

The Strengths and Limitations
of Implementing a Business Intelligence System
in a Higher Education Setting

Carmen Farrugia

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To those courageously enduring their struggles in silence,
always believe in your ability to conquer them.

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Abstract

Integrating Business Intelligence (BI) systems within Higher Education Institutions (HEIs) presents a multifaceted landscape of opportunities and challenges. This comprehensive exploration dives into the strengths and limitations associated with the implementation of BI systems in the context of HEIs.

BI systems offer a transformative potential, promising to elevate HEIs by consolidating and processing voluminous institutional data. This centralised data hub empowers administrators and stakeholders to make informed decisions in real-time, thereby enhancing operational efficiency, data-driven decision-making, and overall institutional effectiveness. BI systems become instrumental in academic planning, aiding in student enrolment, course performance assessment, and resource allocation.

Predictive analytics is a core strength of BI systems, enabling HEIs to forecast enrolment trends, identify at-risk students, and optimise financial resource allocation. This proactive approach fosters student retention and provides a platform for HEIs to make adaptive, data-driven strategic adjustments. Moreover, BI systems streamline reporting processes, facilitating compliance requirements and promoting transparency to external stakeholders, ultimately leading to resource savings and heightened accountability.

However, the implementation of BI systems in HEIs encounters limitations that warrant careful consideration. The initial cost and resource demands for system integration can be substantial, necessitating meticulous budgeting and planning. The human factor also introduces complexities as faculty and staff may resist change, mandating comprehensive training and support to maximise BI system utility. Furthermore, maintaining data quality and consistency

becomes challenging due to divergent data collection methods and standards across departments.

Key words: Business Intelligence (BI), Higher Education Institutions (HEI), Data Analytics, Evidence-Based Decision-Making, Implementation

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1. Introduction

1.1 The Evolution of Higher Education Institutions

Higher education institutions (HEIs) have changed dramatically over time in response to a variety of social, economic, and technical advancements. The way institutions function and serve their students and communities has been profoundly impacted by these changes, which have also had an impact on how higher education is organised, funded, and provided (Altbach et al., 2009). This evolution has been shaped by three major trends: the widespread accessibility of higher education through massification, the growing variety of institutions, and the progression of higher education itself.

Access to higher education in the form of massification has been a significant trend in the evolution of higher education. Higher education used to be mostly exclusive to a small elite, but over time, institutions have opened their doors to a larger range of students (Altbach et al., 2009). Fuelled by substantial government investments and strategic policies, social mobility rose as students from working-class backgrounds joined higher education. These efforts aimed to significantly boost higher education enrolment rates among citizens (Borg, 2018). The growth of the information economy, the expanding value of higher education for one's personal and professional development, and government initiatives to broaden access to higher education have all contributed to this expansion of access (Teixeira, 2015). Malta's journey over the past three decades mirrors global trends. During the late 1980s, the Maltese government aimed to notably enhance tertiary-level student enrolment (Borg, 2018). As a result, a greater proportion of students gained access to tertiary education, leading to the

massification of the University of Malta as the premier academic institution on the island (European Education Area, 2022).

The second significant trend has been the increasing diversity of institutions. Traditional degree programs in a variety of disciplines have been the main focus of higher education institutions, but in recent years there has been a shift towards a more diverse range of programmes and offerings, including professional and vocational programs, online and distance learning programmes, continuing education and lifelong learning programmes (Altbach et al., 2009). The need for flexible learning options is rising, and institutions are under more pressure to adapt to the changing demands of the job market.

The third trend in the advancement of higher education has been the industry's growing globalisation, especially through the phenomenon of staff members and students travelling worldwide to study or work at different universities. This trend has been accelerated recently, with institutions increasingly cooperating and competing on a worldwide level (Altbach et al., 2009). The increased demand for international education, the rising mobility of students and staff, and the development of worldwide rankings are just a few of the reasons that have contributed to globalisation (Teixeira, 2015).

All this is leading to a critical need for developing, creating and capturing value from knowledge and competencies (Augier & Knudsen, 2004). For management to make informed decisions, there is a need for an articulated system that provides a single version of the truth that describes the organisation at any time. Ideally, key performance indicators (KPIs) need to be constantly measured and management should have easy access to real-time and accurate data.

The trends mentioned above have facilitated HEIs in strategically adjusting to meet the requirements of a new era, consequently reshaping their institutional management approaches.

1.2 The Managerial Evolution of Higher Education Institutions

Massification, Globalisation and the diversity of programmes led HEIs to embrace management ideas, processes, and procedures to accomplish organisational goal. Managerialism has recently increased in popularity in HEIs as universities and colleges have been under pressure to operate more effectively and efficiently in a quickly changing and increasingly competitive environment (Rodrigues, 2020).

The emphasis on accountability and performance measurement is one important component of managerialism in higher education. Universities and colleges are frequently expected to provide evidence of their efficacy and efficiency using a variety of indicators, including student retention rates, graduation rates, and graduate employment outcomes (Marginson, 2006). Due to the emphasis on accountability, numerous performance measurement tools have been developed, and data analytics are now used to monitor and improve organisational performance (Olssen & Peters, 2005).

The emphasis on efficiency and cost-cutting in higher education is another important motivation towards managerialism. To be financially sustainable, universities and colleges must limit expenditure and maximise profits (Marginson & Considine, 2000). Due to this existential reason, efforts are now concentrated on streamlining procedures, outsourcing non-core duties, and utilising technology to automate and improve business processes (Rodrigues, 2020). In this context, business intelligence (BI) tools can be helpful to enable HEIs to examine

vast amounts of data and spot patterns and trends that can guide decisions and improve operations (Günther, 2014).

The way HEIs are governed has also changed as a result of managerialism. Traditional, collegial models of governance have been replaced by more centralised, hierarchical ones that place more emphasis on the function of professional managers (Marginson, 2006). Due to this, there is more emphasis on organisational-level strategic planning, budgeting, and decision-making than departmental or faculty-level planning (Olssen & Peters, 2005). Tools for BI can facilitate this transformation by providing managers and even academics the data they require to make appropriate, evidence-based decisions and create winning strategies.

Managerialism has shaped the higher education landscape and will probably continue to do so in the future as universities and colleges carry out their daily business. As institutions look to use data and technology to improve their operations and accomplish their goals, BI tools and other data analytics technologies will probably play an increasingly significant role in this growth.

1.3 An Outcome of Managerialism: Using Data for Evidence-based Decision-making

Making decisions based on the best available evidence is known as evidence-based decision-making (Guyatt et al., 2004). This method is crucial in several industries, including business, education, healthcare, and policy-making (McInerney, 2018). Decision-makers can make more informed and accurate decisions that are based on truth rather than speculation or bias. Decision-making can focus on data rather than personal views or anecdotes (Guyatt et al., 2004).

In recent years, HEIs have also increasingly embraced the use of data to support evidence-based decision-making. As previously highlighted, HEIs are under increasing pressure to operate more effectively and efficiently and to show stakeholders their worth (Kogan & Petrie, 2013). As a result, there is now more emphasis on using data and analytics to guide decisions and improve their operations. EBDM can be utilised in the higher education sector to raise operational effectiveness, boost student results, and make wise resource allocation choices.

BI is a tool that can help entities make evidence-based decisions. Providing precise and timely data on student outcomes is one important way that BI can serve HEIs. Data on student enrolment and graduation rates, as well as information on the effectiveness of various programmes and interventions, can be an integral part of a functioning BI. HEIs can, for instance, utilise BI to monitor the success of a new student support programme or to spot trends in students' academic performance that might call for more support or intervention (Sorour et al., 2020)

Overall, applying BI to higher education can be a very effective way of enhancing institutional effectiveness and student outcomes (Sorour et al., 2020). BI assists organisations in identifying areas for improvement and making data-driven, well-informed decisions that can lead to success by delivering accurate and timely data on important key performance indicators (Javalgi et al., 2018).

1.4 Business Intelligence: Advantages and Drawbacks

Like any other system, BI comes with its own set of advantages and disadvantages. As previously highlighted, a BI system can significantly improve decision-making in a higher education institution by giving decision-makers access to precise and timely data. Using BI

systems, organisations can monitor student outcomes, evaluate the success of various initiatives and interventions, and spot trends in students' performance that might call for more help or intervention amongst other things.

BI systems can also assist with more broad decision-making processes, like resource allocation and long-term planning, by offering a holistic view of institutional performance (Sorour et al., 2020).

Another benefit of adopting a BI system is its capability to enhance institutional effectiveness and efficiency through streamlined data administration and analysis operations (Hmoud et al., 2023). The amount of time and effort needed to obtain and analyse data can be decreased by using BI systems, which can combine data from several sources and provide a central repository for storing and accessing data (Shiau et al., 2023). As a result, institutions may be able to act more rapidly and with fewer resources while making better decisions, increasing their overall competitiveness and performance. A higher educational setting that does not employ a BI solution faces several limitations including the manual processing of data as opposed to the use of visualisation of data features that are offered by BI solution and the institutional risk of being subject to errors that negatively affect the institutional operations.

However, introducing a BI system also involves significant challenges and potential pitfalls. Making sure the data being gathered and evaluated is correct and reliable is a significant problem (McAfee & Brynjolfsson, 2012). To maintain consistent and meaningful data collection and processing, it is essential to pay close attention to data quality and integrity, and to employ suitable tools and processes (Hmoud et al., 2023).

The possibility of bias in the data collection and processing processes is another difficulty. Data collection, storage, and analysis methods all have an impact on BI systems, therefore it's crucial to make sure they're open and objective (Shah et al., 2017). In the higher education sector, the adoption of BI systems can hold significant importance, particularly due to its potential to profoundly influence student outcomes and institutional performance.

When implementing a BI system, there may also be possible privacy and security issues. HEIs frequently possess sensitive personal and financial information, therefore it's crucial to make sure that this information is safeguarded and that the proper measures are in place to prevent illegal access or exploitation (Peng et al., 2017). Maintaining data security may involve careful planning and the application of the right technology and procedures.

Nonetheless, in a competitive environment, access to real-time and accurate data is imperative to increase efficiency and keep evolving in such a way that the organisation can capture insights into students, courses, departments and financial situations.

1.5 Aim and Significance of this Study

The primary research question for this study is:

What are the strengths and limitations of Implementing a Business Intelligence System in a Higher Education Institution?

This research aims to answer the following secondary research questions:

- I. How can a higher education institution (HEI) benefit from a Business Intelligence (BI) System?
- II. Is the implementation of a BI system effective for the analysis of data at a higher education level?

III. What are the possibilities of implementing a BI system within the University of Malta and what are the foreseen difficulties or challenges that can be encountered when implementing such a system?

2 Literature Review

In this chapter, the researcher explores the scholarly literature on the subject matter. The chapter starts by giving an overview of the contextual internal and external factors that prompted the use of BI in a HEI. The study will then analyse the benefits and pitfalls of implementing a BI system within a higher education setting.

2.1 Contextual Factors that Prompted the Use of Business Intelligence

In recent years, BI has grown in significance as an integral part of higher education operations. This trend has been influenced by a variety of contextual factors both internal and external.

2.1.1 Internal Factors

Internal factors refer to those elements of an organisation that can influence its performance and success. In the case of a HEI the organisation's management structure, data infrastructure and quality assurance play a very important role. Internal factors are intimately related to external factors as well as externalities and are not to be analysed in isolation.

2.1.2 Managerialism

Within the domain of HEIs, the emergence of managerialism has introduced unique facets. It places management in a superior position compared to bureaucratic conventions, influenced by methods employed in the private sector. This method amplifies performance tracking, encompassing both external evaluation and self-appraisal. It also brings forth proficient fiscal strategies while fostering cooperative and flexible work frameworks. This paradigm shift introduces potent accountability mechanisms, such as performance metrics and benchmarks, augmenting HEIs operational efficiency and capacity to adapt (Deem & Brehony, 2007).

The shift from administrative to managerial philosophy necessitates a transformation from the concept of an "administrative shell" to a "governing and managerial engine" of higher education institutions. In the absence of effective governance and managerial capabilities, HEI's will encounter difficulties in attaining proficiency across various domains and effectively addressing future challenges (Borg, 2018). Managers in HEIs are nowadays required to rely their decisions on data-driven decision making thus their job involves also the evaluation of big data.

2.1.3 Big Data

Data is the collection of values and characteristics that are both similar and dissimilar in some ways. The sizes of databases have, however, been rapidly growing recently. Big data is described by Mouthaan (2012) as data that is overwhelming in terms of amount, variety, velocity, and connections to other data, making it challenging to manage using conventional database administration or tools. If a dataset may be regarded to perform security, curation, analysis, and perception utilising modern technologies, it can be referred to as large information. The new framework and systems in the organisation's information management represent the advancement of innovation. Analytic-generated awareness will increasingly influence how effectively decisions are made. In this sense, the more accurate and practical these are, the higher the chance a (human or automated) chief has to foresee what adjustments should be made that relate to the organisation's ultimate purpose. According to Buhl et al. (2013), big data "is most importantly a multidisciplinary and developmental combination of innovations in a mix with new measurements in data stockpiling and handling (volume and speed), another period of a variety of data sources, and the challenge of managing information quality sufficiently (veracity)."

One aspect that has contributed to the prominence of BI in universities is the proliferation of big data in higher education. Universities produce enormous amounts of data about their students, faculty, budgets, and other operational components. Several universities worldwide, are making use of BI systems to analyse this data and support decision-making. It was observed that this solved several issues as through the implementation of a BI system they achieved data consolidation. Having a single, unified source of accurate, dependable data that can be used for analysis and decision-making is the ultimate goal of data consolidation. Before this, these universities employed a data extraction process from various sources, leading to limited end-to-end visibility due to data inconsistency. BI supports a single source of truth allowing data consistency in an attempt to eliminate doubt. However, concerns have been raised about the potential implications of relying solely on data-driven decision-making, including the risk of overlooking qualitative factors and reducing the role of human judgment in the decision-making process. As such, the use of big data in higher education must be balanced with a nuanced understanding of its limitations and potential drawbacks.

Nonetheless, combining huge amounts of data from various systems into a BI facilitates cross-functional analysis which helped these universities become more efficient and led to higher-quality decision-making (Kabakchieva, 2015). Through this Big Data and the reports issued by BI, Universities can monitor KPIs and increase quality assurance.

2.1.4 Quality Assurance

BI is important for ensuring quality in higher education. The procedures and actions used to make sure educational programs and services adhere to accepted benchmarks of excellence are referred to as quality assurance. Universities can discover opportunities for improvement

and make data-driven decisions about how to improve the quality of their programs and services by using BI to track and report on a range of quality indicators.

Monitoring and analysing data on student performance is one of the key ways BI helps with quality control in higher education. HEIs can use BI technologies to plan academic programmes, track students' academic progress, evaluate trends in admissions, calculate student-staff ratios and make use of better resource management.

BI is crucial for quality control in higher education because it enables institutions to monitor and analyse academic and research performance. Universities can track faculty output, such as research production, teaching performance, and service efforts. This data can be utilised to pinpoint problem areas and encourage faculty development (Sorour et al., 2020).

