Commercialising Academic Research

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Abstract

Universities are moving beyond their traditional roles of education and knowledge generation, and have started engaging in the commercialisation of academic research. The commercialisation of research findings and academic innovation is hindered by a number of limitations which have not been investigated locally. Thus, the present study aimed to identify how the current procedures adopted by the University of Malta in the commercialisation of research and innovation can be amended to make the process more seamless. This was achieved through the identification of the facilitators and barriers in the commercialisation of research and innovation at the University of Malta, and to make recommendations of how commercialisation can be facilitated. A quantitative cross-sectional methodological approach was adopted. Data was collected using online questionnaires which were distributed to academics within the Faculty of Engineering at the University of Malta. A total of 17 academics responded to this survey. The findings suggest that lack of funding is the main barrier hindering the commercialisation of academic research. This barrier is heightened by the: unwillingness of the investing companies to cover the full costs of commercialisation; and, the inability of UM to secure these funds despite their availability. Other barriers include organisational culture which still favours publications over commercialisation, lack of institutional support, lack of human resources and inadequate marketing strategies. Moreover, the facilitators suggested by the findings are organisational support, industry collaborations, and possessing the necessary commercialisation skills. These facilitators give academics engaging in commercialisation activity the necessary tools, support,

knowledge and funding to increase commercialisation success. Recommendations based on these results included centralisation and an increase in human resources of RSSD, PSO, RIDT and CR&KTO; rewarding commercialisation, government support in funding commercialisation of academic research and, education and training to UM staff and students.

Key words: *commercialisation; academic research; innovation; knowledge transfer; entrepreneurship; barriers; facilitators.*

To my late uncle Paul and uncle Leonard

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Abbreviations

CEBI	Centre for Entrepreneurship and Business Incubation
CR&KTO	Corporate Research and Knowledge Transfer Office
CVP	Commercialisation Voucher Programme
EC	European Commission
EIS	European Innovation Scoreboard
EU	European Union
FREC	Faculty Research Ethics Committee
GDPR	General Data Protection Regulation
IP	Intellectual Property
IPR	Intellectual Property Rights
KTO	Knowledge Transfer Office
MCST	Malta Council for Science and Technology
MUIP	Malta University Innovation Portfolio
PSO	Project Support Office
R&D	Research and Development
RIDT	Research Innovation and Development Trust
ROI	Return on Investment
RSO	Research Support Officer
RSSD	Research Support Services Directorate
TDP	Technology Development Programme
TT	Technology Transfer

TTO	Technology Transfer Office
UM	University of Malta
US	United States

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Chapter 1: Introduction

The concept of gaining a competitive advantage has become very important in today's fast-paced and competitive world economic environment. Organisations are facing difficult challenges to obtain and retain a long lasting sustainable competitive advantage. Consequently, they must continually seek new value-creating strategic methods to maintain their position in the marketplace. In strategic management it is argued that such an advantage can be gained through the management of the organisation's owned resources, one of which is its people. Due to the creative skills they possess, employees have been recognised as a vital resource for an organisation's innovative vision. In fact, organisations are continuously seeking to employ talented individuals (Hitt, et al., 2011, p. 72). This implies that innovation has become a key priority for the success of organisations (Galpin, 2022).

In his work, Galpin (2022) draws a distinction between creativity and innovation. On the one hand, he defines creativity as the establishment of a new idea that can possibly be advantageous. Its implementation is considered to be an innovation. *De facto*, innovation can be defined as being:

> "… the implementation of a new or significantly improved product (good or service), or process, a new marketing method, or a new organisational method in business practices, workplace organisation or external relations." (OECD, 2005, para. 146)

Based on this definition, it can be argued that the innovation process is intertwined in the new-product development process.

1.1 New-Product Development

Further to the definition of innovation, Armstrong and Kotler (2005) argue that the terminology of 'new product' does not only entail the creation of a novel product. They state that it also gets to include product enhancements and adaptations, as well as the establishment of new brands; all of which emanate from research undertaken by the organisation; or through the acquisition of another firm, a patent or a license.

The success of these novel products is dependent on a solid plan that incorporates a systematic process for new-product development (Armstrong & Kotler, 2005). By having the appropriate required resources to succeed in this development process, organisations will be able to produce a customer-oriented product that will bring potential future benefits to its doorstep (Sorli & Stokic, 2009).

Table 1 below summarises the new-product development process as highlighted by Armstrong and Kotler (2005).

