M5.5 an interesting and excellent point, yet more about policies, and they do this sometimes based on the case.

- Participants liked M5.10 and M5.11 as they reflect getting a communication plan and managing stakeholders, respectively. They commented that is something that every organisation should think about, and they will get there one day.

- Regarding M5.12, participants reflected on absorbing intelligence from individual employees as the extent of receiving feedback. However, they mentioned three levels of feedback: feedback on DB, such as the colours: “Someone goes, I hate the colour purple. I think it should be green”. Next there is feedback on seeing from DB weaving issues, such as problems with student satisfaction: “I see from the dashboard that student satisfaction is an issue in basket weaving. How do I think this is – because of the fact that we didn't give them pens at the start of the lecture?”. Third is feedback on measures such as miscounting the number of engagements, “Where they wanted to count how many engagements, major engagements, we've had in the community. Is that something else? And say, ‘Oh, you said we've got 12, but I know there's 13 because they still haven't counted this one that I do’”.

➢ **How does the organisation govern the system (DB & BI)?**

- The three participants felt that the question was not clear and required some clarification. The researcher clarified that the question is about the accountability and transparency of the culture. The participants found the question invalid, because they think that the institution can only manage, not govern, the system.

➢ **How does the institution manage and control the change?**

- Participants found that M6.1 was easier to answer than M6.2. Further, they suggested adding an element about culture within a department or structure.

5.2.3.3 Goal 3: User and Stakeholder

➢ **How can satisfaction with the system (DB & BI) be improved?**

- The three interviewed participants suggested adding an element about measuring behaviours that might be instilled by the DB.
- The three interviewed participants argued about M1.2, as they think that the system does not help individuals to solve a problem, rather alerts users to what is going on to then notice and diagnose issues:

  > So, I suppose it’s kind of like your car dashboard thing, when it says, like, there's a blinking light telling you that you need your oil changed. It won't change oil for you, but it will let you know that there's an oil problem.

- The participants thought that the system does not usually help with understanding why the problem is happening. “So, if we were looking at whether or not students are dropping out, it's not going to tell us why they’re dropping out. It's just going to tell us that they're dropping out”. Consequently, they think that further investigation is required to identify any possible relationships or correlations, which highlights the importance of organisational feedback on the soft and the hard datasets.

- The datasets were described as a pyramid of data, and the same for DB.

➢ **How can involvement of user and stakeholder be ensured?**

- Regarding M3.2, the participants suggested referring to staff, rather than administrators.
- The participants suggested that this part might be more about increasing engagement and whether the system makes them engage with other resources to help them understand the problem. “So, the question is, does it encourage them to seek out further information to help solve the problem? That would be a good thing for me”. “If, on the strategic dashboard, we say there's a problem with withdrawals, and that makes them go and look at the dashboard, it’s going to give them more detail about withdrawals, and that would be, for me, encouraging them to engage with the problem, I guess”.

➢ **Does the system (DB & BI) satisfy the expectations of the user and stakeholder?**

- The participants declared that the question was not clear and required clarification. The researcher clarified that the question is about the accountability and transparency of the culture. One participant found the question invalid, because they think the institution can only manage, not govern the system.
- Participants found M6.1 easier to answer than M6.2. Further, they suggested adding an element about culture within a department or the structure.

➢ **How does the experience help the user?**

- Participants liked the elements within this part.
- The participants commented about the importance of being agile “E: Yes. It's about being agile, it is a key part of the new strategy, so it's kind of giving us permission to not be wedded to something just because we've done it in the past. It's kind of like let's keep in mind what, the best question, what we're actually trying to answer. M: Yeah, it's better that data comes along. We will start using better data, for example.”

5.2.3.4 Goal 4: Financial

Overall, the participants considered the questions asked about financial resources to be valid and worth reflecting on.

➢ **How can adequate budgetary resources be ensured?**

- The participants commented that the DB needs to be designed for finance information and planning budgetary resources. For example, a head of department can check financial information via the finance DB, yet not other DB. One of them explained: “I

have a financial dashboard that is telling me this. Not all dashboards will be able to give me finance information or will help me work that out".

- **How to ensure proper planning of the budget?**
  - To ensure a proper planning of the budget, it was suggested that the overall finance and cashflow are measured and operated respectively by the university KPIs. In this way, the budget is measured and planned appropriately in the organisation.
- **How to increase the financial return?**
  - To increase financial return, the participants said, "The university KPIs are actually our key performance indicators in a dashboard, but we need to have measures underneath". In other words, the KPI DB is the principal one for measuring financial return in the organisation.

5.2.3.5 Goal 5: Learning and Growth

- **Does the system (DB & BI) assist information and output quality?**
  - The participants found the question difficult and were uncertain how to answer it. They suggested that this question was related to the benefits of mapping the system and checking the outputs of the organisation strategy. For example, if the organisation plans a new investment, the system assists in checking the output and performance.
- **Does the institution consider training and competency development?**
  - The participants were uncertain about the meaning of competency development. One claimed, "I'm not sure if I fully understand the term 'competency development'". This metric, therefore, requires clarification and explanation of the term "competency development".
- **Does the institution consider monitoring and feedback of the system (DB & BI)?**
  - The participants commented that two kinds of feedback can be monitored: the data itself; and the definition of the data. These two kinds require different tracking and monitoring through the system. So, the participants agreed that the institution should consider feedback and monitoring of the system.
- **Does the institution consider the internal consultation?**
  - The participants confirmed that the institution imposes internal consultation to track changes in rules. They elaborated, "There is a difference between informal consultation where you just gather information versus a more formal system for that, which could be what this means". In other words, they suggested that internal consultation is responsible for formal consultation of the data in the system rather than just gathering informally the information.

- **How does the organisation perceive individual/organisational impact of the system (DB & BI)?**
  - They suggested that this question would better be addressed to the users of the system to get more informative answers; that is, the question requires refinement for clarity. One of the participants commented, "I would like to say: of course, it does strongly agree with that… we do all of these things". Additionally, it was implied that governance is responsible for the system.

5.2.4 RQ2.4: What are the barriers to and opportunities for applying this technology?

After applying thematic analysis, four main themes were identified as being barriers to applying DB within the HE sector. These themes are culture, perfection, confliction, and multi-customer challenges. Cultural aspects are those such as an expectation that a DB should let the user know exactly what is wrong. In addition, individuals who work at universities always want to have perfect measures and require the DB to be perfect, while the fact is that the data are not always perfect. Moreover, conflict around the appropriate number of measures has been highlighted. Users do not want to have so many measures, even though they want to measure everything. This leads to complexity when designing DB to quantify and explain to various customers who demand different answers.

To overcome these barriers, four main themes were extracted: education; engagement; the pyramid approach; and what to measure. Educating individuals within this complicated sector is essential. This could assist people to understand that perfection is no longer feasible. However, the processes of educating might be slow and require iteration. Keeping re-educating by continuing receiving feedback and responding to this feedback can lead to increased engagement among individuals. This because more would feel a part of the design, thus it would improve user engagement. Further, this would enhance users' understanding of what to measure, taking into account that not everything can be measured. Interestingly, a pyramid approach or, as they called it as well, an 'iceberg approach' is presented. The idea behind it is to start with a strategic DB to include few metrics, where plenty of things underlying these metrics are picked from various DB with their own potential to have large, overarching DB.

The main derived themes that feature opportunities and recommendations around using DB within the HE sector are dynamic data, weaving data, engagement, and transparency. It was commented that it has been frustrating for either users or developers to have static data that can be changed only once a year, which might result in very slow movement. Consequently, being creative in designing metrics would imply engagement, because individuals do not tend to engage with

something that never changes. Further, it is important to have new measures to enable the measurement of things that are needed, such as quality, diversity, and inclusion.

In addition, weaving data could become an interesting opportunity to get a new picture, such as the triple helix diagram, even though that could be difficult. It is crucial to have a clear rationale of why things are done in a specific way, besides involving individuals in the design from the beginning.

5.3 Case Study Two: University B

In this institution only one male participant was interviewed, and he provided his comments and overall evaluation of the proposed metrics.

5.3.1 RQ2.1: How does the higher education sector measure and improve its performance?

The participant said that one of the main elements in PM is ensuring a quality experience to students. This is based on data metrics that are related to various aspects, such as student outcomes, student experience, research, and finance. Measuring performance is important for reasons that can be categorised as either community impact or taxpayers' money. Universities have a huge impact on communities, as they recruit individuals and are important to the economic output of a region or multiple regions. Consequently, having at least a baseline quality that should be met through institutions is vital. Further, it has an impact on young adults, vulnerable adults, and people from disadvantaged backgrounds who deserve a quality experience. He stated that a student's success and satisfaction are the two most important parts within the institution, considering students as customers who are putting in their money to get a return. Further, their feedback is important to ensure promoting the institution and meeting their needs.

The participant emphasised that staff measure performance at his organisation at multiple levels, starting at a very top where there is a corporate scorecard composed of about 10 to 15 key metrics that the institution is working towards. Then, there is a hierarchy or breakdown of those measures, which might be further detailed into lead indicators and supplementary indicators. Having an academic hierarchy structure, there is a faculty scorecard, department scorecard, and programme-level scorecard. "We do have various other levels, perhaps more strategic metrics, which we might call our corporate scorecard".

As the university has mission statements and strategy documents that guide the institution to get to 2030 with the support of many objectives and milestones to attain, staff build scorecards around

those to achieve the strategy goals. They provide analysis and reporting to stay on track and to have a positive impact on the institution.

Interestingly, while designing the measures and building up DB, the participant takes a two-pronged approach to ensure people's involvement across the whole institution. The first technique is working with the senior team members, considering their specialism oversight to understand their needs, what they think is important, and their key aims. Then, they turn it around and look at the bottom-up management levels to find out what is important to them, what helps them to achieve that goal, and what is useful. Subsequently, they try to discover what determines success for them, going through much discussion and research to identify what is available.

To examine the number of managerial levels that constitute their organisation, the participant thinks that it is a good question, even though it is complicated: "Honestly, quite tricky for us to understand". Generally, there is the board of governors, then a senior level containing the vice-chancellor, deputy vice-chancellor, pro vice-chancellors, and leads for each faculty. The next level is the senior management team, which brings in other senior colleagues across the institution, including heads of the directors of service. Further, each faculty has an executive team, which is then hierarchical down to the department. The participant stated that the institution is very hierarchical, instead of being particularly horizontal: "There is not a lot of spread, and that has pros and cons for us".