2.1.5 Data Security

Finally, the importance of data security in higher education is another factor that has led to the importance of BI (Guster & Brown, 2012). Universities must make sure that the sensitive personal and financial data they manage is protected (Lee et al. 2017). Universities can find and address such weaknesses with the aid of BI (Kaur et al., 2019) as such platforms prioritise data protection. Data will only be accessible to users that require it. Dashboards and reporting features need to show only the data accessible to the user, and IT should have the capability to swiftly configure data permissions.

2.2 External Factors

External factors refer to elements outside of an organisation that can impact its performance and success. In the case of a higher education institution, several external factors can influence its performance, including internationalisation, globalisation and international rankings.

2.2.1 Internationalisation and Globalisation

As highlighted in the introduction, the rising level of competition in higher education contributed to the significance of BI in universities (Sorour et al., 2020). Traditional and non-traditional institutions are putting more and more pressure on universities (Heckman et al., 2016). BI can assist institutions in understanding their market position and locating improvement opportunities (Kaur et al., 2019). HEIs are presently operating in a complex and changing environment. The process of globalisation, together with the rapid growth of information and communication technologies triggered a sense of rivalry, not only between companies but also between universities (Kabakchieva, 2015). The competitive nature of this rivalry has fostered internationalisation, the emergence of virtual universities, and the establishment of cooperative entities affiliated with prominent private organisations (Mintzberg & Rose, 2003). The availability of data on student learning and engagement has increased as a result of the expansion of online education (Heckman et al., 2016). Universities can use BI to comprehend and improve their online curriculum (Kaur et al., 2019) as part of the Annual Programme Review and the Periodical Programme Review.

2.2.2 University Rankings

The value of rankings to institutions is another element that has influenced BI's significance. Numerous indicators, including productivity in research, overall quality, and student achievement, are frequently used to assess universities. The reputation and financial stability of a university may be significantly impacted by these rankings (Liu et al., 2018). Universities can raise their standing and improve their reputation by using BI to track and report on the indicators that are utilised in these rankings (Kaur et al., 2019). Three of the most influential

and widely observed university measures are the Shanghai Academic Ranking of World Universities, Times Higher Education University Rankings and U-Multirank.

Overall, the necessity for data-driven decision-making and the growing availability of data have made BI a crucial tool for HEI (Sorour et al., 2020). Universities may better understand and optimise their operations with the aid of BI, which can also help them fulfil the needs of a competitive and open higher education market and improve student results (Naven & Whalen, 2022).

2.3 Applying Business Intelligence Technologies at HEIs

The use of information and communication technologies (ICTs) forms part of our everyday lives and in parallel, the management of data is becoming increasingly important. To remain competitive and to proceed toward becoming a performing entity, organisations need to be able to monitor and control their business processes and achieve strategic goals (Tank, 2015). Such a strategy can also apply to HEI which organisations also operate in a highly competitive environment that is also prone to changes caused by a continuum of external factors. Such constant contextual changes render the operations of an organisation more complex, making it more difficult for managers to understand the extensive business processes. Furthermore, HEIs are also required to use important information to help them analyse data concerning students and market demands (Apraxine & Stylianos, 2017).

According to Kabakchieva (2015), although data is usually readily available, Universities rarely base their managerial decisions on data. In today's knowledge-based economy and society, there is a continuous need to change the gathered data into information and knowledge. Consequently, in the past years, several new information technologies and methods were introduced. These technologies are referred to in different terms, such as decision support

systems, and executive information systems. Most of these technologies are now being referred to as BI (Kabakchieva, 2015).

BI is a framework used in decision-making. It combines architecture, databases (or data warehouse), analytical tools and applications, intending to close the gap between the present and the expected performance of an organisation as indicated in its mission, objectives and goals, together with the strategy to achieve them. To successfully implement this framework organisations, need to adopt innovative approaches. Universities have realised that to remain competitive they need to be equipped with a system that helps them make quick and informed decisions. The mentioned analytical tools have already been widely used by organisations in different industry sectors and so these have also caught the attention of managers of educational institutions. Several universities have already adopted such technology while others are presently implementing such reforms. As already indicated such systems help extract data from different sources, combine them and present a single version of the truth. It helps managers receive important timely and accurate data in the best possible formats whilst giving the possibility to have a detailed analysis of the available data through OLAP (OnLine Analytical Processing) tools. Furthermore, this technology helps in finding a pattern and predicts outcomes based on historical performance through Data Mining tools (Kabakchieva, 2015).

Vincent Nyalungu (2011) discusses the importance and the role that a BI system plays within the strategic decision-making process of an organisation. The study provides information on the overall architecture involved in implementing a BI framework and the data-capturing process.

The primary benefit of BI lies in its combination of power and affordability, enabling universities to gather and manage substantial volumes of data concerning students, lecturers, administrative staff, scheduling, financing, and more (Kabakchieva, 2015).

2.4 Implementing a BI System: What to Consider?

2.4.1 BI Techniques and Tools

Like any other organisation, HEIs aim to achieve their strategic goals as detailed in their strategic plan. The BI process can improve the quality and value of the decision-making processes. HEI have a vast amount of student data which is gained throughout the student's life cycle from admission to graduation. Such data can impact the decision-making process as this data can be made available centrally available across the different departments. Such data can then be analysed and highlight any need for change to improve the internal and external environment (Apraxine & Stylianou, 2017a).

A BI system consists of several components. Eckerson and Rouhani (2010) (2012b) highlight how a comprehensive BI system should encompass various components to fulfil its functions effectively. These components include production reporting, end-user query and reporting capabilities, online analytical processing (OLAP), dashboard and screen tools, data mining tools, as well as planning and modelling tools. Moreover, data should be stored in data warehousing which is generally associated with the information technology domain and is aimed at storing large amounts of data. Extract, transform and loading (ETL) processes are must milestones to enable the data transfer from the different external sources to the BI. Such ETL processes tend to be complex due to different source formats and data cleansing. The upcoming sections will highlight the main BI components.

2.4.2 Data Warehouse (DW)

Data warehousing is a concept within the information technology domain which is used for the effective implementation of a BI system. The concept of a data warehouse involves the collection of current and historical data intending to support managers when making decisions. The data should be subject-oriented, integrated, non-volatile and time-variant. Data warehousing is usually achieved by using a data management system together with a considerable amount of server space. Furthermore, a data warehouse does not relate only to BI systems but can be used where large data needs to be stored (Nyalungu, 2011).

Rafalski (2002) describes a data warehouse as a set of programs which extract data from transactional systems. Such data hides valuable information and data mining concepts would be required to refine the data to generate new insights which can be used for predictive modelling and forecasting. BI tools read data from the data warehouse using cubes and queries which are then presented in advanced analytic tooling (e.g., Dashboarding) to add more value and ease information processing. In certain cases, an extraction, translation and loading (ETL) tool is also required during data transfer for external sources (Nyalungu, 2011).

A data warehouse consists mainly of two components – the integration and the analysis component. The integration component is responsible to collect and keep data collected from various sources. Such component data then can be developed further into computed views. The analysis component refers to the need to feed and analyse the information depending on the KPIs of the end users. Finally, a data warehouse should support an OLAP data structure to visualise data in different formats (Inmon, 2005).

In higher education institutions, data warehouses are often used for a variety of purposes, including reporting and analysis, data integration, data privacy and security, and performance and scalability.

A data warehouse should be constantly updated and regular snapshots should be taken for historical data patterns. Decision makers may require specific information aggregated by period; typically, monthly or quarterly, therefore this is required for reporting purposes. A data warehouse is defined by Gargano and Raggad (1999) as a methodology that unifies and integrates numerous sets of diverse data sets into a single set of information. Text, audio, image, geographic, and time series data sets will be supported by data warehouses, which will be more adaptable and accommodate a greater range of data kinds.

The data warehouse architecture must therefore often handle common information delivery mechanisms and data queries. Additionally, it must integrate with programs like executive information systems (EISs), online analytical processing tools, and sophisticated data mining software. The data warehouse will swiftly expand from a small store of data, information, and expertise to a very large database by utilising an interactive prototyping technique and ensuring both scalability and adaptability (Hurley & Harris, 1997).

Since not all of the data captured in the data warehouse would be valuable, data mining techniques should be implemented. Data mining ensures that only valuable data is selected. Although data warehousing and data mining intertwine, they are two different processes.

2.4.3 Data Mining

Over time, data has been increasing in its size making it impossible to process such data with the existing technologies thus making big data a topic of great interest to the scientific community (Burtescu et al., 2013). For this reason, data mining is considered to be a very

important technique as data mining can be defined as the extraction of useful information from large data sets (Hand et al., 2001). It involves the exploration and analysis of large quantities of data through automatic and semi-automatic means to discover meaningful patterns and rules (Berry & Linoff, 1997). These techniques can also be applied in educational institutions. These could be used to group students, predict students' performance, plan and schedule courses and understand students' behaviour (Burtescu et al., 2013).

In data mining data is analysed through the categories as displayed in Table 1.

Table 1 Data mining categories

Function	Description
Classification	This function involves categorising data into predetermined classes or categories based on specific criteria.
Regression	This function aims to predict a real-valued variable based on the classification of data items.
Clustering	This task involves identifying and grouping data into meaningful clusters or categories that describe similarities or patterns within the data.
Association rule learning	This task focuses on finding the most suitable model to describe significant relationships or dependencies between variables in the data.
Anomaly detection	This task is designed to identify and detect the most significant deviations or changes in data when compared to previously measured or established normative values.
Summarisation	The method that finds a summary of a subset of data.



Figure 1 Data mining techniques (Berry & Linoff, 1997)

The following are two examples of how data mining can be used in a Higher Education Institution:

- Data mining can be used to find trends in student information that might point to a risk of dropping out or having academic challenges (Shmueli et al., 2010). For instance, data mining could be used to determine elements that could indicate a student's risk of dropping out, such as poor grades, missed classes due to the lack of attendance, or financial troubles to pay the necessary fees (Hand et al., 2001). To help at-risk pupils succeed, this information might be utilised to create focused interventions or support programmes (Gama et al., 2014).
- Student enrolment data can be analysed using data mining to spot trends in student demand and preferences. The scheduling of courses might be improved using this data, and resources could be distributed more effectively. Data mining, for instance, might be used to determine which courses are the most popular or what hours of the day courses are the most popular, which could help determine when to schedule courses and how many sections to give (Gama et al., 2014; Hand et al., 2001; Shmueli et al., 2010).

2.4.4 Dashboards: Projecting Data Effectively

Greatbanks and Tapp (2007) describe a dashboard as being a tool for monitoring, analysing and annotating data which have a strong relationship to planning, decision-making and control. This is achieved through the possibility of comparing and analysing historical figures, monitoring resources, possibility to build focused dashboarding which can update automatically in real-time and having the possibility of monitoring and sharing across other

business units. Dashboards should present data that the user is interested in to mitigate the loss of focus.

2.5 Adopting a BI system

The introduction of a BI system in an organisation is not considered to be a simple task. Apraxine & Stylianos (2017) studied the introduction of BI practices within the University of Nicosia and found that more than 50% of BI projects failed to satisfy the expectations of stakeholders. Such failures can be attributed to flaws in the organisational support, processes, and technology. Several factors play an important role in a BI system being successfully implemented within an organisation. These include:

- *Management Support:* Management support plays a crucial role in determining the overall success of BI implementation (Arnott, 2008; Yeoh & Koronios, 2010). During BI implementation several obstacles and issues will naturally arise. In this light, management support is of paramount importance to overcome challenges in the form of effective communication strategies such as resource allocation and aligning employees' perceptions (Thamir & Poulis, 2015a; Woodside, 2011). Developing a comprehensive plan that takes into consideration the needs, costs, resources, and benefits of BI systems is essential. Such a plan would enable top management to gain a clear understanding of the requirements and implications of implementing a BI system. Additionally, it would facilitate effective communication and goal-setting across the organisation, ensuring alignment and a shared vision for the BI implementation. This activity will ensure the alignment of the organisation's strategy by ensuring that the right resources are established to recognise the internal and external environments to implement the strategy. Organisational resources refer to

the availability and easy access to technical, financial, and human resources (Grandon & Pearson, 2004) which directly contribute to the success of a BI system.

Management support is essential in the implementation of BI especially when it comes to streamlining the business process and the functions of the departments and offices concerned. At the implementation phase, management has to ensure a collaborative culture across the whole organisation. Thus, all employees across departments and management should work as a cohesive team to ensure the BI is aligned with the overall institutional strategy to accomplish the set goals and achieve an easy-to-use system and a superior system quality whilst ensuring productivity and satisfaction from the end user (Ali El-Adaileh & Foster, 2019).

- *Data sources system:* As highlighted in this chapter the success of BI deployment is significantly impacted by the guarantee of the quality and integrity of the data from the systems from which it is obtained. Research supports this statement and clearly outlines how data sources affect directly the implementation of a BI system and thus also affect whether the project will be successful or otherwise (Mesaros et al., 2016; Wixom & Watson, 2001). Furthermore, BI system data is derived from multiple sources thus the quality of these sources will impact the outcome. Therefore, data is required to be constantly controlled and monitored to ensure that the outcome contains quality which will provide the information to support the decision-making process. If data is insufficient or lacks quality, then negative results will occur.
- *Communication:* A communication channel should be set up for the organisation to educate and inform its employees to understand the need for a BI system and what benefits it would bring along in their immediate and long-term objectives. This can be

facilitated through project management. Project management should be established from the initial days of the decision to introduce and implement a BI system. Project management helps to ensure the availability of requirements and resources as well as the support of the whole organisation during the implementation stage. A lack of resources will result in a negative impact; therefore, resources should be made available before the commencement of the BI adoption and implementation across several departments.

- *Testing and training:* Training should be provided from the initial days and must be an ongoing process. Such training should involve the understanding of BI and its function within the organisation so that its users would be able to report any gaps and suggestions to increase the quality of the system. Furthermore, changes also arise throughout the process, thus training would enable users to adjust to the changing process. Changes could also emanate from constantly avoiding the internal and external environment.

2.5.1 The Benefits and Pitfalls of Adopting a BI System

Across the world, several universities and HEI already adopted a BI system which facilitated their operations. Over time, Kennesaw State University faced an influx of reporting requests that overwhelmed its staff. Additionally, reports contained extraneous data with no utility. With the implementation of a BI system, data access improved, enabling departments to access essential and visualised data, and reducing report requests by 35% (Apraxine & Stylianou, 2017a). Linnaeus University in Sweden has reported several advantages associated with this tool, including reduced reliance on extensive questioning, increased focus on data analysis rather than information retrieval, decreased necessity for expertise in every system

they possess for extracting pertinent data, and the attainment of higher-quality information essential for critical decision-making (Diver BI Group n.d.). Similarly, Umeå University has adopted the same technology as Linnaeus University, experiencing notable time savings – reducing the personnel information compilation process from two weeks to mere minutes. Furthermore, this technology has provided them with enhanced insights and better operational control (Dynamic Business Informatics 2014). Furthermore, as highlighted throughout this chapter another reason why organisations typically implement BI systems is to gain access to valuable information, uncover potential opportunities and risks that could arise at any moment, share and utilise knowledge derived from their data, assess the effectiveness and efficiency of their operational processes, and ultimately make well-informed decisions in a timely and cost-efficient manner (W. Eckerson, n.d.). Using BI, managers can analyse numerous essential performance indicators. They can then make necessary adjustments to their operations based on the insights gained from these analyses (Apraxine & Stylianou, 2017b). Table 2 presents a range of advantages and challenges that may arise when implementing a BI system which are also discussed in detail in the table below.