Table 1. New-Product Development Process

(adapted from Armstrong & Kotler, 2005)

Stage	Definition
Idea Generation	Effectively seeking new-product ideas by exploiting internal and external sources.
Idea Screening	Assessing the feasibility of several ideas while meticulously identifying possible good ideas and discarding bad ones.
Concept Developing and testing	Creating detailed and customer-oriented product concepts for the selected idea and testing them for reaction with a selected group of customers. Through testing the company can identify which concept appeals best to the customer before it is turned into an actual product.
Marketing Strategy Development	Draft a marketing strategy to introduce the product concept to the market. The strategy should include characteristics such as the target market, positioning strategy, distribution strategy, pricing strategy and budgeting for both the short- and long- term.
Business Analysis	Evaluate whether the product concept provides business appeal to the organisation by analysing the forecasted sales, costs and expected profitability against the organisation's objectives.

Stage	Definition
Product Development	The organisation invests in building a successful prototype of the product concept to ensure that it can be turned into a functionable physical product that attracts and provides value to the customer within a production timeframe and the stipulated budget costs. The prototype is also tested with a limited number of customers for their feedback.
Test Marketing	Testing the product and the marketing strategy into a more representative market scenario before fully launching in the market. The amount of testing required varies between types of products and its costs are dependent on the management's confidence level in this product.
Commercialisation	Taking the final decisions and officially launching the new product to the market.

This process occurs during the lead time of the product life cycle (Sorli & Stokic, 2009). This can be defined as the period between the idea generation and the product launch, and thus, the period that leads to the product's market life.

1.2 The EU's stance on innovation

Based on the European Innovation Scoreboard (EIS) published in September 2022, the EU has enhanced its global innovation position, making it an appealing option for innovators (Gabriel & Breton, 2022). However, divergences between its Member States still exist. To overcome this issue, the European Commission (EC) aims to increase its private and public investments in research and development by allocating funds at a national and regional level. Its focus remains in setting agendas and policies that provide the right contexts that promote innovation and its commercialisation. These agendas and policies provide the correct tools that will unite European innovative players; entice and withhold talented individuals in Europe; and better the European policy-making strategy.

The European Union (EU) believes that innovative activities provide solutions to problems such as those related to socio-economical, geopolitical and environmental challenges (Gabriel & Breton, 2022).

The EU invests in Small and Medium-sized Enterprises as they are considered pivotal in consolidating the strength of the European Industry through innovation. Consequently, the Single Market provides great opportunities for innovation and remains successful in Europe (Gabriel & Breton, 2022).

1.3 The role of universities in the innovation process

After considering the importance of research and innovation in today's competitive environment and the European Commission's (EC) stance on innovation, we must now consider the supporting role undertaken by universities.

The depth of knowledge held by universities has become essential for today's knowledge-based economy (Binkauskas, 2012). This is because university research has been associated with societal, economic and wealth generating benefits (Irani, et al., 2018). Traditionally, the function of universities was related to education and science (Binkauskas, 2012). As such, one can argue that knowledge transfer to the industry was achieved through the employment of university alumni.

In recent years, many universities across several countries have engaged in entrepreneurship, thus introducing the concept of entrepreneurial universities. This concept presented several new ways of how knowledge can be transferred to the industry (Rothaermel, et al., 2007). Consequently, Louis at al. (1989) presented 5 ways on how this can be achieved. These are, through:

a. externally funded research projects;
b. enhancing the relationship between the university and the industry;
c. offering consultation services;
d. establishing spin-offs companies; and
e. licensing or patenting of research.

Even though the concept of entrepreneurial universities has been highly challenged, one cannot underestimate the benefits it might bring (Powers, 2003). In fact, the latter have been seen as a vital force which motivates innovation and creativity leading to economic growth (Bogovin & Vidishcheva, 2021).

1.4 The University of Malta

The University of Malta (UM) is a tertiary education institution located across the Maltese islands and mainly accessible through its four main campuses; and, the Gian Frangisk Abela Junior College campus (Univerity of Malta, n.d.). It is composed of 14 Faculties, 18 Institutes, and 3 schools (University of Malta, n.d.).

As an institution, it is established and directed as per Chapter 327 Education Act of the Laws of Malta, Part VII (1991). The latter Legislative Chapter establishes the parameters of the functions undertaken by the university. Apart from education, the law entrusts the university with research, advancements and knowledge transfer. The Article also establishes the university's governing bodies which administer and manage such functions. The responsibilities of these governing bodies are summarised in Table 2.