The responsibilities of each level are classified on the basis of the roles of board of governors, the directorate, and then operational responsibility. The board of governance is there for reassurance and oversight and to ensure that the institution takes the right approach. The directorate was described as steering the ship in the right direction and making the required adjustments.

Going down for each level is operational responsibility; the participant described the levels, such as the head of faculty to enact any of the required changes and to "have oversight in order to make sure that their response with their teams is working towards the strategy objectives via the KPIs and the performance measurements". Regarding communication among these levels, it used to be the formal dissemination of performance information through regular, recognised boards, quality boards, and oversight boards, plus meetings and emails: "We want discussion around the information, then that leads onto further discussion, rather than being a stuffy, formal meeting where things are, sort of, the life is kind of sucked".

The participant mentioned that targeting the right people directly can have more impact. If this is an issue because they are not available, others might represent them. Consequently, there may be individuals in a meeting who do not necessarily understand or are up to speed with the question: "It's like being in a meeting or in a situation where people are talking about something, you've got no idea what it is". This would cause slower responses to change, ineffective use of individuals' time, and being misleading, compared to the private sector, which would not wait for formalised boards in order to raise a problem or a flag to make changes:

> Why should we be limited in that way, just because we have formal governance tick-boxes to hit? We should be responding quickly. There's a problem here, we can make efficiency savings, we can make value added, we can do things differently. Let's do it now rather than in two months' time when those people are going to get together in a room to discuss it.

Regarding promotion, there are standardised and formalised processes, and attempts are made for these to be as open and transparent as possible. When a role becomes available people apply for it and then, depending on its seniority, there are interviews, presentations to test individuals' skills, and panels to make a decision, led by a chair.

5.3.2 RQ2.2: What is the role of business intelligence (BI) and dashboards (DB) in supporting performance measurement of HE organisations?

Regarding how the participant decided that they need BI or DB, three main themes were generated: the meaning of BI and DB; understanding needs; and expertise.

Starting with DB, the participant expressed this as combining reports for a particular purpose to answer a specific business question, yet that there is a limitation to using DB within the organisation: "Now, in all honesty, at the university we do very few dashboards". On the other hand, BI is more towards provision of data and goes beyond being reporting on only data, extending to the ability to add value and change decision-making. However, he stated that the terms are interchangeable:

> I mean, even within the university, it's used as a fairly interchangeable term. BI at the institution means the team that I line-manage, it also means very specific reports. It means just generally looking at data or reporting. So, setting a definition is tricky.

He indicated that understanding needs is essential, achieved by interrogating customers and understanding business questions. Having the experience required to decide on the appropriate way for delivering information to the appropriate audience is important. The experience is

supported with in-house expertise to carry out research, scoping, and looking at the market to understand how to answer the question.

The main outlines of the processes to endorse BI or DB were said to be identifying needs, improving understanding, testing, publishing, and following up. Needs can be identified by building up conversations, by email, and self-research to understand what questions need to be answered. This would lead to understanding people's needs and improve working with customers to shape the required outcomes. Further, it improves understanding of the data limitations in terms of availability, being in market, being sensible to produce or worth avoiding, and understanding also if it will be standalone BI reporting, big integrated DB, or simply a table of data through email, blog post, or verbal update. Then there is working back and forth with customers to be within their expectations by testing data and outcomes. Next involves deciding how to publish data, either using power BI app, as a presentation or email, and, finally, the follow-up stage to find out if this is still working and answering the required questions, if people are using this sort of thing:

> And then follow up, which is the sort of final one which is to go back. Go back and ask how would you know is this worthwhile? Is this still working? Is this still answering the questions you want to ask? Have we missed the boat? Are people using these sorts of things? So those are very rough outline of the steps we would take.

An example of the main presented measures was given by the participant as student journey analytics, which is classified into application-related measures, student satisfaction surveys, and learner analytics data. Application measures include questions like application rates. How many offers were made? What types of response did we get back from our students? How many are coming through clearing? And where are they coming from? How many enrolled? How many of them withdrew from the institution? What's their mark; no matter whether they're getting good marks, whether they are passing their modules or not? What's their final degree classification? Are they getting a graduate job? Are they going into further study?

In addition, student satisfaction surveys for both undergraduates and postgraduates include questions such as whether they are satisfied, how they have performed, their marks, and overall degree classification. Questions to measure learner analytics data are, for instance, whether other students are engaged or attending classes, and whether their engagement is good. It was stated by the participant that the main features of these metrics are variety and being focused.

Metrics are selected and defined on the basis of three main categories: sector-led metrics; league tables; and needs. An example of sector-led metrics was given by the participant as looking at HESA (Higher Education Statistics Agency) to find out what they are measuring and what is important for

institutions to look into However, in the past this was a mirror to HESA performance indicators. In addition league tables, mainly the *Guardian* and other tables like the *Times* and *University Guide,* are used as a guide to measure performance as benchmarks and competitive base.

Interestingly, to compose the strategy to 2030 the participant tends more towards understanding what the university needs: “We've started to look a bit more in terms of what does the university need”. In more detail, they try to raise the question, ‘What do we need to measure to get to 2030?’ to find out the measures that help to make business decisions, whether they are on the journey, if they are going to get there, and to tell in 2030 if they have got there. However, there are issues like not having the right to collect data, not being able to report on it, or the tendency to report on things just because they are available.

The participant stated that, to ensure the accuracy of data presented in the DB, three main themes were extracted: checking; comparison; and working with others. Double-checking was undertaken with data owners to find out whether there are any changes, and also for metrics, measures, and dimensions in the database. Further, there are error-checking reports to flag if there are missing data, inaccuracy, or changes with no reason in the DW. It is an advantage to have a DW to pull data from sources systems, such as the student record system and admission system, to go through the Extract, Transform, and Load (ETL) process then manipulate and add additional data to query them using Power BI or SQL. In addition, there is the judgment of analysts through double-checking, sense-checking, and screening before publishing. Making a comparison with previous data within the institution and market data to ensure being in line with expectations is implemented to improve accuracy, also working with others such as compilers of the statutory returns.

It was admitted by the participant that, even though the stakeholders review the metrics, it ought to be done on more regular basis: “Yes and no. I think it's the idea. Yes, that we do, but we probably should do more often, I think it's fair to say. Because the nature of the data is quite cyclical, production, particularly an annual”. The end of the academic year is when to view metrics such as good honour reporting and degree classification to determine if metrics need to be tweaked or updated. Further, looking at the strategy for 2030, it is important to examine the existed metrics to observe if they are measuring the right data, if data are understood and fit in purpose, and if they are different than the teaching excellence framework. For example, to run a subject or teaching a specific area, they need at least 80% of students to continue, or x% of students to get job or go on to further study. It was emphasised by the participant that they should be reactive and respond to change if things happen in a different way for another purpose: “So, we tend to be quite reactive in the way in which we review and make changes when we know our stuff, otherwise we'll just let it take over until somebody tells us that it's wrong”.

Consequently, one of the main issues is not looking at the metrics in regular base. For example, the university set out its corporate scorecard in 2014 to look at 2020. It had 36 metrics that were run and presented every year without revisiting them. It was found that the corporate scorecard should be more useful and responsive to change. It is vital to have more regular and live documents and processes to respond to changing needs and outcomes, either if the university decides to go in different direction or if they did not get the right data. However, it needs to be realistic, such as revisiting them every six months to construct the cycle, starting with finding out if they got it right, then feeding this back, then looking at it again, and keeping the cycle going.

Looking at the presented data, it was declared by the participant that the corporate scorecard does not present the information that the participant needs: “I think about the corporate scorecard as sort of a dashboard of bringing together metrics to sort of show an initial view of the data. Does that present the information that we needed? No, I'd say no”.

The main reasons for this are the timeliness and limitations in terms of availability and being up to date. In more detail, the participant needs to wait until the end of the year to compare it with the previous year: “We have to wait until the academic year ends before we can look back over the previous year and say how did we do?”, while they need to know how they are doing right now to implement the required change. In addition, there is limitation in what they can report on:

> You know, data is collected in very particular ways in the institution. The market data to compare us against these collected data in a very particular way, and there are limitations in terms of what we can purchase to understand and have the context behind to understand…

or even what they have is out of date:

> The sector moves on and, you know, the market moves on. So, are you risking collecting on something that's already changed? I don't know, that's the big problem, I would say.

Usage is identified by the participant as the main element to confirm the value of BI and DB, particularly by senior level management. If they have been used to drive the whole organisation, this increases their value. Senior management, such as the vice-chancellor, deputy vice-chancellor, and pro vice-chancellor, should buy in and understand that data are important to constitute data-led institution. Further, building up effective discussion by referring to data or introducing questions improve their value. Interestingly, the fact that the BI and strategy group is physically located next to the senior management group enables its voice to be heard and for it to be independent.

In regard to BI or DB being helpful to the organisation to achieve the strategy, the participant confirmed that their understanding towards achieving the goals of strategy is improved by using quantitative, qualitative, and numeric indicators, mainly by being able to produce and circulate data that enable people to read, act, and make the required changes to them. However, this improvement is found in areas such as student satisfaction, while other areas are not successful due to not answering the right question or not being central enough:

> It helps in some areas, but in other areas, we are sort of lagging behind. And I think if you look at some of our competitors, particularly international competitors, people in Australia and America in particular, they use data a lot more centrally to move where they want to go to, and that's primarily because their strategies are based by having a really clear data focus.

Further, the participant said that using BI and DB was helpful for his department to achieve the organisation's strategy. Interestingly, this usage assisted the alignment between his department and the organisation's strategy:

> Yeah, yeah massively. It helps provide a unified goal for the institution. So, we know what we're working towards.

5.3.3 Refining and generating metrics

This part intends to report the findings obtained from the second case study. It answers specifically the third research question:

RQ2.3: What are the appropriate metrics to measure the effectiveness of using BI and DB?

5.3.3.1 Internal process perspective

The participant suggested that the wording and focus of this objective require no refinement and can stand as they are. At the beginning, the participant felt that the objective 'management support and internal processes' was not as high priority as the "clear vision and strategy" objective. He suggested that the goal might be ranked between high and medium. However, he then rethought its sub-parts and changed his ranking to high, compared to a medium rank for the 'clear vision and strategy' objective. While the participant had second thoughts, he shared the following example that reflects on the overall functioning of his institution:

> We could exist as a business intelligence function without having a clear vision and strategy for the institution, because will fill that void. So, we can still add value to the institution without it being incredibly clear. You know, we will still build that understanding. In an ideal world, you would have an incredibly clear strategy in order for the function to actually work.