Table 2 The advantages and challenges that may arise when implementing a BI system

Advantages	Challenges
Elimination of silos - BI systems eliminate silos, connecting departments for accessible data. Universities like Macquarie and Florida improved data sharing.	Measuring the unmeasurable - Prioritise achieving outcomes rather than fixating solely on KPIs is pivotal, to prevent neglecting crucial services.

<p>Improving business process efficiency - BI enhances process efficiency, allowing real-time evaluation and action. It's beneficial for complex HEIs processes.</p>	<p>Too much focus on quantitative data - Data-driven decisions must consider qualitative aspects and human judgment, acknowledging data limitations.</p>
<p>Better financial management - BI aids financial management by consolidating data, reducing costs, and simplifying reporting.</p>	<p>Technological adaptation and cultural barriers - Cultural barriers and lack of technological adaptation challenge BI adoption. Management support is crucial for success.</p>
<p>Marketing and Communication to potential students - Universities use BI for targeted marketing. Tarleton identified potential candidates; Hope College improved applicant insight.</p>	<p>Lack of sufficient resources - Insufficient resources hinder BI projects. Adequate resources are vital for commitment and to overcome obstacles.</p>
<p>Student recruitment, engagement and retention - BI predicts registration demands, improves student engagement, and enhances retention strategies.</p>	<p>Lack of appropriate technical skills - Team skills and user understanding are crucial for BI success. Ongoing support and clear comprehension needed.</p>
<p>Central-local relations - Central-local relations and KPIs impact BI effectiveness. Horizontal strategy and KPIs important for success.</p>	<p>Poor data quality - Data quality is vital for effective BI and decision-making. Poor data quality hinders forecasts and strategy.</p>

2.5.1.1 The Elimination of Silos: Interconnectivity of Departments and Business Processes

A similar experience was observed at Macquarie University based in Sydney Australia, where following the introduction of a BI system the university managed to eliminate knowledge silos making data easily accessible to decision-makers promptly (Lachlan, 2011) across several offices representing different functions. Additionally, Florida State University managed to increase employee productivity through the sharing of information and enabling access to students' data ranging from admissions to financial information (Apraxine & Stylianou, 2017a).

2.5.1.2 Improving Business Process Efficiency

BI has been shown to enhance process efficiency by streamlining execution. Implementation of a BI system allows processes to be executed with greater speed and accuracy. In the context of a university, BI facilitates faster reporting, granting management and staff immediate access to information at the click of a button. This enables them to promptly evaluate situations and take action on any bottlenecks or challenges in nearly real time (Wadsworth et al., 2009). This is particularly useful in complex higher education business processes such as admissions and progression where the input of several offices across the University is required to check large chunks of data.

2.5.1.3 Better Financial Management

A well-functioning BI system that integrates analytics, knowledge management, and business process management, while also monitoring performance, was instrumental in reducing costs (Wang et al., 2007). By consolidating and connecting data from various parts of the organisation and external sources, a BI system enhances the cost-effectiveness of the reporting process (Pine et al., 2012).

The efficiency and simplicity of reporting processes are enhanced through systematic approaches (Lambe et al., 2019). With data readily accessible to users, the need for labour-intensive manual data sorting and abstraction is eliminated (Pine et al., 2012).

2.5.1.4 Marketing and Communication to Potential Students

Universities also use BI solutions for marketing purposes. In the case of Tarleton State University, BI solutions were used to identify candidates with the most likelihood of being admitted to their university. How was this done? By checking automatically, the students' qualifications. This enabled them to focus their limited resources on better success opportunities. In the case of Hope College in Michigan, a BI system helped the administration department to implement a prediction model for managers to identify any problems that their applicants may be facing. They also implemented components to capture the interaction between students and their social media platforms. Chris Lucier, managing director of EM analytics highlights the increasing challenges institutions face whilst attempting to attract and retain students. He discusses the costs entailed for this to be done which can be of concern due to debt or deficit issues that HEIs face. Lucier suggests that the key factor in increasing efficiency is to use predictive analysis and forecast student behaviour. This will help a university focus on students who have a higher probability of joining their university (Burt, 2022).

2.5.1.5 Student Recruitment, Engagement and Retention

At the National University of Health Science (NUHS), BI was used to predict the time registration demands which enabled them to schedule more people to assist the students during the highlighted time to make them more efficient (Apraxine & Stylianou, 2017a).

Horner (2022) discusses the benefits the data can give to higher education institutions. The essential benefits revolve around the fact that institutes can become more innovative in the way they attempt to attract students. Additionally, data analytics can help universities in determining ways in which they can improve students' retention which may result in increasing graduation rates and student engagement (Horner, 2022). Tarleton State University deployed a student retention performance tool to capture data related to course trends, classes and the performance of students (Apraxine & Stylianou, 2017a).

2.5.1.6 Central-local Relations

The central-local relations are another factor that needs to be considered. It reflects the horizontal and vertical power dynamics of the organisation. According to Bezzina et al. (2017) a horizontal strategy rather than a top-down vertical decision-making model must be used in conjunction with KPIs for such a system to be effective. This means that the central administration of the HEIs is responsible for the identification of KPIs that represent the demands of the whole university. This may be challenging as it may somehow be difficult for the management of the HEIs to possess the expertise and sensibility required across the entire university, especially when a lot of departments, faculties, institutes and centres exist as it is the case with the University of Malta.

2.5.1.7 Measuring the Unmeasurable

A university must remember that it should not make the mistake of focusing exclusively on measurable matters rather than on what truly matters to the organisation. Overemphasising KPIs can lead to dangerous practices where only services included in the KPI exercise are

prioritised, neglecting important services that are not counted. To address this, an organisation needs to focus on outcomes rather than processes or outputs (Bezzina et al., 2017).

2.5.1.8 Too Much Focus on Quantitative Data

As previously discussed in section 2.1.3, relying only on data-driven decision-making has prompted questions about the potential repercussions. This includes the possibility of disregarding qualitative considerations and diminishing the need for human judgment in the decision-making process. As a result, decisions made in higher education must be supported by data whilst taking into account its limitations and potential downsides (Schildkamp et al., 2013).

2.5.1.9 Technological Adaptation and Cultural Barriers

These barriers pertain to the overall context in which various components (organisational, social, and technical) interact with each other. Cultural barriers specifically address the resistance to change, which can manifest either at an individual level as individuals resisting change or as a systemic phenomenon due to the gradual or disruptive effects of digital transformation. Gkrimpizi and Peristeras (2022) discuss how Universities face challenges in adapting to technological changes, with key stakeholders (academic and administrative staff) struggling to cope. There is a lack of comprehensive strategies by university administrations to train and develop specialists who can meet the new requirements (Gkrimpizi & Peristeras, 2022). A reason for this could be the lack of a business mentality in the academic world (Carnicero et al., 2021).

Overcoming latency issues involves not only technological changes but also a shift in the organisation's mindset and business processes. Watson et al. (2008) acknowledge that

addressing decision latency is often more challenging than data and analysis latency since it requires significant alterations in people's attitudes and perspectives. Giniat (2011) stresses the importance of change management to ensure that the organisational culture fully embraces the strategic and tactical benefits offered by BI.

Introducing new ways and technology inevitably faces resistance to change, which is a major challenge. Moreover, the successful implementation of BI relies heavily on strong management support (Seah et al., 2010). Management support serves as a catalyst, motivating individuals to actively contribute to BI initiatives and embrace the corporate changes they entail (Curtis, 2015; Wixom & Watson, 2010). When subordinates perceive full support from management, they are more likely to comply with expectations and readily accept a system (Karahanna et al., 1999)

2.5.1.10 Lack of Sufficient Resources

The lack of sufficient resources poses a significant challenge for BI projects. Resources encompass financial capital, time, and the workforce necessary for the successful implementation and maintenance of a BI initiative (Ein-DorPhillip & SegevEli, 1978). Insufficient resources can negatively impact the design and implementation of the BI system (Tait & Vessey, 1988).

Having appropriate resources available is vital to ensure a higher level of commitment to BI and to overcome potential obstacles during the implementation process (Beath, 1991; Tait & Vessey, 1988; Wixom et al., 2008). Adequate resources play a critical role in supporting the organisation's BI efforts and ensuring the success of the project.

2.5.1.11 Lack of Appropriate Technical Skills

The success of a system implementation is directly influenced by the people involved (Wixom & Watson, 2001). The skills of the team, combined with a thorough understanding of the complexities involved in such projects, significantly impact the successful implementation of a BI system (Wixom & Watson, 2010). However, regardless of the team's expertise, users still require guidance and assistance in comprehending the full potential of a BI system, both during the initial stages of the project and throughout its lifecycle as changes occur (Wixom et al., 2008). Providing ongoing support and fostering a clear understanding of the system's capabilities are crucial factors in ensuring a BI project's success.

2.5.1.12 Poor Data Quality

Data quality plays a critical role in supporting effective decision-making (Wixom & Watson, 2001). High-quality data is characterised by its completeness, validity, relevance, accuracy, consistency, and timeliness (Redman, 2013).

Reliable information is vital for the successful execution of business strategies (Giniat, 2011), and data quality is considered a determining factor for the success or failure of a BI system. Poor data quality can significantly impede the work of accountants and lead to inaccurate forecasts (Appelbaum et al., 2017). To fulfil the requirements of a robust BI system, a high level of data quality must be maintained continuously by the organisation (Wixom & Watson, 2001).

Yeoh and Korolios (2010) further emphasise that data quality, particularly in the core systems, directly influences the success rate of BI implementation. Ensuring data is of high quality, adequately stored, and continuously maintained is essential to effectively support decision-making processes and maximise the benefits of a BI system.

2.6 Conclusion

BI solutions provide organisations with access to real-time data and insights so they can make better decisions. BI systems can be used in the higher education sector to track student performance, distribute resources, and pinpoint areas that need improvement. Although BI systems have a lot to offer higher education institutions, they also have certain drawbacks.

The capacity of BI systems to enhance decision-making is one of their main advantages. BI systems can assist management in making more informed decisions about resource allocation, and student support amongst other things. This can be done as BI provides real-time data and insights. HEIs may be able to operate more effectively and efficiently as a result.

BI systems may also boost productivity, improve decision-making, and increase transparency while also promoting student achievement. BI solutions can make it simpler for educators and administrators to track achievement and pinpoint areas for improvement by offering a single source of truth for data. By examining student data, educators can also spot patterns and trends that will enable them to spot kids who are at risk and offer them individualised support, improving student retention and success rates.

The implementation of a BI system within a higher education institution is subject to various restrictions including financial. Furthermore, BI systems can sometimes be difficult to set up and utilise, necessitating particular knowledge and skills. A BI system's effectiveness can be harmed by erroneous or incomplete data, thus it's crucial to ensure the quality of the data provided into the system. As some educators and administrators may be averse to using a BI system if they are accustomed to depending on more conventional techniques for data

analysis, resistance to change can also be a problem. Finally, when establishing a new system, HEIs need to be careful about data security.

Starting with a pilot phase is one possible practical strategy for HEIs thinking about introducing a BI system. This can enable the organisation to test the system in a real-life environment before committing to a full installation. Institutions of higher learning can reduce risks and enhance possible advantages by implementing the BI system in a gradual modality.

3 Methodology

In this chapter, the research approach and design that were utilised to conduct this research project are outlined.

3.1 Introduction

The methodology chosen was selected based on various factors such as the available resources, time frame, existing literature, and the most suitable tools to answer the research question. The chapter begins by providing a rationale for the chosen methodology. Following this, the sample selection criteria, sample characteristics, the research tools, and the statistical techniques and software employed for data analysis are presented. This chapter also addresses the ethical concerns of the project, the limitations of the research, and how they were overcome.

3.2 The Research Approach

This section outlines the fundamental research approach adopted for this study. It serves as the guiding framework for data collection, analysis, and interpretation, ensuring a credible and focused exploration of the subject matter.

3.2.1 Gaining Approval

Before the commencement of the study, the researcher sought and obtained permission from the Administrative Director of the Office for Human Resources Management and Development of the University of Malta. The researcher specified the need to access the research site and permission to recruit participants for the study.

3.2.2 The Concept of Mixed Methods

In this study, a mixed methods research design was adopted and this involves integrating both qualitative and quantitative data. The employment of mixed approaches can be considered as an alternative to validation and shows an effort to achieve a deeper understanding of the phenomenon in issue (Denzin, 2012). Qualitative data was gathered through in-depth interviews. This approach enabled the researcher to capture rich, nuanced insights and perspectives from participants, allowing for a deeper exploration of their beliefs, and attitudes related to the research topic. Quantitative data was collected using structured surveys. This method enabled the researcher to obtain measurable and numerical data, facilitating the identification of patterns, trends, and statistical relationships within the data. The figure below outlines the research approach.

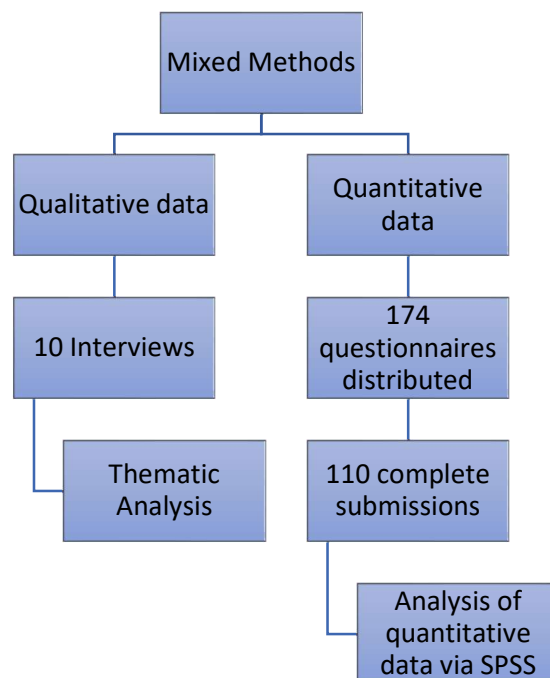


Figure 2 Research Approach

3.2.3 Rationale for the Chosen Methodology

This study utilised an organisation's experience and primary data to analyse the advantages and disadvantages of implementing a BI system at the University of Malta. A mixed methods approach was chosen to understand the research problem comprehensively (Creswell, 2018), minimising bias and enhancing validity through triangulation. As a staff member of the institution where the study took place, I could use my insider knowledge to better understand the meaning of the data. This was considered as a strength of this study. The risk of bias originating from an insider perspective was mitigated by employing diverse sources within a mixed methods framework.

Data was collected from 75 academics, 35 administrative staff, and 10 individuals holding a management position using quantitative questionnaires and qualitative structured interviews as the research instruments (see Appendix I

Interview Guide, Appendix V). The quantitative survey was effective in evaluating employee attitudes and willingness due to accessibility and direct comparisons. The self-completion questionnaire reduced interview effects and variability, increasing study validity (Bryman, 2012). Furthermore, this method was preferred since the researcher has been working in the same entity for several years and personally knows many participants. The qualitative interviews provided in-depth perspectives and descriptive insights, while a structured format ensured focused discussions despite the researcher's familiarity with the participants.