Table 2. Roles and Responsibilities of the governing bodies at the University of Malta (University of Malta, n.d.; Education Act - Chapter 327 of the Laws of Malta, Part VII, 1991)

Governing Body	Roles and Responsibilities
Council	Acts as the supreme governing body that governs the University's administration and appointment of academic and administrative staff members. It is also responsible to oversee and amend the University's Statute.
Senate	Through Regulations, the Senate administers academic affairs such as research and studies.
Faculty Boards	By establishing Bye-laws, Faculty Boards deal with the administration of educational affairs of university students, studies and research conducted by the respective faculty.

As an education institution, the university offers its students courses that vary from post-secondary education, undergraduate bachelor's degrees and postgraduate master's degrees and doctorates (Univerity of Malta, n.d.).

1.4.1 The University of Malta's Strategic Plan 2020 – 2025

Like any other organisation the UM has its own strategic plan to ensure that it continues to deliver up to its vision and mission. Apart from being one of the leading higher education institutions in Malta, the university's vision also encompasses around its aim of delivering knowledge for the betterment of the region, country, society and the world (University of Malta, n.d.). In fact, its current strategic plan for the period of 2020 to 2025 focuses on aspect such as education, research and the transfer of knowledge; impacts on the nation, society, enterprise and industry.

1.4.1.1 Incorporating research, innovation, knowledge transfer and commercialisation in the University of Malta's strategic plan 2020-2025

Placing research and knowledge transfer at the heart of its strategy demonstrates the university's stance towards innovation and commercialisation. Through: (a) investing in research mechanisms; (b) establishing and supporting its research infrastructure; (c) tying the relationship with the industry (even on an educational basis); (d) attracting funding opportunities; and, (e) investing in its personnel even in their early stages as researchers; the university aims at consolidating its role as a knowledge transfer entity (University of Malta, n.d.). In turn, this will stimulate an innovation-oriented environment that will exploit commercialisation opportunities, in terms of intellectual property and spin-outs, and invite commercial partnerships. This environment is further supported through the offering of incentives to academics to declare and commercialise intellectual property, while annually rewarding its top innovators and recognising their

career progression opportunities. Additionally, amongst other measures it plans to better its research outreach; provide academic resources to its research support officers; and, encourage the state to propose studentships.

1.4.2 The University of Malta's research infrastructure towards supporting research, innovation and commercialisation

To support those undertaking academic research and its commercialisation, the UM established several research support facilities and policies. Amongst these several touchpoints one can find the Research Support Services Directorate (RSSD); Project Support Office (PSO); Corporate Research and Knowledge Transfer Office (CR&KTO); and, Research Innovation and Development Trust (RIDT) (University of Malta, n.d.). All these facilities operate in line with Maltese Laws and EU regulations. A summary about the functions of each of the latter is discussed in Table 3.

Table 3. Role of Research Support Facilities within the UM

Support Facility	Function
Research Support Service Directorate (RSSD)	RSSD embrace the mission of offering support to all university units carrying research in terms of obtaining funds access and writing their proposal. (University of Malta, n.d.)
Project Support Office (PSO)	As an extension of the Finance office, PSO aims at offering guidance and support to resident

	academics participating in externally-funded research projects during project proposal stage and its execution. Its services relate to project administration, monitoring of financials and overseeing project-related personnel. PSO also works in collaboration with the CR&KTO. (University of Malta, n.d.)
Corporate Research and Knowledge Transfer Office (CR&KTO)	The services offered by this office relate to assisting the commercialisation process of knowledge elicited from research; management of Intellectual Property owned by the university; and supporting academic collaborations with the industry in terms of research and consultations. (University of Malta, n.d.)
Research Innovation and Development Trust (RIDT)	Founded by the Government of Malta to obtain funding from private and corporate entities with the aim of exploiting university research and its commercialisation. (The University of Malta - Research, Innovation & Development Trust, n.d.)

1.5 The purpose of the present research

1.5.1 Identifying the research problem

In view of the new-product development theoretical framework; the importance of research and innovation in today's economy; the extensive need for new knowledge; the function of universities - with special focus on the UM; one simply can argue that universities play an important function in this context.

As organisations exploit the opportunities provided by the university's knowledge transfer to develop marketable products and services for their customers; university research finds itself being regularised through policies and regulations (Powers, 2003; University of Malta, 2014; Industrial Property Registrations Director within the Commerce Department, 2022). However, these are not the only limitations that hinder the commercialisation of research findings and academic innovations (Irani, et al., 2018). Presently, the evaluation and understanding of the facilitators and barriers of commercialising academic research has not been undertaken in the local scenario. Consequently, a lacuna in this context exists.