That management support bit probably becomes more important. Because even if you don't have buy in from your senior management group, you can still move the institution by having their buy in and their trickledown effect within that. That's why I'm sort of hesitating a little bit.

The above explains what led the participant to rank 'internal process' higher than 'clear vision and strategy'. He claimed that an institution can fail without management support, yet it can move forward with no very clear vision or strategy so long as the management group cooperates. The following presents the participant's evaluation of the metrics related to the 'internal process' perspective:

- **Does management over different levels (e.g. Executives, Senior managers) provide support to apply and use the system (Dashboard/Business Intelligence)?**
    - He commented that this is a good thinking and suggested adding something about understanding, such as, 'Do the appropriate management levels have an understanding of what they are actually accessing?' This is because this might inform whether they are actually going to champion it or not; if they do not understand it, they probably will not champion it.
    - Regarding M1.5, M1.6, he is not sure if that is linked to the question.
- **How to ensure data governance and the quality of data?**
    - The participant agrees with the metrics M2.1 to M2.4.
    - He thinks that there should be clarification off M2.5 and M2.6, as the difference between ownership and control of data is not clear. He thinks that people do not necessarily need to fully understand who produces the data.
    - He strongly agrees with M2.7.
    - He disagrees with M2.8, as he thinks that it is not about single source of data but about the right source of data.
    - He agrees with M2.9.
    - He suggested adding whether there is a common understanding of how data should be governed. He commented that it should not just filter one person to have oversight of that, as there should be group responsibility.

- **How is the quality of the system (Dashboard/Business Intelligence)?**
    - The participant agrees with M3.1 and M3.2 and commented that people become less and less patient.

- He is neutral on M3.3, and disagrees with M3.4 as he does not think that they have to be consistent. However, it is more about answering the right question.
- He is neutral on M3.5, as he thinks that it is useful but not necessarily needed to determine quality.
- He suggested adding ease of use and accessibility, specifically disability accessibility, and making sure that the system is readable, usable, and interactable. Further, the ability for users to get into the system and access the reports through their phones.
- Another interesting point is the licensing structure's cost, even though he thinks this might fall under 'finance'.

- **Does the system (Dashboard/Business Intelligence) have the appropriate infrastructure?**
  - The participant agrees with the presented metrics, as it would be quite limiting if the institution had none of these.
  - He suggested adding terms of support technology support, such as IT support.
- **Are the processes of applying and using the system (Dashboard/Business Intelligence) managed effectively?**
  - The participant likes M5.1, saying, "I wish we had that one. It is important to ensure that it is managed effectively".
  - He agrees with M5.2 and M5.3.
  - He is neutral on M 5.4 and disagrees with M5.5, as he does not think that is needed. He stated that it becomes a balance between culture and politics. He thinks that if you have the culture, you do not necessarily need the politics.
  - He is neutral on M5.6, as it not necessarily needed but is 'nice to have'.
  - He agrees with M5.7, and strongly agrees with M5.9 as it comes back to the previous question about usage and process for converting information into a plan of action.
  - He agrees with M5.10 and M5.11 and thinks that M5.12 is a good question that would show whether a highly functioning management is effective.
  - He suggested adding resourcing as it needs the appropriate resourcing behind it to ensure that it can be managed effectively.
- **How does the organisation govern the system (Dashboard/Business Intelligence)?**
  - He agrees with M6.1 and thinks it helpful to understand what is valuable.
  - He thinks that M6.2 is not clear, and questions whether if it is about the output of the BI or the importance of sharing data in order to facilitate BI.
  - He thinks that M6.3 'records and accountability' should be two separate points, and agrees with M6.4.

- **How does the institution manage and control the change?**
    - The participant agrees with M7.1 and likes the part about self-learning. He wonders whether there is change for the sake of change, or there is change in order to make a specific impact. Consequently, he suggested adding the purpose of the change, that the university responds to appropriate change, or appropriate situations for adding value.

5.3.3.2 Vision and strategy

Overall, the participant considered that the questions in the 'vision and strategy' objective as covering all the components; that is, he did not suggest any refinement to the wording or the focus of the objective. However, he then had second thoughts and suggested adding the actual touchpoints where the system is utilised and the outcomes are useful. He said:

> I'm not sure whether this will be pulled in somewhere else. But about the point: 'Are there key touchpoints where the system will be actually utilised', it's quite key. So, it's not just about generically thinking about, 'yeah, we've got a strategy and is it clear' but are there actual touchpoints where the outcomes will be utilised; that could be useful.

The above suggests that the participant considers a clear vision and strategy for the system as less important unless accompanied by actual and useful results or outcomes; that is, a clear vision and strategy are important to consider, while it is easily made practical and actual. The following presents the participant's evaluation of the metrics related to the 'vision and strategy' perspective:

- **Does the institution follow a clear vision and strategy for applying and using the system (Dashboard/Business Intelligence)?**
    - The participant said it was difficult to separate vision and strategy into separate elements, as they overlap significantly.
    - It is a general question, so he suggested making these elements specific to the strategy that the vision might be looking into.
- **Does the institution state clear objectives for the system?**
    - The participant thinks it would be "tricky" if he was to answer the question, as he does not know what the requirements might be. So, he suggested specifying the individual requirements that the system is asking for in order to make it run. M2.2 needs to be modified to say that the requirements being placed on the system are clearly stated and understood.
- **Does the institution state clear objectives for the system?**
    - The participant liked the metric M3.1: "I am going to steal that".

- He suggested adding whether the senior management group at the university is satisfied that the strategy of the system matches the strategy of the organisation. This can be used as a perception of whether it is or it is not aligned.

5.3.3.3 User and stakeholder

The participant suggested that there are two groups of stakeholders: the end users of the data; and those who provide the data. In the middle are the BI team members, who take data from one side then pass them to the other. Consequently, a new kind of involvement is required and different experience and expectations.

For the involvement part, the participant suggested adding 'training' as a part that gets the user and stakeholder more involved. He said:

> How to ensure the involvement a user and stakeholder… I would say it's pretty high, actually. If you don't get your users involved, then they are not going to use it. Is there anything I would add to that? I don't know if it's going to be later question, but about training; we talked about setting up a level of understanding or ability to use the area, would be quite high importance within the involvement in order to make sure that they can influence, as well.

For meeting expectations, the participant said that it is of high importance for the user and the stakeholder to keep on track and use the system: "Does this system satisfy the expectations of the user and stakeholder? Yeah, that's going to be pretty high, because if it doesn't, people won't use it and, full stop, walk away."

As illustrated in the following quote, the participant believes that if the user and stakeholder have experience and their expectations are met, the satisfaction part is not of high importance: "If you talked about helping the user in terms of helping them to make a decision or helping them do something, then that's going to be quite high. But it's again, there's no point in doing it if doesn't change anything."

The following paragraphs present the participant's evaluation of the metrics related to the 'user and stakeholder' perspective.

- **How to improve satisfaction with the system (DB & BI)?**
  - At the start, the participant was concerned about which users are meant by this metric, as he believes that users have different needs and scopes, thus he suggested neutral. Afterwards, he became aware that only two users were the main focus (dean and head of schools) and suggested a high priority for this metrics.

- The participant found the metric M1.2 to be relevant and requiring no amendment. He said, “Yep, that's fine. No change there in that question, I would say ‘high’.”
- The participant was concerned about the clarity of metric M1.3 and wanted for further explanation.
- He provided a joint comment about M1.5 and M1.6. He suggested that the use long- and short-term goals make the metric more interesting and was a good way of splitting the needs of the departments and organisation.

- **How to ensure involvement of user and stakeholder?**
  - The participant suggested more clarification in terms of the type of “engagement” meant in the metric.
- **Does the system (DB & BI) satisfy the expectations of the user and stakeholder?**
  - The participant believes that this metric (M4.1) is interesting as it covers the aspects of expectations and satisfactions for users and stakeholders.
  - He suggested a splitting the stakeholders into two distinct groups: data input stakeholders; and data output stakeholders.
- **How does the experience help the user?**
  - The participant reflected on the three metrics, then suggested a clarification of the terms ‘opportunity’ and ‘capability’. He shared his perceptions on these two terms: “I see it as an opportunity, as a way to change a behaviour, and a capability might be a new system or tool that you kind of instigate.”

5.3.3.4 Learning and growth

The participant thinks that the objectives within this goal are well-rounded. He thinks that training and competency development can assist senior position to understand data, so they will enforce it down to individuals, which means that effect can be trickled down. He stated that they have much work to do on that, and they need to do more about competency across the institution. Consequently, the base level of all individuals is to be raised to a minimum standard. There are potential issues such as having a data literacy environment. The following presents the participant’s evaluation of the metrics related to the ‘learning and growth’ perspective:

- **Does the system (Dashboard/Business Intelligence) assist information and output quality?**
  - The participant suggested refining the question by add the ‘regulate’ after assist, to read: ‘Does the system assist and regulate information and output quality?’ (checking and reviewing the quality).
  - He did not suggest any amendments to the metrics.

- **Does the institution consider training and competency development?**
    - The participant stated that it depends on what people do with their BI solutions, so it can be made incredibly easy for people to digest. The more training is provided, the better outputs can be obtained, and the better engagement can be received.
    - He commented on the choice of the word 'manager' in M2.2 and the word users in M2.3. He suggested more clarity in terms of which group is meant, as they may be considered as the same group of people.
- **Does the institution consider monitoring and feedback of the system (DB & BI)?**
    - The participant commented that this does not stop it from moving forward.
    - He suggested clarifying what is meant by feedback process and which type of feedback is meant in the metric.
- **Does the institution consider the internal consultation?**
    - The participant commented that internal consultation reflected improving and ensuring that the focus was on the correct aspects.
- **Does the organisation perceive individual/organisational impact of the system (DB & BI)?**
    - The participant thinks that this covers what he said about the return on investment. Further, it is important to have some sort of reflection on matters, even though this is difficult to scope.
    - He thinks that these three metrics are thought-provoking and important. He was concerned about the distinction between the terms 'organisation' and 'institution' in M5.3, 5.4., and M5.5. He suggested using a single term that means the same thing.

5.3.3.5 Financial

The participant stated that the objectives within this goal are fairly standardised. He mentioned that the return was mainly intangible and drip-fed; however, ROI would be the key to finding whether it adds value.

The following presents the participant's evaluation of the metrics related to the 'financial' perspective.

- **How to ensure adequate budgetary resources?**
    - The participant claimed that if it is important for the institution, the money would be there. However, he suggested doing it on an incredibly small scale and as cheaply as possible.
    - He suggested amendments to the word 'adequate', because he thinks the word means different meaning to different people.