3.3 The Research Instruments

In this section, we present the research instruments employed to gather essential data for our study. The two primary tools utilised were in-depth interviews and a structured questionnaire.

3.3.1 A Quantitative Self-Completion Questionnaire

Based on a review of the available literature – a self-completion questionnaire was chosen as a research tool for this project. The questionnaire was adapted from the questionnaire of Chen (2012) which was then modified to suit our study's specific objectives and target population.

The first part of the questionnaire provided a brief outline of the concept of BI. Furthermore, an image of a BI dashboard was also included so that the participants could understand and relate to this concept. The second part of the questionnaire involved personal information. The final part of the questionnaire was based on the Technology Acceptance Model (TAM) introduced by Davis (1989), which suggests that two key elements influence the model - perceived ease of use (PEU) and perceived usefulness (PU). PEU is defined as the extent to which an individual believes that using a particular system would be easy, while PU is the extent to which an individual believes that using a particular system would improve their job satisfaction. In addition, research has shown that these elements are influenced by two other factors - Attitude towards Use (A), which is the user's evaluation of the desirability of employing a common information system application, and Behavioural Intention to Use (BIU), which is a measure of the likelihood that an individual will use the application (Davis, 1993). Therefore, four variables were chosen for analysis: Perceived usefulness, Perceived ease of use, Attitude towards use, and Behavioural Intention to use.

A well-designed self-completion questionnaire ensures data gathering consistency, enabling comparison and analysis of responses from various participants (Babbie, 2016). Participants may feel more at ease being open and honest on anonymous surveys, especially when discussing sensitive or private matters a crucial consideration especially since the researcher works within the same organisation.

To ensure the validity and reliability of the questionnaire used for data collection, a comprehensive process was undertaken. Initially, the draft questionnaire was subjected to experts review by a statistician together with that of an academic in the BI area. The expert provided valuable feedback, which led to several improvements in the questionnaire design.

The suggested changes included the reversal of a few questions to counter potential response bias, amendments to certain questions to enhance clarity and relevance, and randomising the order of Likert scale items to mitigate potential response patterns. Additionally, we strategically repositioned some questions to include similar items further on, enabling us to check for consistency in participant responses.

After incorporating the expert's recommendations, a pilot study was conducted with a small sample of participants (10) representing the study's target population. The pilot study aimed to assess the questionnaire's effectiveness, readability, and comprehensibility.

The rigorous process of expert review and pilot testing ensured that the adapted questionnaire was robust, effectively addressing the research objectives, and capable of yielding reliable and valid responses from the participants. The resulting questionnaire was then employed for data collection in the main study, providing a solid foundation for data analysis and interpretation.

The questionnaire's layout was thoughtfully crafted to be clear and appealing without being overly formal, simplifying completion for respondents. To reduce the risk of respondent fatigue, the questionnaire was designed to be brief, taking no more than five minutes to complete (Bryman, 2012). For the creation of the questionnaire, we utilised Google Forms, an online survey tool provided by Google.

Although the self-completion format limits the ability to question or guide respondents, clear instructions were provided to increase response rates. Participants were informed of their option to clarify or decline to answer, and responses were kept completely anonymous. Properly designed questionnaires can aid in minimising item and unit non-response (Synodinos, 2003), and the researcher should recognise the significance of this unique opportunity to communicate with respondents.

The questionnaires were formulated in English, taking into account the language literacy of all staff members.

The self-administered questionnaire used in this research was distributed through the Office of Marketing, Communications, and Alumni to Deans, Directors, Heads of Departments (HODs), and Faculty Managers. The questionnaire was accompanied by a brief study summary, and responding to it indicated participants' consent to participate. The questionnaire was accessible through Google Forms, and participants were encouraged to contact the researcher and/or primary supervisor for any queries or clarifications.

The questionnaire was distributed to a total of 174 participants, with 110 individuals effectively completing and submitting their responses. The 10 participants who had taken part in the pilot study were excluded from submitting another questionnaire, as their inputs were already part of the sample.

In this study, the researcher utilised SPSS, a widely used software tool in the field of research and data analysis. Descriptive statistics were used to describe the basic features of the data in the sample, providing a simple summary of the data whilst Cronbach's alpha was used to assess the internal consistency of the answers. In the analysis, ANOVA and regression analysis were performed to investigate the relationships and statistical significance between variables.

3.3.2 A Qualitative Structured Interview

A structured interview approach was employed for the collection of qualitative data. It required asking each respondent the identical stimuli while administering the same set of questions in the same setting. Thus, responses can be combined (Bryman, 2012). Such an interview was deemed appropriate for the goals of this study due to these qualities. Nevertheless, each interviewee was given the time and opportunity to add anything else he or she deemed relevant at the end of the interview. Open-ended questions allowed for the collection of more data. Detailed responses given in the respondent's own words may be a rich source of data and prevent respondents from guessing what the typical response would be. However, open-ended questions are more difficult to code, analyse, and compare than closed-ended questions, which increases the researcher's risk that the response will not be precise enough to address the objectives of the question (Martin, 2006).

11 individuals holding a managerial position within the University of Malta were invited for the interview but only 10 accepted to participate. These individuals were chosen as they are all familiar with the BI topic.

The interview guide contained 12 questions. Since all of the interviewees who were selected were fluent in English, the interview was conducted using the English language. Before the interview, each participant provided their verbal and written consent. All interviews were held at the organisation's location in a discrete setting. To provide a deeper analysis and more thorough investigations of participant responses, interviews were audio-recorded. Each interview lasted between 45 minutes to an hour.

Each qualitative interview recording was listened to numerous times by the researcher to guarantee familiarity. Observations were made for each recording. The interviews' responses to the same question were compared, and various points of view were assessed. The interview data was analysed using thematic analysis, following the guidelines proposed by Braun and Clarke (2006).

3.3.3 Inclusion Criteria, Sample Size and Sampling Technique

The participants in this study were exclusively employees of the University of Malta, ensuring that the research findings would be directly relevant to the organisation's context. To select the sample, purposive sampling was employed, a non-probability technique allowing for the swift identification of participants with specific qualities relevant to the research questions (Bryman, 2012).

For the quantitative aspect of the research, the sample was targeted to include employees holding positions as Deans, Directors, Heads of Schools, HODs, Faculty Managers or those in

charge. This resulted in a potential maximum sample size of 174 employees, and thus, this number of questionnaires was distributed. The questionnaire was vetted by an expert to ensure validity. Based on the feedback received, necessary changes were made before forwarding it to the rest of the participants. Furthermore, the questionnaire underwent a preliminary test with ten participants

To ensure that the research objectives could be accomplished within a reasonable timeframe, the sample size for the qualitative portion was deliberately minimised but still considered sufficient. According to Guest, Bunce, and Johnson (2006), conducting twelve interviews is suitable for exploring shared opinions and experiences. Moreover, data saturation, the point where new themes are unlikely to emerge, is typically achieved after analysing around twelve interviews. However, the researchers also acknowledge that fundamental components for meta-themes start emerging after approximately six interviews, with data variability following consistent patterns. For research focusing on high-level, overarching themes, a sample of six interviews may suffice to develop significant themes and meaningful interpretations. Smith et al. (2009) proposed that a sample size of three to six people could be appropriate for qualitative research, although they acknowledged that there is no one-size-fits-all answer to the sample size question. Additionally, in specific cultural contexts,

Given these considerations, the goal of this study was to conduct ten interviews with management personnel. This approach took into account the range of three to twelve interviews considered suitable for this type of research, the time constraints, and the fact that this qualitative component is just one part of the overall research project.

The interviews with management personnel were designed to delve deeply into their perspectives. The interview guide (see Appendix I), a form seeking participants' consent for the

study (see Appendix II), and initial contact information was delivered to potential participants via email (see Appendix III, Appendix IV). Follow-up emails were sent to non-respondents to ensure adequate participation.

3.4 Ethical Considerations

Throughout the entire study, care was taken to uphold ethical standards. Diener and Crandall (1978) categorised ethical principles into four primary categories:

- (1) whether participants suffer harm;
- (2) whether informed consent was obtained;
- (3) whether privacy was invaded; and
- (4) whether deception was used.

Langdridge (2007) emphasises that the most fundamental ethical consideration is consent, which was strictly followed throughout this investigation. Participants were fully informed about the study's scope before providing consent. A recruitment email (see Appendix IV, Appendix VI) explained the study's goals, ensuring informed consent.

Voluntary participation was emphasised, and participants were free to withdraw at any point during the research (see Appendix III, Appendix V). No personal gain was promised, but participants were assured access to the results upon request.

To ensure no harm to participants, measures were taken to avoid physical or mental stress, protect privacy, and preserve confidentiality. Open-ended questions in surveys and interviews allowed participants to skip uncomfortable topics.

Anonymity was maintained to the extent possible, especially in the qualitative phase, and participants were informed that data would be used solely for this study and not for future purposes.

Honesty was upheld, without any deception or misrepresentation, fostering a collaborative approach between participants and the researcher (Bryman, 2012).

3.5 Limitations

The short and stringent time frame prevented the refinement of the interview guide, which could have ensured clarity and appropriateness in achieving the study objectives. Piloting could have offered valuable insights into the data collection process, especially for qualitative interviews.

Two limitations are connected to the researcher's role. Firstly, being a staff member at the University of Malta, there might have been a potential for bias in the responses obtained from the self-completion questionnaires. Additionally, the qualitative interviewees might have limited their responses due to the researcher's position as a colleague and the inability to ensure anonymity.

Lastly, the researcher's lack of experience in using these techniques and interpreting qualitative data presented a limitation. Nevertheless, the detailed answers from the interviewees and the satisfactory questionnaire response rate suggest that their impact may have been mitigated.

3.6 Conclusion

An outline of the techniques used to carry out this research study was provided in this chapter.

The results of this study will be provided in full in the following chapter, which will be followed by a complete analysis of these results.

4 A Qualitative Disposition of the Research Findings: A Thematic Analysis

This chapter presents the interpretation of the data collected from managerial staff, through in-depth interviews. After transcribing the interviews, a thematic analysis was carried out. This analysis included a coding phase where the interviews were broken down into smaller segments, and subsequently, the codes were organised into thematic categories.

Additionally, the researcher conducts a comparison of the findings with prior research in the field of Business Intelligence adoption in higher education, aiming to make a meaningful contribution to the existing body of knowledge.

The decision to conduct a small-scale study was deliberate, as it afforded the researcher the opportunity to explore the research topic in great detail, yielding profound and comprehensive insights.

4.1 Demographic Data of Interviewees

This small-scale study included 10 participants, all of whom worked at the University of Malta and who are familiar with the BI topic. The participants' ages ranged between 31 and 58 years, with a mean age of 41 years. The participants' years of experience ranged between 2 to 17 years. The overall mean working experience was 9 years. To safeguard the participants' identities, a pseudonym was assigned to each participant as can be viewed in Table 3.

A thematic analysis was conducted to delve into qualitative data. This was done to reveal intricate insights and interrelations, fostering a deeper comprehension of the research topic's complexity. The main themes that are to be discussed in this chapter are the following:

- Moving towards evidence-based decision-making;
- A holistic approach to data management and analysis;
- Challenges of implementing a BI system; and
- The way forward: practical suggestions.

Table 3 Interview Participants' Information

Participant's Pseudonym	Occupation	Age	Years of Experience
Respondent 1	HR Member of Staff	44	10
Respondent 2	Faculty Manager	38	15
Respondent 3	Office of the Registrar	34	10
Respondent 4	Finance Office	31	4
Respondent 5	*	53	2
Respondent 6	Dean	58	20
Respondent 7	Faculty Manager	34	15
Respondent 8	Dean	39	10
Respondent 9	Quantitative Data Expert	39	16
Respondent 10	IT Expert	41	16

*The occupation of Respondent 5 was not disclosed so as not to reveal the respondent's identity

4.1.1 Thematic Analysis

Data was analysed according to Braun and Clarke (2006). Four themes and eleven sub-themes were elicited, as shown in Table 4. A discussion of each theme and its respective sub-theme follows below:

Table 4 Thematic Table

Theme	Sub-theme	Codes	Quote
Moving towards evidence-based decision-making	Benefits and Strengths of BI	Reliable, Efficient, Free of human error	<i>"BI will help transform the available data into information which can be easily visualised and analysed"</i> (Respondent 2)
	Enhanced Decision Making	Data-driven, Evidence-based, KPIs	<i>"For every decision, there must be some underlying evidence that would warrant or justify a decision being made, which is why BI is required"</i> (Respondent 6)
A Holistic Approach to Data Management and Analysis	Improvement in data management and analysis	Different, Holistic	<i>"You can really go into details by analysing data coming from different sources"</i> (Respondent 1)
	Impact on stakeholders	Data quality, Insights, Operational effectiveness	<i>"BI can help us identify whether our qualifications are leading our students to their desired jobs or not and whether they are actually using their qualifications."</i> (Respondent 8)

Challenges of Implementing a BI System	Resources	IT People, BI Developer, BI Office, Data Analyst	<i>"we need an office with the right people, with a leader, with a vision for BI" (Respondent 4)</i>
	Resistance to Change and Organisational Culture	Challenge, Culture, Resistance	<i>"Sometimes I think that we are tied to the past, we are not willing to change. Irrespective of the system, we need to change the culture as well." (Respondent 1)</i>
	Data, Quality and Organisation	Integration, Data, Quality	<i>"Some of the UM IS have been in place for several years and when planning for BI, there may be the need to re-organise data stored. This in itself may be a bigger challenge than one expects due to a number of processes being built to rely on a specific data structure." (Respondent 10)</i>
The Way Forward: Practical Suggestions	Training	Education, Knowledge, Courses, Handholding	<i>"Only when they understand the importance of the data and the importance of the evidence that they will buy in" (Respondent 6)</i>
	Feedback and Support	Feedback, Suggestions, Meetings	<i>".. A periodic interview with Deans or a selection of people and ask them how can this improve?" (Respondent 6)</i>
	Flexibility	Different needs,	<i>'The needs of one faculty is completely different from that of another Faculty so we need to be flexible and receive feedback on what they really need.'"(Respondent 1)</i>

	information systems	
Incremental Approach	Incremental, step by step	<i>"Introducing BI should be approached incrementally, with a phased implementation strategy. Gradual adoption allows our institution to better understand the unique needs and challenges, enabling them to fine-tune the BI solution as it evolves, ensuring a successful and effective integration." (Respondent 10)</i>

4.1.2 Theme 1: Moving Towards Evidence-based Decision-making

The first primary theme that can be elicited from the findings reveals the willingness of the University of Malta to move towards evidence-based decision-making. Management voiced their understanding of BI and revealed their perceptions towards the use of a BI system. This theme further encompasses the 'benefits and strengths of implementing a BI system' and its importance in 'enhancing decision making'.

Respondent 7 highlighted the importance of *'Having the information available at the touch of a button rather than asking for it provides significant advantages in terms of efficiency and decision-making.'* Similarly, Respondent 6 discussed how, *"It will allow us to make strategic decisions at the right time, at the right place, ideally within minutes."* The importance of having data quickly was articulated by respondent 10 who commented how *"Having faster speed of reporting will allow UM to be able to react faster to opportunities and threats that can be identified following detailed data analysis, thus leading to less impact of threats or more exploitation of opportunities."* With business intelligence (BI) tools, organisations can access relevant data instantly, empowering decision-makers to make informed choices without delay. The literature aligns with these findings, since scholars such as Eckerson (2006) emphasise that BI enables organisations to access valuable information, discover opportunities and threats, and make effective decisions in a timely and cost-effective manner. Furthermore, in line with the observation of Wadsworth et. Al. (2009) in the context of a university, BI facilitates faster reporting, granting management and staff immediate access to information at the click of a button. This enables them to promptly evaluate situations and take action on any bottlenecks or challenges that the institution is facing in real-time.