- **How to ensure proper planning of the budget?**
  - The participant stated that this was by focusing on the right areas.
- **How to increase the financial return?**
  - The participant suggested balancing the financial return with the non-financial return. As a team they had found it not necessary: "We know that eventually, if things are done right, there will be financial return. But we are looking at improvement for the university, and that will always cost".
  - He thinks that if they were in a different organisation, the financial return would be massive in order to increase sales and profits. He mentioned that the return is the not strategic objectives of the institution.

5.3.4 Challenges, barriers, and implications

The participant shared the barriers that the organisation may face, and Table 5.2 summarises the barriers and challenges recognised by the participant. He considered cost and the availability of data as the main barriers: "Cost, resource, reflection and the availability of the data, probably the big barriers."

5.3.4.1 Barriers and challenges

Table 5.2: Barriers and challenges

Barrier/ Challenge	Reflection	Quote
The availability of the appropriate data	The participant thinks that data availability is a potential barrier that requires more time and ready people to be able to sit down and properly analyse. This is again being able to produce the data is fine, but the barrier is the ability for academics and senior management to find time to reflect	"You know that being able to measure the right thing, it's quite tricky. You know, the sector's facing the same thing, the sector wants to measure teaching quality. How do you do that? What data presents that? So, you know, dashboarding and business intelligence is only as good as the data that can be available, and your understanding of the question will be able to pull that stuff together".
Cost	He first confirmed that cost is not a potential barrier. Then he gave it a second thought and acknowledged that cost is a barrier as well when a priority is on investing on data analyst and data producers.	"I don't think cost or tools are a barrier as much as anymore. I think there are incredibly cheap. I mean, no, I take that back. Cost can be a quite significant one depending on what tools or what things you want to implement it in institution. Both in terms of having

		to invest in analysts to undertake and IT development and things like that as well as tools implementing the right tools."
Education and Training for quality education (cultural change category)	He suggested that the HEI may face the education and training barrier when it strives to reach the quality culture and environment.	"Maybe education, let's say training as well, ensuring that people can't have the right training to understand. These two (education and training) kinds of comes under culture, in that way".
Cultural changes	He suggested a change in cultural attitudes to provide an environment for the institution users. This environment should encompass affordable cost and high quality.	"You have to have an environment. There is receptive to that and for a long time the HE environment has managed to get by with not needing to look at data. As much as, a private company or a retail company or something will be looking it up to the second sales data. Institutions of kind of coasted for a long time, so there's a bit of a big attitude change there. A big cultural change that provides a significant barrier".
Governmental	The participant suggests that government influence the conduct of the institution as it sets certain restrictions. These restrictions limit the kind of available and useful data in the system.	"A final barrier is a sort of a governmental. You know, in terms of restrictions on what data is important, where the focus needs to be placed? It doesn't necessarily stop an institution looking at it, but it can just provide particular focus. Sort of a bit of restriction in that way because it limits where that effort might want to be put towards?"

5.3.4.2 Implications for overcoming barriers

The researcher asked for potential ways to overcome the five barriers. The participant decided to list them in a different order to that used in listing the barriers:

- Showing impact and improving analysis of data with low financial investments.
- Setting strategic goals and strengthening the knowledge about understanding the data.
- The governmental restrictions cannot be removed, but they are manageable and suggest metrics accordingly.
- Investing time and money on training stakeholders for producing and analysing data effectively.

5.3.4.3 Opportunities for applying BI and DB in higher education

The participant started by providing information about when the DW started in his institution, questioning how useful are the data when only some institutions use BI. In his institution, the business intelligence and data warehouse team started in 2008, and when he joined in 2009 it was one of the few institutions that used this system of data.

Compared to previously, the participant mentioned, most institutions now have BI. He described it as collective BI based on some sort of presentations, network emails, and conferences that require separate members or a team to implement the data system in their own faculty or department. He defined people as the passive recipients of data who had to understand the competitive edge that the institution is working to achieve. This competitive edge enables the institution to stand out from other institutions.

The participant considers that the BI DB is not as important for the success of institution as it used to be. According to him, it is a traditional practice, but it may yet help the recent practice in those institutions that should act as a business and use BI and DB to achieve a competitive edge.

Therefore, the participant suggested that HEIs have opportunities to apply BI and DB to report data, yet they are not of great importance, as institutions have improved and act as businesses to reach this competitive edge.

5.3.4.4 Optimisation of using the system to support performance measurement and decision-making within the higher education sector

The participant suggested communication as the solution, and the components under this communication requirement are:

- Working and communicating with senior members
- Working and communicating with the data owners and governors to secure quality data, to have a high-quality output, and to meet the expectation of the customers.

He believes that communication can enable get analysts who can create change. He claims that communication:

> Is more than just the tool. It's more than just the sort of technological ability, and just by having a tool that does dashboarding, it's all about how you can create and foster analysts to undertake that work and get the most out of them.

5.4 Case Study Three: University C

In this case study, one male participant was interviewed to provide his views about the metrics.

5.4.1 RQ2.1: How does the higher education sector measure and improve its performance?

Performance measurement within the HE sector involves a multifaceted approach that includes the principal areas of teaching, research, and engagement. Other areas include financial performance to measure expenditure and various financial resources like student requirement and research income generation.

The participant emphasised that measuring performance in the HE sector is vital for reasons classified into the main themes of marketisation, reputation, accountability, and competitive advantage.

The marketisation concept is regulated to some degree. Among undergraduates it becomes strongly regulated, yet is less regulated among postgraduate students. Reputation is linked to the performance of the institution, based on a whole range of facets like education and research performance, and how to be more competitive over time. Consequently, a senior executive in the university is accountable to the governing body of the university and board of directors, where it is expected by students that the institution performs optimally, whatever optimally means, which depends on the institution itself.

A whole range of levels within the institution are interested in measuring performance. This is established by the governing body and the executives to illustrate the holistic overview of all aspects of performance across the pillars of teaching, research, and engagement; in other words, ensuring that recruitment, research generation, and engagement performance are good. Further, the results of educational performance are tested and assessed on the continuation league table and based on KEF, REF, and Tapper. Then these are cascaded down to deans, heads of departments, and individuals who care about the performance of their faculty and department. However, deans and heads tend not to care as much about the overall institutional performance, as their main concern is their area of operation to assure that it is performing well. Interestingly, this could be a challenge because some academics are collegial, and their work is somewhat isolated from the main university's vision. They care properly if their department is performing well, because this has an impact on their reputation. Consequently, executives should mobilise the academy to ensure individual buy-in.

The participant described the various managerial levels within the organisation, beginning with the pinnacle of the organisation. This comprises the university executive board, which is effectively the vice-chancellor, his two deputies, the deputy vice-chancellor, and the deputy CEO of operations. Then comes the pro vice-chancellor of matters such as engagement, teaching, and research, followed by the executive deans of the full faculties. Accordingly, that is the highest level at which all the individuals report to the vice-chancellor. Beneath that, under the deputy CEO of operations, there are centrally all the professional services and a series of divisional directors, such as the director of strategic planning and governance. The next level is the academy underneath the deans, then there is their senior management team, including a deputy dean and thematic associate deans of research, teaching, and engagement. Also, there are heads of department, who report directly to the deans, then the rest of the academy.

As a result, there are four tiers including the vice-chancellor. Communication among the staff within the organisation is either by regular meetings or internal communications that are written and published. Regarding meetings, the executive board chaired by the vice-chancellor meets fortnightly to consider a diverse range of university business that the deans take items from to cascade them down through their senior team. Further, the University Leadership Group (ULG) monthly meetings are the broader leadership of the institution, including all the deans, all the associate deans, the professional services directors, and heads of department, to constitute a single large group of around 90 members to acknowledge major topics.

To measure performance, the organisation adopts analytics by developing a DW and using Tableau software. However, the current status of analytics is not like other firms undertake, and still uses standard chart DB, looking at standard areas of activity relating to research and educational performance. The organisation is still on a journey, even though there is encouragement to establish future workshops about developing a broader analytics strategy and making DB widely available.

5.4.2 RQ2.2: What is the role of business intelligence (BI) and dashboards (DB) in supporting performance measurement of HE organisations and their decision-making process?

Processes for deciding that the organisation needs DB commenced in 2005, the participant explained, with triggers like forecasting income by looking at student number planning in a planning tool. It was explained that doing the work with Excel to forecast hundreds of millions of pounds' worth of income was enormous and extremely complex. The university appointed a new vice-

chancellor who developed a new strategy for the university, including a goal around research excellence. They needed to have a more quantitative approach to measure research performance.

This triggered the institution into dashboarding as a strategic imperative for the new strategy to facilitate the delivery of the goal. Consequently, after investigating various software vendors, the IBM analytics tool named Cognos was selected. Even though the tool was procured for planning for student number forecasting, its DW was further extended to encompass research data. Therefore, a range of DB on research performance was presented and a new process created to challenge departments on their research performance. This new process proved to be effective, if slightly controversial.

Concerning the presented measures on research applications and awards., the analytics on research are executed and educational analytics are created. Therefore, the entire database related to REF is included in the DB, which can assist benchmarking against REF performance. Other data such as citations, and research income are included. HESA data are combined as well, to enable benchmarking of research income by department against particular HESA cost centres.

The main extracted themes to define metrics are based on experience and consultation. In connection with experience, having a long background in measuring performance and professional expertise has been the facilitator to perceive what to measure. As a consequence, metrics are selected on the basis of personal expertise and that of the senior analyst, who is highly talented. This experience commenced with the role of professional services in the research office. Prior to that the participant was a researcher, who undertook a PhD and a postdoctoral study to improve understandings around research. Consultation on the developed metrics was compounded with this, as well. This consultation was conducted with the requisite pro vice-chancellors and presented to the senior team. In terms of education, many things were done with NFS data, UCAS data, continuation rates, graduate entry tariff, graduate outcomes to benchmark graduate and employability, and a wide array of metrics.

The participant described the specified processes and protocols to be followed to ensure the accuracy of the defined metrics. Further, it was imperative to have well-trained data scientists to assure that data were accurate, and most of the time they were. It is acknowledged that, even though the data would be challenged sometimes, nine times out of 10 the reason would be that the user did not understand the data for the entire time period that was reported.

The participant emphasised that the data were rarely wrong. Updating data is performed on the basis of the decided frequency, either daily, quarterly, or annually. It is partly dictated by business requirements and partly by the frequency with which data are produced or calculated. For example,

research applications and awards are updated daily, because there are constantly new data going in. On the other hand, research expenditure and income are reported quarterly, as the finance office compiles the data quarterly. Other data, such as National Student Survey data, are produced only once a year.

Regarding the quality of the information presented in the DB, the main themes are the availability of data, knowledge of performance, and presenting data to a high standard. The HE sector is providential, as there is much data available. However, their being static data is an issue where data are needed to be reported more frequently. Consequently, work is ongoing on a plan to report HESA data more frequently. Moreover, producing DB had a major impact, which made the knowledge of performance very powerful. In addition, it is important to present data to a high standard in terms of colour and choice of chart type. DB should be purposeful, not just colourful and elaborate. Further, attending a course with a stakeholder specialising in data visualisation and DB design enriched the participant's experience by following his standards, besides having strong team including the analyst and the senior analyst. The only limiting factor was the selected tool, Congo, but it complements Tableau and does ad hoc analysis with a good aesthetic standard.

It is acknowledged by the participant that confirmation of the value of a DB can be on the basis of its influence, its financial return, or formulation of strategy. Using the DB within the organisation was transformational and became part of the norm. When applied within the organisation, it had a major influence on the sector, thus so many other institutions had the desire to learn from the experience. The university gained a reputation for being good at what it had done. There was no debate about its financial return, as the expenditure was only around £1,000,000, yet by bringing in dashboarding the organisation turned over more than half a billion sterling. As a result, it is indisputable that it was not a waste of money. Moreover, it is embedded in the strategy formulation, strategic review processes, and resource allocation processes, and informs the strategy.

On the role of the DB in achieving the strategy, the participant stated that we should understand what achieve means. The term can be unpacked to say that it helped to formulate strategy. It formed the strategy to shape the future and performance, the setting of KPIs, and to track its delivery. It was powerful in reviewing the institution's performance to find out whether a strategy existed or not. Moreover, it assisted in the alignment of the department's strategy to the organisation's strategy. The participant developed a process of strategy renewal, which encompasses the development of a strategic plan for a department based on an analytics-driven approach. This approach has been popular, and is described by the current vice-chancellor as outstanding and rewarding.

5.4.3 RQ2.3: What are the appropriate metrics for the effectiveness of using BI and DB?

To measure the confirmed framework, it was shared and discussed with the participants and comments received back. The framework has been described as process-driven, rather than driven by the normal themes of the organisation's strategy. Most university strategies have both a goal and sectional goals around education, teaching, research, engagement, and so on. It is considered that these are enabling factors to achieve objectives, rather than goals in themselves. The participant argued that:

> However, they are all sensible and thorough enabling factors. As we engage with stakeholders, we have got to think about the budget, we need to communicate with the vision, and try to engage people. In addition, looking at the maturity of BI and finding out what is going on, and what cutting-edge industries are already there would be beneficial.

He seems to be inclusive of various stakeholders in his use of "we", and suggested considered points while measuring DB effectiveness, such as budget and people engagement.

After applying the GQM approach, a reflection on the system was usefully undertaken. It was stated by the participant that the approach looks good and covers most bases. It was mentioned that the only gap is around assessing the current capability and maturity of the system and understanding the basic competencies of the organisation. The participant said:

> So, what business, you know, they're going to have data, they are going to be processing data, they're going to be presenting data, even if they're doing it in Excel, right? Or the Department of Egyptology, in that he's got his own copy of Tableau. So, you need to assess the BI, maturity and capability, and skills.

Going through the questions and metrics related to the goal of vision and strategy is believed to be highly important, and there is no adjustment proposed.

Moving to the questions and metrics related to internal processes, most questions are highly important. It was confirmed by the participant that receiving the support of the vice-chancellor was integral to applying metrics and getting the system done. The quality of the system is highly important, otherwise it would undermine the infrastructure.

From the user and stakeholder's perspective, all the presented questions were seen to be highly important. The participant used to release data DB to users' satisfaction. If DB are not well designed, individuals will not use or understand them. Stakeholder involvement is very high, and the participant held sessions with stakeholders where they showed them that they sought feedback.

They have an email feedback system, so if individuals have any comments on DB they could give feedback on them.

Having adequate budgetary resources is vital, because the system will fail if there is not the right budget. Regarding the ROI, the participant did not look into that. He thinks that universities are incompetent in this field and should do better. He said "But it certainly did, we just know it did. I mean, I know that's a very bad response, because you should be more empirical than that. But we just know it did." He added:

> I mean, I think I think the thing for me was when we had the REF (Research Excellence Framework) outcome, and we did really well in the REF, and I think the dashboards and the process we put around the dashboard data challenge research performance really helps our REF performance. So, I think I think that more than paid for it and I think that was realised.

The participant thought carefully about DB design and aesthetics. Further, they undertook training sessions and demonstrations to assist people to understand data and to be able to ask questions through their integrated email system. They carried out internal consultation and recognised the internal impact of the system such as the REF.

5.4.4. Barriers and opportunities

5.4.3.1 RQ2.4: What are the barriers to and opportunities for applying this technology?

Within this case study, the main barrier presented is cultural change. Institutions in the HE sector might be not familiar with a quantitative culture, and this can be a real challenge. As a result, it is essential to have effective change management, including strong leadership and great advocacy. In addition, acquiring both the proper budget and the skills required to improve the competency of the individuals leading the project should be considered.

Regarding opportunities, it is believed that they are enormous and could support aspects such as investment, prediction, and competition. However, it was pointed that institutions with hundreds of millions of pounds turnover might not possess good capabilities and could do far more if they wanted. This means that the HE sector is lagging behind the commercial sector. Moreover, it is suggested that predictive analysis could be a great opportunity to support aspects such as recruitment and admissions. It is important to the institution’s competitive advantage, understanding its own performance and benchmarked performance relative to other competitors to optimise performance. It is recommended to apply it widely over the whole institution, including the main pillars of the strategy and its activities, whether financial, research, educational, or engagement analytics. Further recommended are human resources analytics to test staff sentiment

satisfaction, equality and diversity, and the gender pay gap. Understanding how to apply these usefully, without flooding people with poorly presented data and low-quality visualisation, should be taken into account. This could be applied by developing a framework to answer the main business questions: What data are available? How best to present data? Can we benchmark? Are there targets?

5.5 Final Version of the Metrics

The researcher generated the final version of the instrument from the three case studies presented in Chapter 5 to answer the research question:

- What are the appropriate metrics to measure the success of using BI and DB?

The researcher added and modified the metrics on the basis of the participants' responses to the three sub-questions:

- How does the HE sector measure and improve its performance?
- What is the role of business intelligence (BI) and dashboards (DB) in supporting the performance measurement of HE organisations and their decision-making process?
- What are the appropriate metrics that measure the effectiveness of using BI and DB?

The research concentrates on developing an understanding of the successful use of BI and DB to improve an organisation’s performance within the HE sector. One of the main issues in using DB is misalignment with the strategy of improving the organisation’s performance. Instead, DB might present colourful and splashy visualisations that pay no attention to essential aspects, such as the quality of presented data and information.

Consequently, the researcher examined adapting the concept of the BSC to introduce and confirm the framework for improving the alignment and measuring the success factors of using this technology. After that, the researcher combined the concept of BSC with the GQM approach to generate the appropriate set of metrics. This combination would benefit from the appropriate number of metrics, as BSC generates a small and concentrated set of metrics that might be inadequate, while GQM might generate a larger number of metrics that might be redundant. Further, this would fit the purpose of strategic-tactical DB, which is the scope of the study.

5.5.1 Final version of the instrument to measure the framework of factors of success

Based on all case studies, participants understood the vision and strategy of their universities and know how both to illustrate this on DB and to deliver it to individuals. Some suggestions and modifications were provided and approved by the researcher, for example clarifying the questions

to demonstrate that they reflect the strategic plan and enabling the strategy of the organisation, as illustrated in the following table.

Table 5.3: Final version of the metrics

Goal 1	**Vision and Strategy**
Q1	**Does the institution follow a clear vision and strategy for applying and using the system (Dashboard/Business Intelligence) based on the case of the strategic plan?** M1.1: The institution understands what it wants to achieve with the dashboards. M1.2: The institution has the key touchpoints where the system will be utilised.
Q2	**Does the institution state clear objectives for the system?** M2.1: The objectives around the system (Dashboard/Business Intelligence) to enable the strategy are clearly stated and understood. M.2: The requirements for using the system (Dashboard/Business Intelligence) to enable the strategy are clearly stated and understood.
Q3	**Does the content of the system (Dashboard/Business Intelligence) align with the vision and strategy of the organisation?** M3.1: The institution tests the linkage of the system (Dashboard/Business Intelligence) with the actual strategy to ensure the alignment. M3.2: The senior management group is satisfied that the system matches the strategy of the organisation.
Metric identifier	Rating score: 1. Strongly agree, 2. Agree, 3. Neutral, 4. Disagree, 5. Strongly disagree.

Goal 2	**Internal process**
Q1	**Does management over different levels (e.g. Executives, Senior managers) provides support to apply and use the system (Dashboard (DB)/Business Intelligence (BI))?** M1.1: The institution keeps championing the use of the system (DB & BI). M1.2: The institution provides practical support to generate content and source data.

	M1.3: The importance of the system (DB & BI) for the success of the institution is understood to users. M1.4: There is encouragement for regular use of the system (DB & BI) by many people for a variety of purposes. M1.5: The institution facilitates authorisation to access the system (DB & BI). M1.6: Executives or the senior management group own the result of the dashboard and have accountability for its performance. M1.7: The appropriate management levels have an understanding of what they are accessing.
Q2	**How to ensure data governance and the quality of data?** M2.1: There is a clear ownership of data. M2.2: There is a clear ownership of processes that generate the data. M2.3: There is a clear understanding of uses of the data. M2.4: The purpose of using the data is clear. M2.5: There is a clear understanding of who produces data. M2.6: There is clear definition of data used to compose key ratios. M2.7: Individuals stick to the agreed definition of data. M2.8: The institution has the right source of its data. M2.9: The institution demonstrates periodic validation of data. M2.10: The governance process of data is appropriate. M2.11: There is a common understanding and group responsibility of which data should be governed.
Q3	**How is the quality of the system (DB & BI)?** M3.1: The system (DB & BI) is easy to use. M3.2: The system (DB & BI) loads quickly (has minimal downtime). M3.3: Reaching out for the required information in the system is quick. M3.4: The visual displays used in the system (DB & BI) answer the right question. M3.5: The system is readable and supports disability accessibility. M3.6: There is documentation for the system to ensure transparency and improve maintenance.
Q4	**Does the system (DB) have the appropriate infrastructure?**

	M4.1: The tool used to deliver the system fits well with individuals' needs and activities. M4.2: The required hardware, software, computer network, and IT support are provided. M4.3: Authorised access to data is managed effectively.
Q5	**Do the processes of applying and using the system (DB & BI) managed effectively?** M5.1: The institution communicates the purpose and the processes of using the system (DB & BI) to multiple levels of staff. M5.2: The institution constitutes the fundamental processes for updating, presenting, modifying the system (DB & BI). M5.3: The institution establishes explicit policies for the system (DB & BI) production and usage. M5.4: The institution has processes for converting information into plan of action. M5.5: The institution has processes for distributing intelligence throughout the organisation. M5.6: The institution has processes for sharing organisational intelligence with individual employees. M5.7: The institution has processes for absorbing intelligence from individual employees into organisational framework.
Q6	**How does the organisation govern the system (DB & BI)?** M6.1: The structure of departments enables exchange and sharing of intelligence within the organisation. M6.2: The institution has clear records and accountability for decisions about the system (DB & BI). M6.3: The institution has transparency to know when particular snapshots are taken, and what data is included and why.
Q7	**How does the institution manage and control the change?** M7.1: The institution controls the change and adaptation of the system to changing environment and self-learning. M7.2: The institution responds to the appropriate changes for value-adding. M7.3: The institution is agile to respond to change if needed.