Responses were not only concentrated on the time taken to have data at hand. Shedding light on certain aspects of the decision-making was proposed by Respondent 9. The respondent commented on how *“Casting light on the darkest corners of data, BI is the beacon that guides decision-makers through the labyrinth of uncertainty.”*

Therefore, it became evident that one of the essential impacts of BI on decision-making is directly related to the quantity and quality of data available. As the volume of data increases, the potential for making impactful decisions grows. Respondent 2 highlighted how *“The more data we have, then the more impactful the decisions will be.”* Respondent 6 goes one step further in that. *“For every decision, there must be some underlying evidence that would warrant or justify a decision being made, which is why BI is required”*. Respondent 1 focused on how the *“BI can be key to developing an evidence-based culture in HEIs and can be a way to support fast-based decision making.”* BI will aid the organisation in improving its decision-making process. As highlighted by Apraxine and Stylianou (2017a), BI has a significant impact on operational performance by enabling improved decision-making through the utilisation of both historical and real-time data. This empowers managers to enhance organisational performance, identify areas for improvement, and closely monitor changes that influence the organisation. Additionally, BI offers the advantage of identifying opportunities by thoroughly analysing data patterns, trends, and hidden relationships.

Respondent 1 also recognised the fact that *“BI should also give an idea of what goes on in research”* given that research is a major pillar of any University.

Respondent 6 highlighted how *“BI can help us calibrate ourselves when it comes to marking. In ensuring that the Board of Examiners procedures are conducted in an informed manner.”* The

respondent also insisted that the BI could lead to *"a far better learning experience for all of us as academics than having an external examiner."*

Respondent 7 discussed the benefits of having visuals of the data, *"Having systems and somebody analysing the data, you will notice new trends, and you will be the first one to take advantage of that trend, that change"*. The literature concurs those BI technologies, including reporting, analytics, and data visualisation, aim to support better business decision-making.

The context of HEIs is particularly relevant to this study. Myllarniemi et al. (2009) explain that BI can facilitate strategic vision by analysing graduates' employability rates, strategic planning analysis, and comparing education quality results across different units and universities, aligning with the perspectives of the respondents.

The above reveals the transformative power of Business Intelligence (BI) in enhancing decision-making and fostering a culture of evidence-based choices. As the University of Malta moves forward, the integration of BI will not only streamline operations but also empower it to adapt proactively to opportunities and challenges, ultimately leading to continued growth and success in the ever-evolving landscape of higher education.

4.1.3 Theme 2: A Holistic Approach to Data Management and Analysis

The second theme represents managers' perceptions of the 'Improvement in data management and analysis' which is a key benefit of BI that also has a positive 'impact on stakeholders', including students and industry requirements.

By utilising data analytics, organisations can develop study-units that better address the needs of the industry. This was acknowledged by Respondent 6 who stated, *"Analytics can help us develop study units which would preferably better address the requirements of the industry as*

well as societal needs." Similarly, Respondent 8 pointed out that in terms of graduate employability *"BI can help us identify whether our qualifications are leading our students to their desired jobs or not and whether they are using their qualifications"*.

As can be noticed, the integration of BI in students' relationship management and course management systems was one of the points that emerged in the interviews. The literature supports this perspective, emphasising the value of BI applications in enhancing academic performance and supporting students' holistic and individual needs (Baepler & Muedoch, 2010; Laclan, 2014; Piedade & Santos, 2010).

Respondent 1 commented on the benefits that BI provide in terms of patterns analysis by analysing data from different sources by stating that: *"You can really go into details by analysing data coming from different sources"*.

The view was confirmed by Respondent 9 *"One of the significant advantages of BI is its ability to unveil patterns and trends that may not be visible to the naked eye"* Similarly Respondent 10 commented how *"Manual comparison of data can often be insufficient in capturing certain observations or detecting trends promptly. By leveraging BI systems and analytical tools, organisations can uncover hidden patterns and gain valuable insights."* Respondent 2 highlighted this, stating, *"Sometimes certain trends can't be seen with the naked eye. You need to have systems that come up with certain patterns"* and Respondent 9 commented *"If you have to compare the data yourself in a manual way, sometimes you won't be able to come up with certain observations or else you realise when it is too late."*

The literature reinforces this perspective, showcasing the strategic value of BI in HEIs by enabling evidence-based decision-making on programme offerings, course preferences, and

market demands (Curtis, 2015) . Furthermore, the literature recognises BI's capability to identify opportunities by analysing patterns, trends, and hidden relationships in data (Sabherwal & Becerra-Fernandez, 2011). BI tools are instrumental in tracking and evaluating key performance indicators, enabling predictive analytics such as data mining to forecast future tendencies and enhance planning strategies (Apraxine & Stylianou, 2017a).

Another crucial benefit of BI is not just responsiveness but also its reliability. All participants were indeed aware of this essential benefit. Respondent 5 reflected on how *“Collecting data manually exposes it to human and input errors, potentially compromising its accuracy. By leveraging BI, we can ensure data integrity and minimise the risk of errors.”* Moreover, Respondent 3 pointed out how *“Not just responsiveness but also reliability in the sense that collecting data manually might expose the data to human error and input error.”*

This aligns with the literature's emphasis on data integrity and reliability achieved through BI systems. Nonetheless, Data quality plays a critical role in supporting effective decision-making (Wixom & Watson, 2010). High-quality data is characterised by its completeness, validity, relevance, accuracy, consistency, and timeliness (Redman, 2013) thus a HEI must ensure that data is recorded and kept properly because as one of the respondents well commented *“the BI system is only as good as the foundation on which its information is based.”*

The interviews and literature converge to highlight the multifaceted advantages of BI in improving data management, decision-making, and overall organisational performance. BI's ability to identify opportunities, predict trends, enhance data reliability, and support personalised student services has profound implications for the success of HEIs and their ability to meet the needs of various stakeholders. Therefore, as a concluding general remark, an

automatic process of data that is not manually based and which reflects the richness of the BI-generated data is an aiding tool for HEIs to make optimal use of the available data.

4.1.4 Theme 3: Challenges of Implementing a BI System

This third theme represents managers' perceptions of the 'Challenges' a HEI can encounter when implementing a BI system. This theme encompasses a further four sub-themes namely 'Resources' and 'resistance to change', 'organisational culture' and 'data, quality and organisation'.

Most participants commented on the fact that organisations tend to resist change and the focus should therefore be on how to overcome the barriers of resistance to change. Respondent 1 pointed out that *"We have to train people, change their mentality, teach them to embrace technology, and how to use technology to their advantage."* He added: *"Sometimes I think that we are tied to the past, we are not willing to change. Irrespective of the system, we need to change the culture as well."* Respondent 10 also commented on this by stating: *"Like any other organisation, the UM is not immune to cultural resistance to change."*

This aligns with the literature, which emphasises the significance of top management support and sponsorship to overcome resistance during BI implementation (Cohen, 2009; Thamir & Poulis, 2015b). Twinoujuni (2019) also discussed this where he commented how organisational culture plays a crucial role in the adoption of information systems. It has been acknowledged in the literature that the neglect of human factors often leads to the failure of information system implementation projects. Researchers in the field of Information Systems (IS) have noted that specific types of organisational culture can significantly influence the adoption of

IS. According to Twinomujuni (2019), a hierarchical culture type hurts IS adoption. For this reason, the University of Malta should plan to tackle this issue.

Two respondents emphasised the importance that the University employees need to embrace the advantages of using BI and focus on the long-term benefits even though the short-term challenges can be quite significant. Respondent 7 explained how: *"The system will give you a tool. It has great benefits... but unless you use the tool and you know how to use the tool, we won't see any results because just having the system will not solve the issue"*. Similarly, Respondent 4 suggested that *"Having a BI is a magnificent tool. It's about how you use it"* and *"It's about you changing the way how to do things and embracing technology to the fullest to get the full potential of the technology."*

Another challenge which was mentioned by three participants is the huge amount of available data when using BI which can at times be daunting and difficult to manage. Respondent 5 insisted that *"Some people will tell you the more data we've got the better, but it's not like that because when you get overwhelmed with the amount of data generated you still can't decide."* Respondent 10 also mentioned that *"Some of the UM IS have been in place for several years and when planning for BI, there may be the need to re-organise data stored. This in itself may be a bigger challenge than one expects due to several processes being built to rely on a specific data structure."* Respondent 10 also emphasised the importance of data cleansing which is *"an exercise that encompasses all IS that will be a source of data for the BI system to ensure that data is well maintained and any identified sources of wrong data being provided, rectified as early as possible."* The literature supports the importance of managing data quality and governance to ensure the reliability and usability of BI results (Apraxine & Stylianou, 2017a; Thamir & Poulis, 2015b). To address these challenges, fostering a learning organisational

culture that supports the BI system is essential (Arefin et al., 2015; Marsick & Watkins, 2003). Data governance and establishing a reliable data repository were deemed vital for ensuring continued BI adoption and usage (Apraxine & Stylianou, 2017a; Twinomujuni, 2019). The literature further highlights the significance of data quality and reliability in achieving desired BI outcomes (Thamir & Poulis, 2015b; Yeoh & Koronios, 2010).

Some participants also mentioned the issue of data ownership which is connected to the fear of losing power or the risk that data will expose deficiencies in their respective work practices. Respondent 2 highlighted how *"One of the issues would be data boundaries"* and *"You will have people who resist because now they are the owners, and they will want to protect their source, their data."*

Finally, all participants mentioned the issue of lack of resources and how a BI office employing people with the right knowledge and skills must be set to ensure the successful implementation of BI. Respondent 2 and Respondent 5 commented on how *"The first phase is crucial. If you don't do it the right way, you are wasting time"* and *"If the initiation phase is done properly, it's quite low maintenance from there onwards."* Respondent 4 also stated that *"we need an office with the right people, with a leader, with a vision for BI"*. Respondent 9 agreed with this vision and argued that also comments *"Lack of talent may also be a challenge, especially in the initial stages of the project. It is important that the project, both technically as well as strategically, gets a strong foothold and a proper sense of direction, otherwise the effort put into it may not be justified when looking at the results obtained"*. The literature emphasises the negative impact of resource problems on BI implementation and underscores the importance of allocating resources before the BI process (Boyton et al., 2015).

In conclusion, the interview findings and literature converge to highlight the multifaceted challenges faced by HEIs during BI implementation. Overcoming resistance to change, managing data overload, addressing data ownership concerns, and ensuring adequate resources are key considerations for successful BI adoption in higher education. By fostering a culture of learning and data governance, HEIs can maximise the benefits of BI and enhance decision-making processes within the institution.

4.1.5 Theme 4 – The Way Forward: Practical Suggestions

This theme represents the ‘Way Forward’ and includes the sub-themes ‘Training’, ‘Feedback and Support’, ‘Flexibility’ and ‘Incremental Approach’

All participants mentioned the importance that they feel that the way forward is for the University to have an office dedicated to BI. Respondent 6 highlighted the need for professional individuals by saying *“We need a technical person who would be available to address IT issues”*. Similarly, Respondent 5 stated: *“We need an individual who understands what kind of data the user requires and what kind of analytical processes or analysis would need to be carried out”*. In addition to this Respondent 1 specified that *“if you are implementing a new system, you need a proper team to take over to drive the change.”* Respondent 7 also commented on the way forward by saying *“I think that there has to be an owner of the BI and you need a driver first to make sure that the system is well maintained as data and systems are all the time evolving”*. Scholarly literature supports the significance of top management support and sponsorship, as well as the establishment of a learning organisational culture to facilitate BI adoption (Arefin et al., 2015; Cohen, 2009; Thamir & Poulis, 2015b).

Training emerged as another critical sub-theme, with respondents recognising the need to provide comprehensive training to various stakeholders. Respondent 1 commented on how *“Only when they understand the importance of the data and the importance of the evidence that they will buy in”* to the introduction of a BI system, indicating that this should be achieved by giving adequate training and emphasising the need for evidence-based decision making. Respondent 10 proposed that *“Training of current staff, including hands-on sessions, will enable the users to familiarise themselves with the software provided for reporting. Training also refers to that of technical staff involved in the analysis and setup of the BI system.”* Respondent 5 specified the need for training by saying: *“With regards to training, first and foremost we need to make sure that we provide adequate support and training”*. Respondent 9 confirmed what others mentioned by stating that *“Training individuals in BI is key to unlocking the power of data-driven decision-making and empowering organisations to thrive in a competitive landscape.*

The literature emphasises the importance of ongoing education and support to maximise the value of BI tools (De Voe & Neal, 2005; Yeoh & Koronios, 2010). Furthermore, research reveals how one of the frequently cited reasons for the non-adoption and non-integration of technology in higher educational institutions is the lack of specialised and ongoing technical support (Bonk, 2001; Jones & Moller, 2002; J. Lee, 2001; McCorkle et al., 2001; Schifter, 2000).

Another theme is that of Feedback and support where Respondent 6 expressed his opinion by saying: *“A periodic interview with Deans or a selection of people and ask them how can this improve?”*. Respondent 1 also commented on this by stating: *“you need to have two sources of people supporting the BI system. One from a technical perspective, one from a strategic perspective because that way, it would have the system evolve throughout the years.”* Whilst

respondent 5 states that *"if out there you never find support it will fail. This is a part of our proposal. If the university tends to go on with this let's start strong straight away and provide support because we will fail before we even depart."* The importance of feedback and support aligns with the literature, which underlines the need for ongoing support and a business-driven, flexible technical framework (Bijker & Hart, 2015; Yeyoh & Popovic, 2015; Davenport, 2006).

Flexibility emerged as another important sub-theme. Respondent 1 commented on *"The needs of one faculty is completely different from that of another Faculty so we need to be flexible and receive feedback on what they really need"*. Flexibility is a pivotal factor that empowers end users, placing them firmly in the driver's seat. When users feel in control of their Business Intelligence (BI) tools, they are not only more likely to embrace and utilise them but also become enthusiastic collaborators. It's the freedom to tailor and adapt the BI system to their unique needs and preferences that cultivates a sense of ownership, ultimately driving a culture of collaborative usage. This factor was proved to be pivotal in the adaptation of BI (Scholtz et al., 2018).

Finally, several respondents commented on the need to implement the project slowly with Respondent 9 commenting how *"Introducing BI should be approached incrementally, with a phased implementation strategy. Gradual adoption allows our institution to better understand the unique needs and challenges, enabling them to fine-tune the BI solution as it evolves, ensuring a successful and effective integration."* Respondent 5 also commented on this by emphasising the importance to go slow by saying that *"And that is how I see our institution it was to go, because otherwise it will jeopardise the effectiveness. So, one of the things that I think we should do is go slow"*. This approach aligns with the literature, which emphasises the

need for an incremental approach that aligns with strategic business objectives and continuously delivers value (Bijker & Hart, 2015; Yeyoh & Popovic, 2015; Davenport, 2006).

In conclusion, the respondents' insights, coupled with the relevant literature, underscore the importance of a systematic approach to BI implementation in HEIs. Establishing a dedicated BI office, providing comprehensive training, fostering a supportive culture, and adopting an incremental delivery strategy are key factors that can pave the way for successful BI adoption and utilisation within the higher education setting. By addressing these aspects, HEIs can harness the power of BI to make informed decisions and drive positive organisational outcomes.

4.2 Conclusion

In this chapter, we delved into the key findings and insights obtained from interviews. The research highlighted the significant role of BI in enhancing decision-making processes, optimising operational performance, and supporting strategic vision across various organisational settings, including the unique environment of universities.

To move forward, fostering a learning organisational culture, ensuring data governance, providing comprehensive training, and adopting an incremental approach to BI implementation are crucial steps. By doing so, HEIs can harness the power of BI to make well-informed choices, support personalised student services, and drive positive organisational outcomes.

Overall, this research offers valuable insights for HEIs seeking to leverage BI effectively, promote evidence-based practices, and navigate the complexities of the modern education landscape with agility and foresight.

5 A Quantitative Analysis of the Research Findings

The purpose of this study was to investigate and assess the perceptions and attitudes of individuals within a higher education institution towards the adoption and utilisation of BI. To achieve this, a survey was conducted to examine four key constructs: perceived usefulness of BI, perceived ease of use of BI, attitude towards using BI, and Behavioural Intention to Use BI. By exploring these constructs, the researcher aimed to shed light on the potential drivers and barriers to BI adoption in the higher education setting.

This chapter presents the findings together with an in-depth examination of the data collected highlighting noteworthy patterns, correlations, and implications. Furthermore, the researcher compares and contrasts the findings with existing literature to contribute to the broader body of knowledge in the field of BI adoption within higher education. The quantitative data was collected from the University's Faculty Managers, Officers in Charge, Deans, Directors, Heads of schools and HODs using a questionnaire which was distributed in May 2023. By identifying the underlying factors influencing the intention to use BI, this study offers practical insights into promoting effective BI implementation strategies that cater to the specific needs and challenges of the higher education context.

The findings and analysis of the survey data, unravelling the intricacies of perceived usefulness, perceived ease of use, attitude, and Behavioural Intention to Use BI in the context of a higher education institution can be found in the upcoming sections.

5.1.1 Response Rate

The research tool was distributed to a total of 174 staff working at the University of Malta who occupy the position of Faculty Managers, Officers in Charge, Deans, Directors, Heads of schools

and HODs. Since the questionnaire did not require any amendments, the 10 respondents who contributed to the pilot study were included in the sample.

The survey encompassed 110 (N) participants selected from a population of 174, yielding a response rate of 63% with a confidence level of 95% and a margin of error of 5.7%. Given these parameters, the results can be deemed statistically reliable and can be confidently extended to represent the entire population with a 95% level of certainty. The margin of error at 5.7% suggests that the estimated values obtained from the sample are expected to be within 5.7 percentage points of the true values for the entire population.

It is important to outline that 31.8% (n=35) were administrative staff whilst the rest 68.2% (n=75) were academics.

5.1.2 Demographic Data

Respondents were asked to disclose their gender. Figure 3 shows that an approximately equal number of respondents from both genders contributed to this study, including 59 males (53.64%) and 51 females (46.36%).

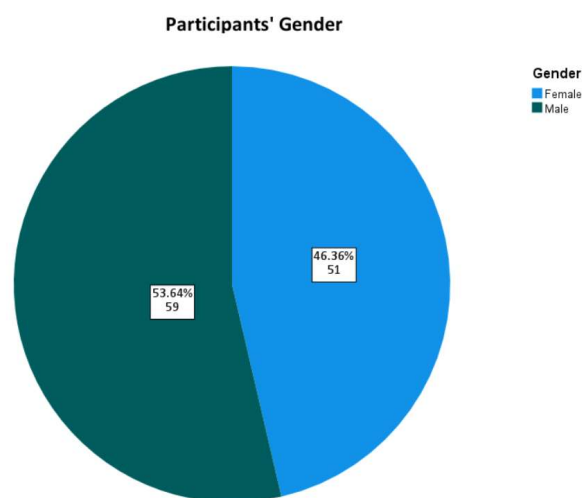


Figure 3: Participants' Gender Distribution

Findings further portray that the greatest number of respondents (n = 47; 42.73%) were between 40-49 years old. Moreover, 30% (n = 33) of respondents were categorised in the age group of 50-59, 20.91% (n = 23) were between 30-39 years old and 6.36% (n = 7) were over 60 years of age (Figure 4).

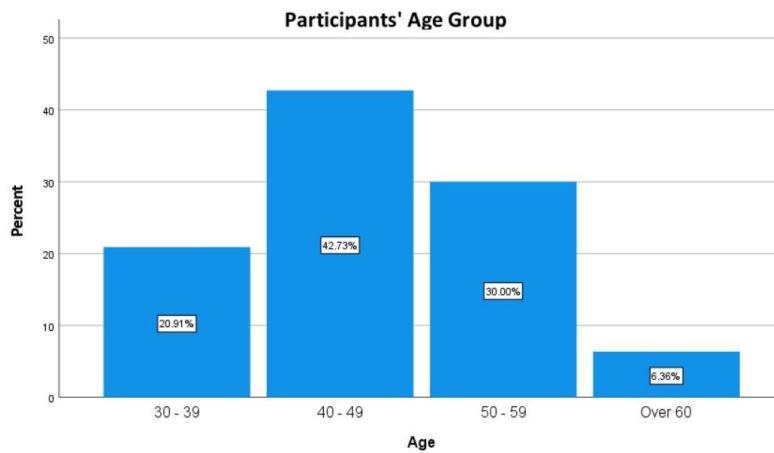


Figure 4 Survey Participants' Age Group Distribution

Participants were asked whether they make use of statistical data when making decisions such as attrition, retention rates etc. The findings for this question portray that 30.91% (n = 34) do not make use of statistical data with 67.65 % (n = 21) who gave out this response being academics.

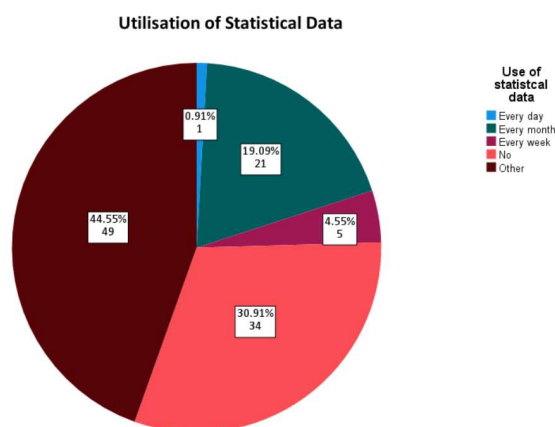


Figure 5 Utilisation of Statistical Data

Table 5 Occupation * Use of statistical data crosstabulation

Occupation * Use of statistical data Crosstabulation

Count

	Use of statistical data					Total
	Every day	Every month	Every week	No	Other	
Administration Officer	0	0	1	0	0	1
Administration Specialist	0	0	0	6	4	10
Administrator II	1	1	0	2	1	5
Associate Professor	0	3	3	6	4	16
Lecturer	0	3	0	6	4	13
Manager I	0	2	0	1	4	7
Manager II	0	2	1	1	2	6
Professor	0	3	0	0	6	9
Senior Administrator	0	0	0	1	5	6
Senior Lecturer	0	7	0	11	18	36
Senior Teaching Associate	0	0	0	0	1	1
Total	1	21	5	34	49	110

The findings of the survey revealed how a substantial proportion of academics within the University of Malta, approximately 25.6% of the respondents, do not utilise statistical data when making decisions. This finding aligns well with existing literature that suggests decision-

making among academics in HEIs tends to be more intuitive than analytical (Goldstein & Katz, 2005; Kuncel et al., 2013). Despite being active contributors to research and scholarly publications, a considerable number of academics appear to rely on their intuition rather than adopting evidence-based practices.

The prevalence of intuitive decision-making among academics is noteworthy, especially in the context of a rapidly evolving and complex higher education environment where numerous alternatives and factors must be considered. Previous studies have indicated that intuitive decision-making alone may not always lead to optimal choices when faced with multifaceted challenges (Cerigion, 2015; Jamieson & Hyland, 2006). Given the vast array of data sources and analytical tools available, academics' limited reliance on statistical data may raise questions about the extent to which evidence-based practices are integrated into their decision-making processes.

The coexistence of intuitive decision-making and the academic inclination for research publication presents an intriguing paradox. It begs further exploration into the factors influencing academics' preference for intuition over data-driven approaches in decision-making. Potential explanations may include time constraints, lack of training or exposure to data analytics, or a cultural emphasis on experiential knowledge within the academic community.

Promoting evidence-based decision-making among academics can have profound implications for enhancing the quality and effectiveness of decisions made within HEIs. Integrating data analytics and statistical tools such as BI into academic training and professional development programs could bridge the gap between intuition and data-driven decision-making. By cultivating a culture that encourages the use of BI, HEIs can empower academics to navigate

the complexities of modern higher education with more informed and confident decision-making.

The researcher also assessed whether Faculty Managers, Officers in Charge, Deans, Directors, Heads of schools and HODs are aware of the strengths that a BI system can bring to their Institution. Based on the findings of my survey, it became apparent that a significant proportion, specifically 58.2% (n=64) of the participants, lacked awareness regarding the potential advantages that the implementation of BI could offer to the University. Figure 6 below outlines this result.

Awareness of Business Intelligence (BI) Benefits among Participants

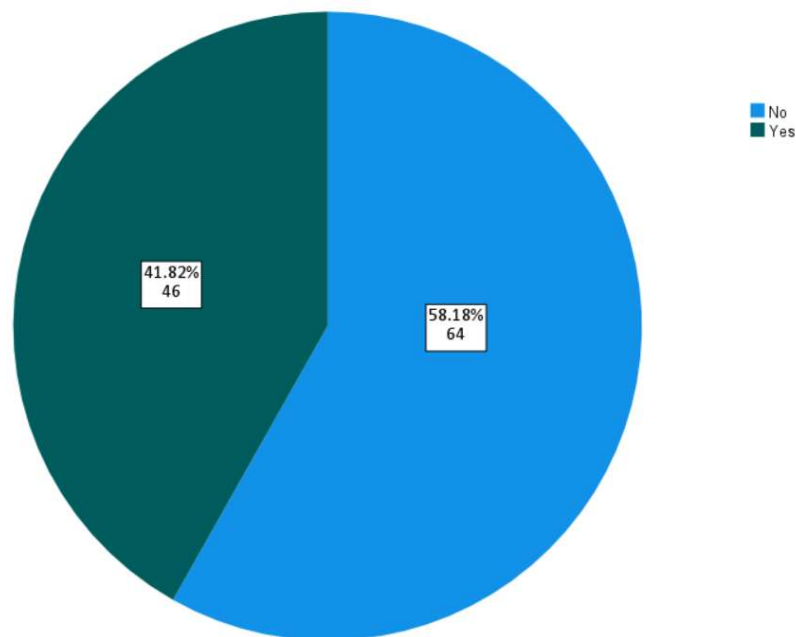


Figure 6 Awareness of BI Benefits among Participants

Table 6 Awareness of BI Benefits among Participants table

Are you aware of the benefits that the potential use of BI may bring to the University?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	No	64	58.2	58.2	58.2
	Yes	46	41.8	41.8	100.0
	Total	110	100.0	100.0	

The above research findings reveal a significant knowledge gap, with 58.2% of respondents lacking awareness of the benefits of Business Intelligence (BI). This underscores the need for targeted efforts to educate and inform potential users about BI's advantages. Additionally, in the upcoming results in line with the Technology Acceptance Model (TAM), the study demonstrates a positive relationship between perceived usefulness and users' intention to use BI. This highlights the critical role of enhancing BI's perceived usefulness through factors like user-friendly interfaces, tailored solutions, and clear demonstrations of its value. Addressing these aspects not only promotes BI adoption. As previously highlighted in the literature a communication channel should be set up for the organisation to educate and inform its employees to understand the need for a BI system and what benefits it would bring along in their immediate and long-term objectives.

The survey also included a set of questions which can be found in the following page:

Table 7 Survey questions

On a scale of 1 to 6 (with 1 being strongly disagreeing and 6 being strongly agreeing), how would you react to this statement: 'BI would provide valuable service to me'
On a scale of 1 to 6 (with 1 being strongly disagreeing and 6 being strongly agreeing), how would you react to this statement: 'Using BI would enable me to better understand students'
On a scale of 1 to 6 (with 1 being strongly disagreeing and 6 being strongly agreeing), how would you react to this statement: 'Learning how to use BI would be easy for me'
On a scale of 1 to 6 (with 1 being strongly disagreeing and 6 being strongly agreeing), how would you react to this statement: 'Using BI is not a good idea'
On a scale of 1 to 6 (with 1 being strongly disagreeing and 6 being strongly agreeing), how would you react to this statement: 'Using BI would enhance the quality of my work'
On a scale of 1 to 6 (with 1 being strongly disagreeing and 6 being strongly agreeing), how would you react to this statement: 'Using BI would not make it easier to do my job'
On a scale of 1 to 6 (with 1 being strongly disagreeing and 6 being strongly agreeing), how would you react to this statement: 'I do not find BI useful in my job'
On a scale of 1 to 6 (with 1 being strongly disagreeing and 6 being strongly agreeing), how would you react to this statement: 'I would find it easy to acquire targeted information by using BI'
On a scale of 1 to 6 (with 1 being strongly disagreeing and 6 being strongly agreeing), how would you react to this statement: 'I would find BI difficult to use'
On a scale of 1 to 6 (with 1 being strongly disagreeing and 6 being strongly agreeing), how would you react to this statement: 'Using BI would enhance my effectiveness in my job'
On a scale of 1 to 6 (with 1 being strongly disagreeing and 6 being strongly agreeing), how would you react to this statement: 'Using BI is a good process'
On a scale of 1 to 6 (with 1 being strongly disagreeing and 6 being strongly agreeing), how would you react to this statement: 'I do not intend to use the services offered by BI if available'
On a scale of 1 to 6 (with 1 being strongly disagreeing and 6 being strongly agreeing), how would you react to this statement: 'Using BI would be beneficial to my work'
On a scale of 1 to 6 (with 1 being strongly disagreeing and 6 being strongly agreeing), how would you react to this statement: 'I do not intend to use BI to acquire target information once available'
On a scale of 1 to 6 (with 1 being strongly disagreeing and 6 being strongly agreeing), how would you react to this statement: 'I intend to use BI when it becomes available'
On a scale of 1 to 6 (with 1 being strongly disagreeing and 6 being strongly agreeing), how would you react to this statement: 'As much as possible, I will use BI, once available, to help make decisions'

5.1.3 Cronbach alpha coefficients

A test was conducted to determine the Cronbach alpha coefficients which can be viewed in the table below:

Table 8 Cronbach alpha coefficients

Perceived Usefulness (PU)	0.894
Perceived Ease of Use (PE)	0.786
Attitude towards Use (AT)	0.749
Behavioural Intention to USE (BI)	0.810

All the Cronbach alpha coefficients exceeded the 0.70 threshold. This means that the construct items hang well together and hence there is evidence of the internal consistency reliability of the construct measures

Table 9 below shows a descriptive summary of the study's main constructs – perceived usefulness of BI, perceived ease of use of BI, attitude towards using BI and Behavioural Intention to Use BI.