Metric identifier	Rating score: 1. Strongly agree, 2. Agree, 3. Neutral, 4. Disagree, 5. Strongly disagree.

Goal 3	**User and stakeholder**
Q1	**How to improve satisfaction with the system (DB & BI)?** M1.1: The system (DB & BI) meets the user's needs and scope to influence. M1.2: The system (DB & BI) helps users in solving issues related to performance and decision-making. M1.3: The system helps users to perceive the requirements for improving organisation/department's performance and decision-making process. M1.4: The system (DB & BI) helps users to respond to enquiries about the organisation/department's performance and decision-making process. M1.5: The use of the system (DB & BI) has helped to meet the short-term goals of the department. M1.6: The use of the system (DB & BI) has helped to meet the long-term goals of the organisation
Q2	**Does the system encourage users and stakeholders to seek out further information to help solve the problem?** M2.1: The use of the system (DB & BI) has increased communication among users and stakeholders. M2.2: The use of the system (DB & BI) has enabled users and stakeholders to engage in fact-based decision-making. M2.3: Users and stakeholders have been involved in metrics design. M2.4: The institution Incentivises and rewards performance based on the system (DB & BI).
Q3	**Does the system (DB & BI) meet the expectations of the user and stakeholder?** M3.1: The expectations of the users and stakeholders about the system (DB & BI) are realistic. M3.2: The expectations of the users and stakeholders about the system (DB & BI) are managed.

	M3.3: The institution expects a high level of participation in capturing and sharing intelligence.
Q4	**How does the experience help the user?** M4.1: The user can use their previous experience to gain a better understanding of the visualised information. M4.2: The user can use their previous experience to have a sense checking of information accuracy.
Metric identifier	Rating score: 1. Strongly agree, 2. Agree, 3. Neutral, 4. Disagree, 5. Strongly disagree.

Goal 4	**Financial**
Q1	**How to ensure adequate budgetary resources?** M1.1: Using the system (DB & BI) facilitates financial sustainability (financial cost of the system and financial return). M1.2: There is investment in good infrastructure and technology. M1.3: There is adequate funding to support development, maintenance, and training of the system (DB & BI).
Q2	**How to ensure proper planning and scoping of the budget?** M2.1: The institution has a clear and scoped financial plan.
Q3	**How to increase the financial return?** M3.1: Using the system (DB & BI) has increased the financial resources. M3.2: Using the system (DB & BI) will increase the future financial resources.
Metric identifier	Rating score: 1. Strongly agree, 2. Agree, 3. Neutral, 4. Disagree, 5. Strongly disagree.

Goal 5	**Learning and growth**
Q1	**Does the system (DB & BI) assist and regulate information and output quality?** M1.1: The institution uses the system (DB & BI) to deliver meaningful information.

	M1.2: The institution uses the system (DB & BI) to extract knowledge from BI data to improve its decision-making. M1.3: The institution uses the system (DB & BI) to measure the outputs and impact of its strategy.
Q2	**Does the institution consider training and competency development?** M2.1: The institution considers training to strengthen users' belief in the system (DB & BI). M2.2: The institution considers training to help users to become familiar with the system (DB & BI). M2.3: The institution considers training to assist users in understanding data and developing competency across the institution.
Q3	**Does the institution consider monitoring and feedback of the system (DB & BI)?** M3.1: The institution monitors the impact of its data-based decisions. M3.2: The institution monitors the feedback of data and its definition.
Q4	**Does the institution consider the internal consultation?** M4.1: The institution receives internal consultation to improve the system (DB & BI). M4.2: The institution receives internal consultation to enhance the use of the system (DB & BI) to make more individuals use it.
Q5	**Does the organisation perceive individual/organisational impact of the system (DB & BI)?** M5.1: The system (DB & BI) assists users with the quality of their decisions. M5.2: The system (DB & BI) assists users to create and try innovative ideas for their work. M5.3: The system (DB & BI) assists the organisation to improve its ranking. M5.4: The system (DB & BI) assists the institution to improve its social impact. M5.5: The system (DB & BI) assists the institution to improve its reputation. M5.6: The institution recognises the internal impact of the system, such as the REF.
Metric identifier	Rating score: 1. Strongly agree, 2. Agree, 3. Neutral, 4. Disagree, 5. Strongly disagree.

5.6 Chapter Summary

This chapter has presented the findings from the three case studies. It has demonstrated how the participants from each institution evaluated the metrics and suggested amendments accordingly. Next, the final version of the metrics to measure the framework is illustrated.

Chapter 6 Conclusion

Improving PM is an essential task in any organisation. Awareness of its importance has been raised by both for-profit and non-profit organisations. This correlates to the increase in the data available to support organisations with their decisions. By focusing on PM in HE, this study demonstrates the factors that impact the successful use of BI and DB by considering them in alignment with the PM strategy. While other studies have touched upon success factors, this study emphasises the importance of alignment to improve efficiency in using these technologies.

Further, metrics of success should be multidimensional, as the study advocates using the four perspectives of BSC: finance; internal process; learning and growth; and user and stakeholder alignment with the success factors. In Chapter 2, various aspects related to BI and DB are presented to construct the holistic understanding that led to proposing the first version of the framework (Figure 2.21).

As outlined in Chapter 3, this study adopted a sequential triangulation methodology. This commenced by reviewing the literature to determine the gap and propose a framework of success factors. This was followed by collecting qualitative data through interviewing experts, categorised as decision-makers, planning and strategy members, or consultants, to gain more comprehensive insights and consider further points of views.

Consequently, a second version of the framework is presented (Figure 4.1). After that, quantitative methods were applied with an alternative group of people to confirm the final version of the framework (Figure 4.2). In terms of results, it is clear that almost all the proposed factors are important and belong to the proposed perspectives. After applying the triangulation approach and confirming the framework, a case study at three universities was conducted to evaluate and generate the metrics of the success factors presented in the framework, using the GQM technique presented in section 5.5.1.

Interestingly, the researcher noticed a potential relationship between understanding, championing, and ownership. Having a better understanding of data, what to measure, and what to access could improve championing of the system. This would lead to better ownership of results and activities. This could be supported by group responsibility for which data are to be governed. The importance of the required support from the vice-chancellor, specifically, and senior management has been raised in all three case studies. In addition, being agile is an interesting element that the researcher decided to add to the metrics.

Further, the researcher found that training could improve users' involvement, leading to a better understanding and usage of the system. In addition, distinguishing between long- and short-term goals can improve the understanding of needs.

6.1 Limitations of the Study

Some limitations need to be addressed. First, the case studies were intended to be focus groups to enrich discussion and gain various insights. However, due to the Covid-19 pandemic, this was difficult to achieve. For example, in the second case study the second participant could not attend the scheduled meeting because he had contracted Covid and in the third case study the researcher had to reschedule, again because the participant had contracted Covid and this had had an impact on his work. Consequently, we had to reduce the duration of the planned meeting to an hour.

Second, results might vary if concentrated on a single specific region, as various aspects might have an impact based on the region's main characteristics.

Third, further investigation is required to establish the maturity of the technology and current practices at the universities; the instrument generated can assist in developing this understanding.

6.2 Future Research

Future researchers can measure the maturity level of BI and DB within the HE sector. To establish a ranking for BI and DB maturity within universities, the scale from the Software Engineering Institute's capability maturity model (CMM) can be adopted and applied on the generated instrument following these steps:

- The weight of each factor is identified by calculating the average of the assigned ranks from the metrics of each factor
- The weight of each perspective is specified by calculating the average of factor's scores within each perspective
- The overall maturity score (M) is determined by calculating the average of scores of the five perspectives.

Moreover, structural equation modelling (SEM) can be applied to discover possible relationships among factors, which would present a better understanding of how factors are correlated which could be the first step towards constructing the DS concept.

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Appendix A Information Sheet

Participant Information Sheet

Study Title: Principles for the design and development of dashboard

Researcher: Asmaa Abduldaem
ERGO number: 47154

You are being invited to take part in the above research study. To help you decide whether you would like to take part or not, it is important that you understand why the research is being done and what it will involve. Please read the information below carefully and ask questions if anything is not clear or you would like more information before you decide to take part in this research. You may like to discuss it with others but it is up to you to decide whether or not to take part. If you are happy to participate you will be asked to sign a consent form.

What is the research about?
The research is about investigating successful adoption of dashboard within organisations. It begins with exploring if there is any different of using dashboard within profit organisations and non-profit organisations such as higher education. This will lead us to investigate the related factors to ensure successful adoption of dashboard then to find out the measures that reflect these factors.

Why have I been asked to participate?
You invited to participate in this study because you are an expert in using dashboard. Consequently, your opinion will help in improving the understanding regarding successful adoption of dashboards.

What will happen to me if I take part?
You will be asked to sign a consent form at the beginning. Then you will be shown the proposed framework followed by closed and open questions. The interview will be recorded and it might last for about an hour.

Are there any benefits in my taking part?
The research is designed to support the researcher to understand how dashboard can be adopted successfully. Consequently, it is not designed to help you personally directly but your opinion and answers will help the researcher to confirm the appropriate framework.

Are there any risks involved?
No

What data will be collected?
First of all, you will be asked some background questions such the domain of your organisation what level of dashboard you are using or have used, and your work experience. There is no sensitive questions such as ethnicity or sexual orientation. The rest of the questions are about the purpose, level, and feature of dashboard you are using or have been used and about the presented factors in the proposed framework. Your answers will be recorded and will be dealt with securely and anonymously and stored in password-protected computer. The collected data will be deleted and destroyed at the end of the study.

Will my participation be confidential?
Your participation and the information we collect about you during the course of the research will be kept strictly confidential.

Only members of the research team and responsible members of the University of Southampton may be given access to data about you for monitoring purposes and/or to carry out an audit of the study to ensure that the research is complying with applicable regulations. Individuals from regulatory authorities (people who check that we are carrying out the study correctly) may require access to your data. All of these people have a duty to keep your information, as a research participant, strictly confidential.

Your information will be stored and used on secure systems and will be used for this study purpose only and your responses are voluntary and will be confidential. Once the research is completed and result from the data analysis is achieved, the data will be destroyed.

Do I have to take part?
No, it is entirely up to you to decide whether or not to take part. If you decide you want to take part, you will need to sign a consent form to show you have agreed to take part. In addition, all the required documents will be sent to you by email.

What happens if I change my mind?
You have the right to change your mind and withdraw at any time without giving a reason and without your participant rights being affected by contacting me on my email: a.m.m.abduldaem@soton.ac.uk

What will happen to the results of the research?
Your personal details will remain strictly confidential. Research findings made available in any reports or publications will not include information that can directly identify you without your specific consent. The findings of data will published in conferences or journals.

Where can I get more information?
For further details, please contact me or my supervisor.
Investigator: Asmaa Abduldaem, a.m.m.abduldaem@soton.ac.uk
Supervisor: Dr. Andrew Gravell, amg@ecs.soton.ac.uk

What happens if there is a problem?
If you have a concern about any aspect of this study, you should speak to the researchers who will do their best to answer your questions.
If you remain unhappy or have a complaint about any aspect of this study, please contact the University of Southampton Research Integrity and Governance Manager (023 8059 5058, rgoinfo@soton.ac.uk).

Data Protection Privacy Notice
The University of Southampton conducts research to the highest standards of research integrity. As a publicly funded organisation, the University has to ensure that it is in the public interest when we use personally identifiable information about people who have agreed to take part in research. This means that when you agree to take part in a research study, we will use information about you in the ways needed, and for the purposes specified, to conduct and complete the research project. Under data protection law, 'Personal data' means any information that relates to and can identify a living individual. The University's data protection policy governing the use of personal data by the University can be found on its website (https://www.southampton.ac.uk/legalservices/what-we-do/data-protection-and-foi.page).

This Participant Information Sheet tells you what data will be collected for this project and whether this includes any personal data. Please ask the research team if you have any questions or are unclear what data is being collected about you.

Our privacy notice for research participants provides more information on how the University of Southampton collects and uses your personal data when you take part in one of our research projects and can be found at http://www.southampton.ac.uk/assets/sharepoint/intranet/ls/Public/Research%20and%20Integrity%20Privacy%20Notice/Privacy%20Notice%20for%20Research%20Participants.pdf

Any personal data we collect in this study will be used only for the purposes of carrying out our research and will be handled according to the University's policies in line with data protection law. If any personal data is used from which you can be identified directly, it will not be disclosed to anyone else without your consent unless the University of Southampton is required by law to disclose it.

Data protection law requires us to have a valid legal reason ('lawful basis') to process and use your Personal data. The lawful basis for processing personal information in this research study is for the performance of a task carried out in the public interest. Personal data collected for research will not be used for any other purpose.

For the purposes of data protection law, the University of Southampton is the 'Data Controller' for this study, which means that we are responsible for looking after your information and using it properly. The University of Southampton will keep identifiable information about you for xx years after the study has finished after which time any link between you and your information will be removed.

To safeguard your rights, we will use the minimum personal data necessary to achieve our research study objectives. Your data protection rights – such as to access, change, or transfer such information - may be limited, however, in order for the research output to be reliable and accurate. The University will not do anything with your personal data that you would not reasonably expect.

If you have any questions about how your personal data is used, or wish to exercise any of your rights, please consult the University's data protection webpage (https://www.southampton.ac.uk/legalservices/what-we-do/data-protection-and-foi.page) where you can make a request using our online form. If you need further assistance, please contact the University's Data Protection Officer (data.protection@soton.ac.uk).

Thank you.

Appendix B Consent Form

CONSENT FORM

Study title: Principle for the design and development of dashboards

Researcher name: Asmaa Abduldaem
ERGO number: 55703

Please initial the box(es) if you agree with the statement(s):

I have read and understood the information sheet and have had the opportunity to ask questions about the study.	
I agree to take part in this research project and agree for my data to be used for the purpose of this study.	
I understand my participation is voluntary and I may withdraw for any reason without my participation rights being affected.	

Name of participant (print name)
……

Signature of
participant……

Date……

Name of researcher (print name)
……

Signature of researcher
……

Date……

Appendix C Information Sheet

Participant Information Sheet

Study Title: Principles for the design and development of dashboards

Researcher: Asmaa Abduldaem
ERGO number: 55703

You are being invited to take part in the above research study. To help you decide whether you would like to take part or not, it is important that you understand why the research is being done and what it will involve. Please read the information below carefully and ask questions if anything is not clear or you would like more information before you decide to take part in this research. You may like to discuss it with others but it is up to you to decide whether or not to take part. If you are happy to participate you will be asked to sign a consent form.

What is the research about?
The research is about investigating the successful application of dashboards within the higher education sector.

Why have I been asked to participate?
You are invited to participate in this study because of your role or responsibilities include managing strategic and operational decisions in improving and monitoring performance.

What will happen to me if I take part?

You will be asked to follow a link that will take you to the questionnaire. You should read the participant information sheet and agree with the consent form at the beginning. Then you should answer the questions of the questionnaire that should not take more than 10 minutes.

Are there any benefits in my taking part?
The research is designed to support the researcher to understand how dashboards can be applied successfully. Consequently, it is not designed to help you personally directly but your opinion and answers will help the researcher to confirm the proposed framework.

Are there any risks involved?
No

What data will be collected?
There are no sensitive questions such as ethnicity or sexual orientation. The questions are about the presented factors in the proposed framework of the successful application of dashboards.

Will my participation be confidential?
Yes

Do I have to take part?
No, it is entirely up to you to decide whether or not to take part. If you decide you want to take part, you will need to sign a consent form to show you have agreed to take part.

What happens if I change my mind?
You have the right to change your mind and withdraw at any time without giving a reason and without your participant rights *(or routine care if a patient)* being affected.

What will happen to the results of the research?
Collected data will be anonymous.

Where can I get more information?
For further details, please contact me or my supervisor.
Investigator: Asmaa Abduldaem, a.m.m.abduldaem@soton.ac.uk
Supervisor: Dr. Andrew Gravell, amg@ecs.soton.ac.uk

What happens if there is a problem?
If you have a concern about any aspect of this study, you should speak to the researchers who will do their best to answer your questions.
If you remain unhappy or have a complaint about any aspect of this study, please contact the University of Southampton Research Integrity and Governance Manager (023 8059 5058, rgoinfo@soton.ac.uk).

Data Protection Privacy Notice
The University of Southampton conducts research to the highest standards of research integrity. As a publicly-funded organisation, the University has to ensure that it is in the public interest when we use personally-identifiable information about people who have agreed to take part in research. This means that when you agree to take part in a research study, we will use information about you in the ways needed, and for the purposes specified, to conduct and complete the research project. Under data protection law, 'Personal data' means any information that relates to and is capable of identifying a living individual. The University's data protection policy governing the use of personal data by the University can be found on its website (https://www.southampton.ac.uk/legalservices/what-we-do/data-protection-and-foi.page).

This Participant Information Sheet tells you what data will be collected for this project and whether this includes any personal data. Please ask the research team if you have any questions or are unclear what data is being collected about you.

Our privacy notice for research participants provides more information on how the University of Southampton collects and uses your personal data when you take part in one of our research projects and can be found at http://www.southampton.ac.uk/assets/sharepoint/intranet/ls/Public/Research%20and%20Integrity%20Privacy%20Notice/Privacy%20Notice%20for%20Research%20Participants.pdf

Any personal data we collect in this study will be used only for the purposes of carrying out our research and will be handled according to the University's policies in line with data protection law. If any personal data is used from which you can be identified directly, it will not be disclosed to anyone else without your consent unless the University of Southampton is required by law to disclose it.

Data protection law requires us to have a valid legal reason ('lawful basis') to process and use your Personal data. The lawful basis for processing personal information in this research study is for the performance of a task carried out in the public interest. Personal data collected for research will not be used for any other purpose.

For the purposes of data protection law, the University of Southampton is the 'Data Controller' for this study, which means that we are responsible for looking after your information and using it properly. The University of Southampton will keep identifiable information about you for xx years after the study has finished after which time any link between you and your information will be removed.

To safeguard your rights, we will use the minimum personal data necessary to achieve our research study objectives. Your data protection rights – such as to access, change, or transfer such information - may be limited, however, in order for the research output to

be reliable and accurate. The University will not do anything with your personal data that you would not reasonably expect.

If you have any questions about how your personal data is used, or wish to exercise any of your rights, please consult the University's data protection webpage (https://www.southampton.ac.uk/legalservices/what-we-do/data-protection-and-foi.page) where you can make a request using our online form. If you need further assistance, please contact the University's Data Protection Officer (data.protection@soton.ac.uk).

Thank you.

Appendix D Consent Form

CONSENT FORM

Study title: Principles for the design and development of dashboards

Researcher name: Asmaa Abduldaem
ERGO number: **47154**

Please initial the box(es) if you agree with the statement(s):

I have read and understood the information sheet (*version 1*) and have had the opportunity to ask questions about the study.	
I agree to take part in this research project and agree for my data to be used for the purpose of this study.	
I understand my participation is voluntary and I may withdraw (at any time) for any reason without my participation rights being affected.	
I agree to having my voice recorded during my participation in this study. I understand this will be transcribed then destroyed.	
I understand that information collected about me during my participation in this study will be stored on a password-protected computer and that this information will only be used for the purpose of this study. All files containing any personal data will be made anonymous. At the end of the study these files will be destroyed.	