Table 9 Descriptive Statistics

	Minimum	Maximum	Median	Mean	Std. Dev.
Perceived Usefulness	1.67	6.00	4.50	4.39	1.02
Perceived ease of use	1.00	6.00	4.33	4.24	1.06
Attitude towards BI	1.33	6.00	5.00	4.75	0.94
Behavioural Intention to Use BI	2.50	6.00	5.00	4.81	0.96

Note: N = 110

Table 9 shows that the average ratings were relatively high as shown by the median and the mean. However, it is worth noting that there was also a wide range of scores as indicated by the range (difference between the minimum and the maximum scores) and the standard deviation.

The box plots in Figure 6 provide a graphical illustration via the five-figure summary (minimum, lower quartile, median, upper quartile, and maximum) of the various distributions.

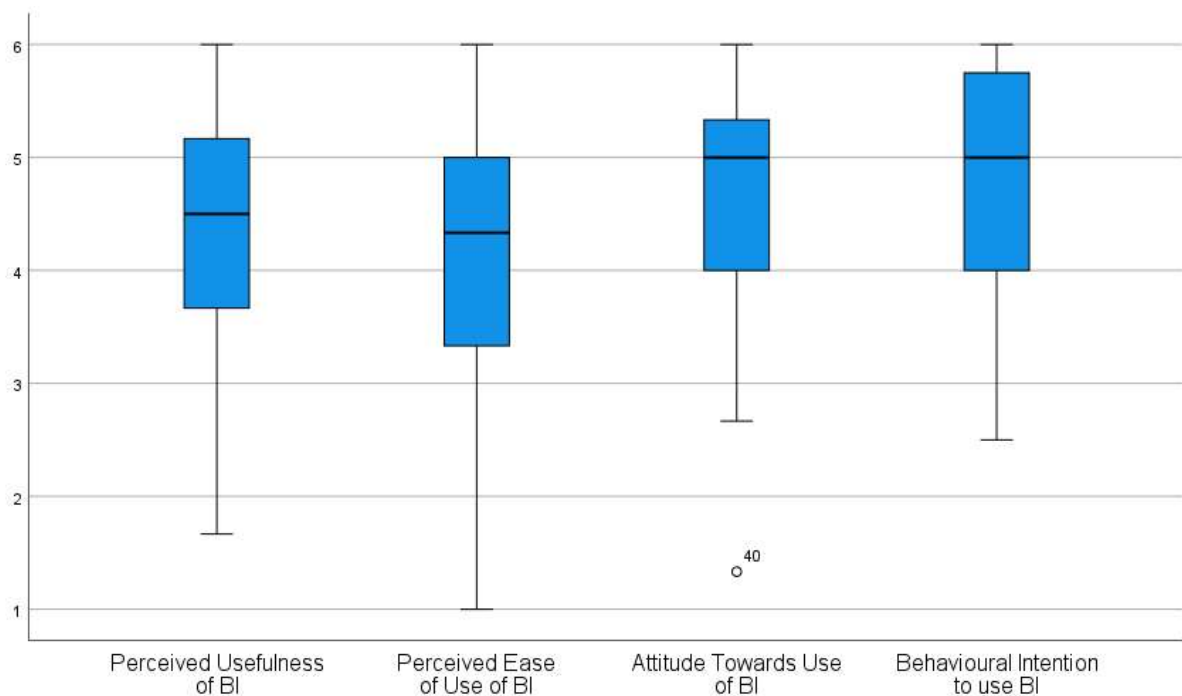


Figure 7 Graphical illustration via the five-figure summary

In the following page Table 2 exhibits the correlation coefficients and their significance between the main study variables.

Table 10 Correlation coefficients and their significance between the main study variables

		PU	PE	AT	BI	Age	Gender	Work Experience	Position
PU	Pearson r	1	.663**	.800**	.804**	-.209*	.062	-.157	-.035
	Sig. (2-tailed)		<.001	<.001	<.001	.030	.528	.105	.719
	N	107	107	105	107	107	107	107	107
PE	Pearson r	.663**	1	.664**	.633**	-.142	.254**	-.019	-.058
	Sig. (2-tailed)	<.001		<.001	<.001	.140	.007	.844	.548
	N	107	110	108	110	110	110	110	110
AT	Pearson r	.800**	.664**	1	.775**	-.172	.078	-.058	-.038
	Sig. (2-tailed)	<.001	<.001		<.001	.075	.420	.551	.698
	N	105	108	108	108	108	108	108	108
BI	Pearson r	.804**	.633**	.775**	1	-.195*	-.038	-.138	-.038
	Sig. (2-tailed)	<.001	<.001	<.001		.041	.694	.151	.694
	N	107	110	108	110	110	110	110	110
Age	Pearson r	-.209*	-.142	-.172	-.195*	1	.130	.676**	.171
	Sig. (2-tailed)	.030	.140	.075	.041		.177	<.001	.075
	N	107	110	108	110	110	110	110	110
Gender	Pearson r	.062	.254**	.078	-.038	.130	1	.092	.105
	Sig. (2-tailed)	.528	.007	.420	.694	.177		.341	.273
	N	107	110	108	110	110	110	110	110
Work Experience	Pearson r	-.157	-.019	-.058	-.138	.676**	.092	1	.079
	Sig. (2-tailed)	.105	.844	.551	.151	<.001	.341		.415
	N	107	110	108	110	110	110	110	110
Position	Pearson r	-.035	-.058	-.038	-.038	.171	.105	.079	1
	Sig. (2-tailed)	.719	.548	.698	.694	.075	.273	.415	
	N	107	110	108	110	110	110	110	110

** . Correlation is significant at the 0.01 level (2-tailed).

* . Correlation is significant at the 0.05 level (2-tailed).

Table 10 shows that there are strong, positive, and linear correlations between perceived usefulness, perceived ease of use, attitude towards use and behavioural intention to use. This correlates well with research and the core idea behind TAM that an individual's acceptance of technology is shaped by their behavioural intention, which, in turn, is influenced by their perceived usefulness and perceived ease of use of the technology (Wu & Tsai, 2006). Behavioural intention refers to how inclined a user is to deliberately use or not use a system. Furthermore, when users perceive a technology as useful and easy to use, they develop a positive attitude towards it (Lee, et al. 2003). In simpler terms, when users see a technology as highly useful and easy to use, they tend to have positive attitudes, leading to an intention to use it (Lucas Jr & Spittler, 1997). In summary, the actual usage of a system is determined by the individual's behavioural intention, attitude, perceived usefulness, and perceived ease of use of the system (2004).

Furthermore, the impact of demographic variables (namely: gender, age, work experience and position) were assessed on the construct measures. Only gender produced a significant correlation with perceived ease of use, with males reporting greater ease of use than females. Age produced negative and significant correlations with perceived usefulness of BI and behavioural intention to use BI; with younger persons reporting higher scores on average in both perceived usefulness and behavioural intention to use BI. Work experience and position did not produce any significant correlation with the four main study variables.

Finally, I investigated which of the following variables - the perceived usefulness of BI, perceived ease of use of BI, attitude towards use of BI and age (the only demographic variable significantly correlated with behavioural intention) emerged as significant predictors of the

behavioural intention to use BI. Table 11 provides the ANOVA table generated in the regression analysis.

Table 11 ANOVA Table

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	69.042	4	17.261	57.498	<.001 ^b
	Residual	30.020	100	.300		
	Total	99.062	104			

a. Dependent Variable: BI

b. Predictors: (Constant), Age, PE, PU, AT

Table 11 revealed that there was at least one significant predictor of behavioural intention to use BI. Table 12 provides the coefficients table.

Table 12 Regression coefficients output

Model		Unstandardized Coefficients		Standardized Coefficients		Sig.	Collinearity Statistics	
		B	Std. Error	Beta	t		Tolerance	VIF
1	(Constant)	1.096	.444		2.465	.015		
	PU	.442	.092	.464	4.826	<.001	.328	3.049
	PE	.076	.070	.084	1.090	.278	.506	1.975
	AT	.348	.099	.340	3.515	<.001	.323	3.094
	Age	-.004	.006	-.040	-.709	.480	.953	1.050

a. Dependent Variable: BI; Durbin Watson statistic = 1.96

Before interpreting the correlation coefficients output, I assessed the main statistical assumptions of regression analysis. The first was to assess for autocorrelation in the regression

model's output. Since the Durbin Watson statistic was close to 2.0 implies zero autocorrelation (Field, 2000). The second assumption was to assess the severity of multicollinearity in the regression analysis. Since the Variance Inflation Factors were all below 5.0, I could safely assume that there was a tolerable and non-critical correlation of model predictors (James et al., 2013).

Table 12 revealed that behavioural intention to use BI was significantly predicted by the perceived usefulness of BI and attitude towards use but not perceived ease of use and age. As the perceived usefulness of BI and attitude towards BI increases, behavioural intention to use BI increases. Furthermore, these two variables explained 69.7% of the variability in the behavioural intention to use BI (the dependent variable).

In a study on Saudi Arabian organisations, Al-Gahtani (2004), suggested how an individual's perception of using Information Technology software IT is affected by several characteristics such as age, and gender. The analysis of the survey data yielded intriguing insights into the relationship between age, experience, gender, and the key constructs of perceived usefulness and behavioural intention to use BI within the University of Malta. Consistent with the literature by Venkatesh et al. (2003), the findings revealed a significant and negative correlation between age and behavioural intention to use BI. Younger individuals exhibited higher scores on both perceived usefulness and behavioural intention to use BI, affirming the notion that younger generations are more inclined to adopt and utilise technological innovations, such as BI tools. Interestingly, while Venkatesh et al. (2003) included experience as a significant determinant, our data did not demonstrate a significant correlation between experience and behavioural intention to use BI. This discrepancy suggests that other factors may play a more prominent role in influencing BI adoption within our institution. Furthermore,

it was observed a gender-related difference in perceived ease of use, with males reporting greater ease of use than females. Although gender did not directly impact behavioural intention to use BI, this finding underscores the importance of addressing gender-related usability concerns to facilitate seamless BI adoption across all user groups.

5.2 Conclusion

This chapter presented the findings that emerged from the data analysis of semi-structured interviews, which were conducted to explore the University's Faculty Managers, Officers in Charge, Deans, Directors, Heads of schools and HODs views and experience on the strengths and limitations of implementing a BI system at the University of Malta. The survey revealed that most participants were not aware of BI technologies and their benefits. Nonetheless, the findings revealed that the majority of participants will be willing to learn and make use of such a system.

The following chapter presents the conclusion drawn from this study, together with its strengths and limitations. It will additionally offer recommendations for future research, education and practice.

6 Conclusion and Recommendations

This chapter provides a comprehensive summary of the key findings derived from this study, along with practical and actionable recommendations to address the identified research objectives and contribute to the advancement of knowledge in the field.

6.1 Conclusion of the Study

The present study aimed to identify the strengths and limitations of implementing a BI system in a higher education setting. The research objectives were to identify ways in which a HEI can benefit from a BI system and whether the implementation of a BI system is effective for the analysis of data at a higher education level. The possibility of implementing a BI system within the University of Malta and the foreseen difficulties or challenges that can be encountered when implementing such a system were further objectives of the study.

The findings of this study shed light on employees' initial perception of BI and its potential benefits within the institution. Before being exposed to a dashboard display, employees demonstrated limited awareness of BI and its advantages. However, once presented with a visual representation of the system's capabilities, employees perceived its usefulness and expressed a willingness to utilise it if made available. This indicates the pivotal role of visualisations and practical demonstrations in bridging the knowledge gap and garnering support for BI adoption.

Moreover, the study revealed management's eagerness to leverage a BI system's potential benefits for the institution. Recognising the value of BI in enhancing decision-making processes, optimising operational performance, and supporting strategic vision, management displayed a keen interest in implementing the system. However, alongside their enthusiasm,

management also demonstrated awareness of the challenges and limitations associated with BI adoption.

The challenges highlighted by management included resistance to change, data quality issues, and resource constraints. This insight indicates the importance of addressing organisational and cultural factors when implementing a BI system. Strategies to overcome resistance and foster a culture of openness to technological advancements are crucial to ensure a smooth adoption process.

Data quality emerged as a vital consideration, emphasising the significance of reliable and accurate data for successful BI implementation. Ensuring data integrity through effective data governance and data management practices is essential to obtain meaningful insights from the BI system.

Resource constraints were also acknowledged by management, underscoring the need for proper resource allocation and investment in technical infrastructure and skilled personnel. Adequate resources are essential to support the implementation and maintenance of a BI system, ensuring its long-term sustainability and effectiveness.

In response to these challenges and limitations, management suggested several ways to adapt the institution. These suggestions included providing comprehensive training to employees, ensuring top management support, and fostering a learning organisational culture that embraces technological advancements. Additionally, adopting an incremental approach to BI implementation was deemed beneficial to manage complexities and facilitate smooth integration.

6.2 Strengths and Limitations

The utilisation of a mixed-methods approach, which combined qualitative interviews and quantitative surveys, played a pivotal role in providing a comprehensive understanding of the adoption and utilisation of BI in our institution. By integrating multiple data collection methods, the study achieved a triangulation of data, enhancing the credibility and reliability of the findings. This robust approach enabled the researchers to cross-validate information, leading to more confident and meaningful conclusions.

The inclusivity of perspectives further strengthened the study. By incorporating the viewpoints of both employees and management, the research ensured a holistic examination of BI adoption within the institution. This inclusivity allowed for a richer understanding of the challenges and benefits of BI from various stakeholders' perspectives. The insights gained from these diverse viewpoints enriched the study's depth and breadth, making it more relevant and applicable to real-world situations.

An additional strength lies in the researcher's insider knowledge as a staff member of the institution. This intimate familiarity with the organisation and its dynamics allowed the researcher to contextualise the data effectively and understand the nuances that may have otherwise been overlooked. The researcher's insider perspective facilitated a deeper interpretation of the findings, which could have been challenging for an external researcher lacking institutional knowledge.

One significant limitation of the study was the short and stringent time frame, which constrained the refinement of the interview guide. A more extended pilot phase could have allowed the researchers to fine-tune the interview questions, ensuring clarity and appropriateness in achieving the study objectives. Such piloting would have provided valuable

insights into the data collection process, especially for qualitative interviews, and could have led to more precise and relevant data.

The potential for bias arising from the researcher's dual role as a staff member at the University of Malta and a researcher cannot be overlooked. Respondents might have been hesitant to provide honest or critical responses, fearing repercussions or a lack of anonymity. This limitation could have influenced the accuracy and authenticity of the data obtained from self-completion questionnaires, reducing the study's overall reliability.

Additionally, the researcher's lack of experience in using mixed methods and interpreting qualitative data presented a potential limitation. Despite the attempt to mitigate this by providing detailed interview questions and ensuring a satisfactory questionnaire response rate, the impact of the researcher's inexperience on data analysis cannot be entirely ruled out. A more experienced researcher might have extracted additional insights and nuances from the data.