Name of participant (print name)
……

Signature of participant
……

Date……
Name of researcher (print name)
……

Signature of researcher
……

Date……

Appendix E Interview Questions

Part 1: Background questions

1. **What is your organisation domain?**
   ☐ Education
   ☐ Industry
   ☐ Government
   ☐ Other, please specify…….
2. **Your organisation considers as**
   ☐ Profit organisation
   ☐ Non-profit organisation
3. **To what part of the organisation do you belong?**

……

4. **Do you use any of BI tools or strategies to improve performance or make decisions?**
   ☐ Yes
   ☐ No
5. **This tool or strategy belong to ……..**
   ☐ Strategic level
   ☐ Tactical level
   ☐ Operational level
6. **For how long have you been using similar tools or strategies?**

……

Part2: Questions related to the proposed framework

In this part, please have a look at the proposed framework to discuss in the following questions of the proposed factors for successful adoption of Business Intelligence based on your experience

2.1 On a scale of 1-5, where 5= 'Strongly agree, 4= 'Agree', 3= 'Neutral, 2= 'Disagree', 1= 'Strongly disagree' try to rate the following factors and explain why please.

2.1.1 Financial perspective of alignment:

- Adequate resources (budgetary)
- proper planning/scoping of project

2.1.2 Customer and user perspective of alignment:

- Customer and stakeholder involvement
- Task compatibility
- User's technology experience
- Customer and stakeholder satisfaction
- User expectations

2.1.3 Learning and growth perspective of alignment:

- Information and output quality
- External support (consultants)
- Monitoring and feedback
- Training and competency development
- Net benefits

2.1.4 Internal process perspective of alignment:

- Management support
- Management process
- Project management
- Proper infrastructure and Data quality
- Governance
- System quality

2.1.5 Vision and strategy perspective of alignment:

- Defined business objectives and goals
- Clear vision and strategy

Part 3: Following the previous discussion, please answer the following questions

3.1 Do you think that each factor belong to the appropriate perspective? If no, could you explain?

……

3.2 Do you think there are other factors need to be considered? If yes, could you explain and discuss how they belong to the perspectives mentioned above?

…….

3.3 Do you think there are other perspective(s) need to be considered?

……

3.4 From your knowledge and experience, what do you think about the proposed framework?

Appendix F Results of the Quantitative Analysis (Frequency Tables)

Management Process

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Absolutely essential	14	37.8	37.8	37.8
	Very important	13	35.1	35.1	73.0
	Of average importance	10	27.0	27.0	100.0
	Total	37	100.0	100.0	

Management Process

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Absolutely essential	10	27.0	27.0	27.0
	Very important	19	51.4	51.4	78.4
	Of average importance	6	16.2	16.2	94.6
	Of little importance	1	2.7	2.7	97.3
	Not important at all	1	2.7	2.7	100.0
	Total	37	100.0	100.0	

Project Management Office

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Absolutely essential	2	5.4	5.4	5.4
	Very important	5	13.5	13.5	18.9
	Of average importance	15	40.5	40.5	59.5
	Of little importance	11	29.7	29.7	89.2
	Not important at all	4	10.8	10.8	100.0
	Total	37	100.0	100.0	

Governance

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Absolutely essential	14	37.8	37.8	37.8
	Very important	20	54.1	54.1	91.9
	Of average importance	3	8.1	8.1	100.0
	Total	37	100.0	100.0	

Governance

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Absolutely essential	8	21.6	21.6	21.6
	Very important	19	51.4	51.4	73.0
	Of average importance	9	24.3	24.3	97.3
	Of little importance	1	2.7	2.7	100.0
	Total	37	100.0	100.0	

Proper Infrastructure

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Absolutely essential	18	48.6	48.6	48.6
	Very important	18	48.6	48.6	97.3
	Of average importance	1	2.7	2.7	100.0
	Total	37	100.0	100.0	

System Quality

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Absolutely essential	16	43.2	43.2	43.2
	Very important	18	48.6	48.6	91.9
	Of average importance	3	8.1	8.1	100.0
	Total	37	100.0	100.0	

Data Quality and Data Governance

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Absolutely essential	19	51.4	51.4	51.4
	Very important	17	45.9	45.9	97.3
	Of average importance	1	2.7	2.7	100.0
	Total	37	100.0	100.0	

Automation

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Absolutely essential	1	2.7	2.7	2.7
	Very important	17	45.9	45.9	48.6
	Of average importance	14	37.8	37.8	86.5
	Of little importance	5	13.5	13.5	100.0
	Total	37	100.0	100.0	

Change Management

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Absolutely essential	4	10.8	10.8	10.8
	Very important	18	48.6	48.6	59.5
	Of average importance	14	37.8	37.8	97.3
	Of little importance	1	2.7	2.7	100.0
	Total	37	100.0	100.0	

Management Support

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Absolutely essential	13	35.1	35.1	35.1
	Very important	21	56.8	56.8	91.9
	Of average importance	3	8.1	8.1	100.0
	Total	37	100.0	100.0	

External Consultation

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Very important	2	5.4	5.4	5.4
	Of average importance	20	54.1	54.1	59.5
	Of little importance	15	40.5	40.5	100.0
	Total	37	100.0	100.0	

Internal Consultation

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Absolutely essential	10	27.0	27.0	27.0
	Very important	17	45.9	45.9	73.0
	Of average importance	10	27.0	27.0	100.0
	Total	37	100.0	100.0	

Networking

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Absolutely essential	1	2.7	2.7	2.7
	Very important	13	35.1	35.1	37.8
	Of average importance	19	51.4	51.4	89.2
	Of little importance	4	10.8	10.8	100.0
	Total	37	100.0	100.0	

Information and Output Quality

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Absolutely essential	13	35.1	35.1	35.1
	Very important	20	54.1	54.1	89.2
	Of average importance	4	10.8	10.8	100.0
	Total	37	100.0	100.0	

Monitoring

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Absolutely essential	12	32.4	32.4	32.4
	Very important	14	37.8	37.8	70.3
	Of average importance	11	29.7	29.7	100.0
	Total	37	100.0	100.0	

Net Benefits

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Absolutely essential	5	13.5	13.5	13.5
	Very important	17	45.9	45.9	59.5
	Of average importance	13	35.1	35.1	94.6
	Of little importance	2	5.4	5.4	100.0
	Total	37	100.0	100.0	

Net Benefits

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Absolutely essential	7	18.9	18.9	18.9
	Very important	19	51.4	51.4	70.3
	Of average importance	10	27.0	27.0	97.3
	Of little importance	1	2.7	2.7	100.0
	Total	37	100.0	100.0	

Feedback

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Absolutely essential	8	21.6	21.6	21.6
	Very important	19	51.4	51.4	73.0
	Of average importance	10	27.0	27.0	100.0
	Total	37	100.0	100.0	

Training

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Absolutely essential	13	35.1	35.1	35.1
	Very important	20	54.1	54.1	89.2
	Of average importance	2	5.4	5.4	94.6
	Of little importance	2	5.4	5.4	100.0
	Total	37	100.0	100.0	

User Involvement

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Absolutely essential	7	18.9	18.9	18.9
	Very important	18	48.6	48.6	67.6
	Of average importance	9	24.3	24.3	91.9
	Of little importance	3	8.1	8.1	100.0
	Total	37	100.0	100.0	

Stakeholder Involvement

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Absolutely essential	7	18.9	18.9	18.9
	Very important	25	67.6	67.6	86.5
	Of average importance	4	10.8	10.8	97.3
	Of little importance	1	2.7	2.7	100.0
	Total	37	100.0	100.0	

Stakeholder Satisfaction

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Absolutely essential	7	18.9	18.9	18.9
	Very important	27	73.0	73.0	91.9
	Of average importance	3	8.1	8.1	100.0
	Total	37	100.0	100.0	

User Satisfaction

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Absolutely essential	10	27.0	27.0	27.0
	Very important	23	62.2	62.2	89.2
	Of average importance	3	8.1	8.1	97.3
	Of little importance	1	2.7	2.7	100.0
	Total	37	100.0	100.0	

User Expectations

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Absolutely essential	10	27.0	27.0	27.0
	Very important	22	59.5	59.5	86.5
	Of average importance	5	13.5	13.5	100.0
	Total	37	100.0	100.0	

Stakeholder Expectations

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Absolutely essential	11	29.7	29.7	29.7
	Very important	18	48.6	48.6	78.4
	Of average importance	8	21.6	21.6	100.0
	Total	37	100.0	100.0	

Experience

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Absolutely essential	6	16.2	16.2	16.2
	Very important	9	24.3	24.3	40.5
	Of average importance	16	43.2	43.2	83.8
	Of little importance	4	10.8	10.8	94.6
	Not important at all	2	5.4	5.4	100.0
	Total	37	100.0	100.0	

Technology Experience

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Absolutely essential	2	5.4	5.4	5.4
	Very important	4	10.8	10.8	16.2
	Of average importance	15	40.5	40.5	56.8
	Of little importance	15	40.5	40.5	97.3
	Not important at all	1	2.7	2.7	100.0
	Total	37	100.0	100.0	

Budgetary Resources

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Absolutely essential	19	51.4	51.4	51.4
	Very important	16	43.2	43.2	94.6
	Of average importance	2	5.4	5.4	100.0
	Total	37	100.0	100.0	

Financial Sustainability

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Absolutely essential	14	37.8	37.8	37.8
	Very important	19	51.4	51.4	89.2
	Of average importance	3	8.1	8.1	97.3
	Of little importance	1	2.7	2.7	100.0
	Total	37	100.0	100.0	

Proper Scoping

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Absolutely essential	12	32.4	32.4	32.4
	Very important	14	37.8	37.8	70.3
	Of average importance	10	27.0	27.0	97.3
	Of little importance	1	2.7	2.7	100.0
	Total	37	100.0	100.0	

Return of Investment

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Absolutely essential	10	27.0	27.0	27.0
	Very important	17	45.9	45.9	73.0
	Of average importance	8	21.6	21.6	94.6
	Of little importance	2	5.4	5.4	100.0
	Total	37	100.0	100.0	

Clear Vision

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Absolutely essential	15	40.5	40.5	40.5
	Very important	14	37.8	37.8	78.4
	Of average importance	5	13.5	13.5	91.9
	Of little importance	3	8.1	8.1	100.0
	Total	37	100.0	100.0	

Define Objectives and Goals

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Absolutely essential	14	37.8	37.8	37.8
	Very important	15	40.5	40.5	78.4
	Of average importance	7	18.9	18.9	97.3
	Of little importance	1	2.7	2.7	100.0
	Total	37	100.0	100.0	

Define Mission and Values

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Absolutely essential	6	16.2	16.2	16.2
	Very important	13	35.1	35.1	51.4
	Of average importance	11	29.7	29.7	81.1
	Of little importance	6	16.2	16.2	97.3
	Not important at all	1	2.7	2.7	100.0
	Total	37	100.0	100.0