6.3 Recommendations

Based on the findings of this study on the implementation of a BI system in a higher education institution, several key recommendations emerge. These recommendations are illustrated in Table 13 below and are intended to guide decision-makers, stakeholders, and the institution in maximising the benefits of BI implementation and addressing the challenges identified during the research.

Table 13 Maximise BI implementation and challenges

Recommendations
Establish a Dedicated BI Office To ensure the successful implementation and sustainable use of BI, it is essential to establish a dedicated BI office within the institution. This office should be staffed with skilled personnel who can address technical issues, provide training to users, and offer strategic guidance for BI integration. A dedicated BI office will serve as a central hub for BI-related activities, fostering a data-driven culture and promoting efficient decision-making.
Provide Comprehensive Training Considering that employees demonstrated increased perceived usefulness and willingness to use BI, it is crucial to provide comprehensive training to all users. Training should cover not only technical aspects of the BI system but also emphasise the significance of evidence-based decision-making and data-driven practices. Investing in continuous training programs will empower users to harness the full potential of BI tools effectively.
Foster a Learning Organisational Culture Overcoming resistance to change and encouraging a culture that embraces technological advancements are critical factors in successful BI adoption. Institutions should foster a learning organisational culture that values continuous improvement and innovation. This can be achieved through top management support, open communication, and recognition of data-driven achievements.

Address Data Quality and Governance

Resource constraints were identified as a significant challenge in BI implementation. Institutions must allocate adequate resources, both financial and human, to support the BI initiative. Investing in the necessary technical infrastructure, software, and skilled personnel will facilitate the smooth integration and ongoing maintenance of the BI system.

Allocate Adequate Resources

Resource constraints were identified as a significant challenge in BI implementation. Institutions must allocate adequate resources, both financial and human, to support the BI initiative. Investing in the necessary technical infrastructure, software, and skilled personnel will facilitate the smooth integration and ongoing maintenance of the BI system.

Adopt an Incremental Approach

To manage the complexities of BI implementation effectively, institutions should adopt an incremental approach. Implementing BI in phases allows for iterative improvements and continuous adjustments based on user feedback. An incremental approach also minimises disruption and increases user acceptance during the adoption process.

Encourage Collaboration and Communication

Effective BI adoption requires collaboration and communication among different stakeholders. Departments and units within the institution should share data and insights obtained from the BI system to foster a culture of data-driven decision-making. Encouraging cross-functional collaboration can lead to comprehensive and well-informed decisions.

Monitor and Evaluate BI Usage

Continuous monitoring and evaluation of BI usage and outcomes are vital to measure the system's effectiveness and identify areas for improvement. Establishing key performance indicators (KPIs) related to BI adoption and utilisation will enable the institution to track progress and make data-based decisions on BI enhancements.

6.4 Further Research

The study's findings offer valuable implications for evidence-based practices in academia and decision-making, promoting a culture of data-driven insights. Future research should explore factors influencing intuitive decision-making among academics, understand the impact of BI adoption on academic performance, and investigate the role of data governance in BI success.

Further to the above an interesting area for further research would be Faculty Engagement where strategies to enhance faculty engagement with BI systems are explored. Understanding the barriers and enablers for faculty members in utilising BI for evidence-based decision-making will contribute to maximising its impact.

Another concept which is worth researching is the role of organisational culture and change management in BI adoption. Understanding how to foster a data-driven culture and effectively manage change can contribute to successful BI implementation.

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8 Appendices

Appendix I

Interview Guide

1. What are the main benefits or strengths that in your opinion the university can gain from implementing a business intelligence system?
2. How can the business intelligence system improve data management and analysis for the University of Malta?
3. How can the university's business intelligence system support decision-making and strategy development? Can you outline specific ways?
4. How will the business intelligence system support collaboration and communication among different departments or stakeholders within the university and strengthen synergies?
5. How will the university address any potential limitations or challenges that the business intelligence system can potentially present?
6. In what ways can the university ensure that the business intelligence system is being used to its full potential (what type of KPI's, feedback etc)?
7. How can the university ensure that the business intelligence system is flexible and adaptable to changing needs or requirements?
8. How can the university measure the success or impact of the business intelligence system over the short-term, medium-term or long-term process?
9. How can a BI system be used to inform quality improvement?

Appendix II

Participants Consent Form

- I hereby declare to have read the information about the nature of the study, my involvement and data management.
- I have had the opportunity to ask questions about the study and my questions have been satisfactorily answered.
- I declare that I am 18 years or older.
- I understand that should I have any further queries, I can contact [REDACTED]
[REDACTED]
- I agree to participate in this research study.

MARK ONLY IF APPLICABLE

- I agree to be identified in the research records.
- I agree to be identified in the research publications.

Participant's name (in block)

Researcher's name (in block)

Participant's signature

Researcher's signature

Date

Appendix III

Participants' Information Sheet

Dear Participant

My name is [REDACTED] and I am currently reading for an Executive Master's in Business Administration at the University of Malta. As part fulfilment of this course, I am conducting a research project entitled, "The strengths and limitations of implementing a Business Intelligence system in a higher education setting". The aim of the study is to explore the strengths and limitations that a higher education institution is likely to encounter when implementing a Business Intelligence system. Your participation in this study will help me gain a better understanding of the views related to the subject. Furthermore, all data collected from this research shall be used solely for the purpose of this study.

You are invited to participate in an interview exploring the implementation of a business intelligence system. The interview will take 45 minutes and will be held at a time and place most suitable for you. You are not obliged to answer all the questions and may withdraw from the study at any time without giving a reason. Furthermore, withdrawal from the study will not have any negative repercussions on you and any data collected will be destroyed. Unless you have any objections, this interview will be audio-taped. I can assure you that confidentiality will be maintained throughout the study and that your identity and personal information will not be revealed in any publications, reports or presentations arising from this research. All data collected will be pseudonymized meaning that the transcripts will be assigned codes and that this data will be stored securely and separately from any codes and personal data. This data may only be accessed by the researcher and participants will only be asked to share data that is necessary for the research. The academic supervisor and the examiners will have access to coded data only. The coded audio recordings, and transcripts will be stored on the researcher's personal laptop which is password protected and in an encrypted format. Audio recordings will not be replicated or stored/uploaded in any online servers. Any quotes used will be published under fictitious names to safeguard anonymity and confidentiality. Any material in hard-copy form will be placed in a locked cupboard.

Participation in this study is completely voluntary and you are free to accept or refuse to take part without giving a reason. A copy of the information sheet and consent form will be provided for future reference. As a participant, you have the right under the General Data Protection Regulation (GDPR) and national legislation that implements and further specified the relevant provisions of the said regulation, to access, rectify and where applicable ask for the data concerning you to be erased. All recordings will be destroyed once the study is completed.

Thank you for your time and consideration. Should you have any questions or concerns do not hesitate to contact me by email [REDACTED]

Your Sincerely



Researcher

Appendix IV

Interview Invite

Dear Dr Marmara

I hope this email finds you well.

My name is Carmen Farrugia, a member of staff at the Office of the Registrar and I am currently reading for an Executive Master of Business Administration at the University of Malta.

I am reaching out to you today to request an opportunity to interview you as part of my research project. The aim of my research project is to explore the strengths and limitations of implementing a business intelligence system in a higher education setting. In this regard, I believe that your expertise in quantitative data can provide valuable insight that could greatly contribute to my study.

I anticipate that the interview would take approximately 45 minutes and can be conducted at your convenience, either in person or via a preferred online platform such as Zoom or Skype. I understand that your schedule might be busy, and I deeply appreciate your time and consideration in assisting me with this research project.

Thank you for considering my request and I look forward to hearing from you soon.

Regards

Carmen

Business Intelligence within a Higher Education Setting

Survey Consent Form

My name is [REDACTED] and I am currently reading for an Executive Master's in Business Administration at the **University of Malta**.

I am currently conducting research that aims to investigate the strengths and limitations of implementing a business intelligence system in a higher education setting. The survey that you have been invited to complete forms part of this study. This will take you not more than 3 minutes to complete. Any data collected from this survey will be used solely for purposes of this study. There are no direct benefits or anticipated risks in taking part. Participation is entirely voluntary, i.e., you are free to accept or refuse to participate.

At no point will you be asked to provide your name or any other personal data that may lead to you being identified [1]. Furthermore, you may skip over any questions that you do not wish to answer.

If you wish to participate in this study, please click the button that says "I agree to participate". If not, please close the browser window (or click "I do not wish to participate").

Should you have any questions or concerns, you may contact myself or my supervisor on the details provided below.

Yours Sincerely,

[REDACTED]

Researcher

Conducting the study under the supervision of [REDACTED]

[1] If collecting data anonymously, the survey instrument used should NOT collect IP addresses, which may constitute personal data.

* Indicates required question

Appendix VI

Survey Invite

➔ **Announce** <announce@um.edu.mt>
to Announce ▾

Tue, 16 May, 08:46

Announcement

Questionnaire

Questionnaire: The Strengths and Limitations of Implementing a **Business Intelligence (BI) system in a Higher Education Setting**

My name is Carmen Farrugia, a member of staff at the Office of the Registrar, and I am currently reading for an Executive Master of **Business** Administration at the University of Malta.

This research aims to identify the strengths and limitations of implementing a **Business Intelligence** (BI) system in a higher education setting. Deans, Directors, Head of Departments, Faculty Managers and Officers in Charge are invited to kindly answer the questionnaire which can be accessed [here](#).

Participation is completely voluntary and one can withdraw at any point during the questionnaire. All responses will remain confidential and will be used solely for the purpose of this research. This questionnaire should take approximately 5 minutes to complete.

Should you have any questions, please do not hesitate to contact me at



Appendix VII

Survey

1. DECLARATION BY RESPONDENT

I hereby confirm that I am 18 years of age or older. I am aware that completing and submitting this anonymous questionnaire implies that I am participating voluntarily and with full informed consent on the conditions listed above.

Mark only one oval.

- I agree to participate
- I do not wish to participate

Section 1 of 2

2. 1. What gender do you identify with?

3. 2. What is your current age?

4. 3. How long have you been working at the University of Malta?

5. 4. What is your current position within the organisation?

6. 5. Do you make use of statistical data such as attrition and retention rates, class average, admission related data, etc during decision-making processes? If so, how frequently do you do so?

Mark only one oval.

- No *Skip to question 11*
- Every day
- Every week
- Every month
- Other

Business Intelligence

7. 6. From a scale of 1 to 6 how easy is it to obtain the data you need? (1 being very easy and 6 being very difficult)

Mark only one oval.

- 1
- 2
- 3
- 4
- 5
- 6

8. 7. How accurate and up-to-date is the data at hand?

9. 8. How long does it normally take to obtain the data you need?

Mark only one oval.

- 1 day
- 2 days
- 1 week
- 1 month

10. 9. For how long would the data that you request (such as attrition and retention rates) be valid for?

Mark only one oval.

- 1 week
- 1 month
- 1 year

Business Intelligence

11. 10. Are you aware of the benefits that the potential use of Business Intelligence (BI) may bring to the University?

Mark only one oval.

- Yes *Skip to question 12*
- No *Skip to section 5 (Business Intelligence)*

Business

Intelligence is a framework used in decision-making. It combines architecture, databases (or data warehouse), analytical tools and applications, intending to close the gap between the present and the expected performance of an organisation as indicated in its mission, objectives and goals, together with the strategy to achieve them. BI helps extract data from different sources, combine them and present a single version of the truth. It provides timely and accurate data in the best possible formats whilst offering the possibility to have a detailed analysis of the available data. Furthermore, this technology helps in finding a pattern and predicts outcomes based on historical performance. Finally, business intelligence turns data and awareness into insight and action.



12. On a scale of 1 to 6 (with 1 being strongly disagreeing and 6 being strongly agreeing), how would you react to this statement: **'BI would provide valuable service to me'**

Mark only one oval.

- 1
 2
 3
 4
 5
 6

13. On a scale of 1 to 6 (with 1 being strongly disagreeing and 6 being strongly agreeing), how would you react to this statement: **' Using BI would enable me to better understand students'**

Mark only one oval.

- 1
 2
 3
 4
 5
 6

14. On a scale of 1 to 6 (with 1 being strongly disagreeing and 6 being strongly agreeing), how would you react to this statement: **'Learning how to use BI would be easy for me'**

Mark only one oval.

- 1
 2
 3
 4
 5
 6

15. On a scale of 1 to 6 (with 1 being strongly disagreeing and 6 being strongly agreeing), how would you react to this statement: **'Using BI is not a good idea'**

Mark only one oval.

- 1
 2
 3
 4
 5
 6

16. On a scale of 1 to 6 (with 1 being strongly disagreeing and 6 being strongly agreeing), how would you react to this statement: **'Using BI would enhance the quality of my work'**

Mark only one oval.

- 1
 2
 3
 4
 5
 6

17. On a scale of 1 to 6 (with 1 being strongly disagreeing and 6 being strongly agreeing), how would you react to this statement: **'Using BI would not make it easier to do my job'**

Mark only one oval.

- 1
 2
 3
 4
 5
 6

18. On a scale of 1 to 6 (with 1 being strongly disagreeing and 6 being strongly agreeing), how would you react to this statement: **'I do not find BI useful in my job'**

Mark only one oval.

- 1
 2
 3
 4
 5
 6

19. On a scale of 1 to 6 (with 1 being strongly disagreeing and 6 being strongly agreeing), how would you react to this statement: **'I would find it easy to acquire targeted information by using BI'**

Mark only one oval.

- 1
 2
 3
 4
 5
 6

20. On a scale of 1 to 6 (with 1 being strongly disagreeing and 6 being strongly agreeing), how would you react to this statement: **'I would find BI difficult to use'**

Mark only one oval.

- 1
 2
 3
 4
 5
 6

21. On a scale of 1 to 6 (with 1 being strongly disagreeing and 6 being strongly agreeing), how would you react to this statement: **'Using BI would enhance my effectiveness in my job'**

Mark only one oval.

- 1
 2
 3
 4
 5
 6

22. On a scale of 1 to 6 (with 1 being strongly disagreeing and 6 being strongly agreeing), how would you react to this statement: **'Using BI is a good process'**

Mark only one oval.

1

2

3

4

5

6

23. On a scale of 1 to 6 (with 1 being strongly disagreeing and 6 being strongly agreeing), how would you react to this statement: **'I do not intend to use the services offered by BI if available'**

Mark only one oval.

1

2

3

4

5

6

24. On a scale of 1 to 6 (with 1 being strongly disagreeing and 6 being strongly agreeing), how would you react to this statement: **' Using BI would be beneficial to my work'**

Mark only one oval.

- 1
 2
 3
 4
 5
 6

25. On a scale of 1 to 6 (with 1 being strongly disagreeing and 6 being strongly agreeing), how would you react to this statement: **'I do not intend to use BI to acquire target information once available'**

Mark only one oval.

- 1
 2
 3
 4
 5
 6

26. On a scale of 1 to 6 (with 1 being strongly disagreeing and 6 being strongly agreeing), how would you react to this statement: **'I intend to use BI when it becomes available'**

Mark only one oval.

- 1
 2
 3
 4
 5
 6

27. On a scale of 1 to 6 (with 1 being strongly disagreeing and 6 being strongly agreeing), how would you react to this statement: **'As much as possible, I will use BI, once available, to help make decisions'**

Mark only one oval.

- 1
 2
 3
 4
 5
 6

Thank you for your time