1.5.2 The purpose of the study

The purpose of this research study is to analyse the current procedures adopted by one of Malta's leading universities – specifically the UM – in terms of commercialising

research and innovation; and, to make recommendations on how these processes can be more seamless.

1.5.3 Relevance of the research

This study is relevant to research academics – specifically academics working at the UM – who are aiming at commercialising their findings. Additionally, the results of this study will help the UM determine the success of its current strategy while identifying possible ways of how it can be improved. Policy makers and stakeholders may also find relevance in this study.

1.6 Outline of the Dissertation

This chapter has provided an introduction highlighting the need for this study to be conducted. Chapter 2 will give an overview of the present available literature and is followed by the methods adopted in conducting this research. Presentation of the results and their analysis will be provided in the subsequent chapter. Chapter 5 will discuss the findings of this research in light of the available literature and limitations of this study. This is followed by the concluding chapter which will highlight the recommendations for practice and training, and future research.

Chapter 2: Literature Review

2.1 Introduction

Universities are moving beyond their traditional roles of education and knowledge generation, and have started engaging in the commercialisation of academic research (Binkauskas, 2012). Different definitions of commercialisation of academic research have been adopted in the literature which range from broad definitions to narrow definitions which only include university spin-offs and academic start-up companies (Davey, et al., 2015; Klofsten & Jones-Evans, 2000; Perkmann, et al., 2013). In this study, a broad definition of commercialisation is used to encompass all activities which attribute to the commercialisation of knowledge transfer which originate from academic institutions (Klofsten & Jones-Evans, 2000; Leišytė & Sigl, 2018). Commercialising academic research is key for universities, not just because of its associated income, but also due to their obligation to share their research findings to improve society's wellbeing (Fini, et al., 2018; Mustar, et al., 2006; Mustar, et al., 2008; Parker & Zilberman, 1993; Scholten & van der Duin, 2015). Furthermore, it enhances universities' interaction with the industry which may lead to future research collaborations which are essential for improving career progression for both staff and students (Knowledge Commercialisation Australasia, n.d.; D'Este & Perkmann, 2011).

The purpose of this chapter analyses the present literature pertaining to: the demographics of academics engaging in the commercialisation of academic research;

the process of commercialising academic research; the marketing perspective of the commercialisation process and its challenges; and, the barriers and facilitators associated with commercialising academic research. This chapter will include, the identification of the main stakeholders; a detailed analysis of the current UM commercialisation-related procedures; and the identification of the current available local/foreign tools that have been designed as facilitators for the commercialisation of academic research. This literature review will inform the subsequent chapters of this study.

2.2 The Demographics of academics engaging in the commercialisation of academic research

Demographic trends amongst academics who engage in academic commercialisation have been noted in the literature. Being male has be positively associated with engaging in commercialisation of academic research (Azoulay, et al., 2007; Bercovitz & Feldman, 2008; Ding, et al., 2006; Haeussler & Colyvas, 2011; Whittington, 2009). In fact, Azoulay et al. (2007) concluded that male researchers are 49% more likely to patent for the first time compared to their female counterparts. Nevertheless, research also shows that women are equally active in other commercialisation activities such as consultancy, which might be due to their less binding nature (Haeussler & Colyvas, 2011).

The influence of age on the commercialisation of academic research is less clear (Perkmann, et al., 2013). More established academics are more likely to engage in the commercialisation of academic research due to their experience and connections made

through previous students and colleagues (Casper & Murray, 2005; Haeussler & Colyvas, 2011; Stuart & Ding, 2006). Conversely, other studies have suggested that younger academics may engage in commercialisation because they were nurtured in a culture in which commercialisation had already become established (Bercovitz & Feldman, 2008). Moreover, the legitimising of commercialisation in recent years makes it more likely for post-doctoral fellows to be included as co-inventors in commercialisation arising from their advisors' research (Azoulay, et al., 2007).

2.3 The Process of Commercialising Academic Research

The process of university technology transfer (TT) achieved through commercialisation is considered to be a complex process that involves numerous phases and tasks (Friedman & Silberman, 2003; Parker & Zilberman, 1993). Parker and Zilberman (1993) identify that the TT process engages in several tasks, being: (a) seeking patentable ideas; (b) receiving and assessing invention disclousures; (c) conducting groundwork analyses of the market; (d) writing and submitting applications for patenting; (d) obtaining patent and marketing licenses, and sustaining them; (e) collecting and distributing income eminating from royalties; and (f) contracts monitoring. All of these tasks are reflected in the process steps identified by Friedman and Silberman (2003), summerised in Figure 1.

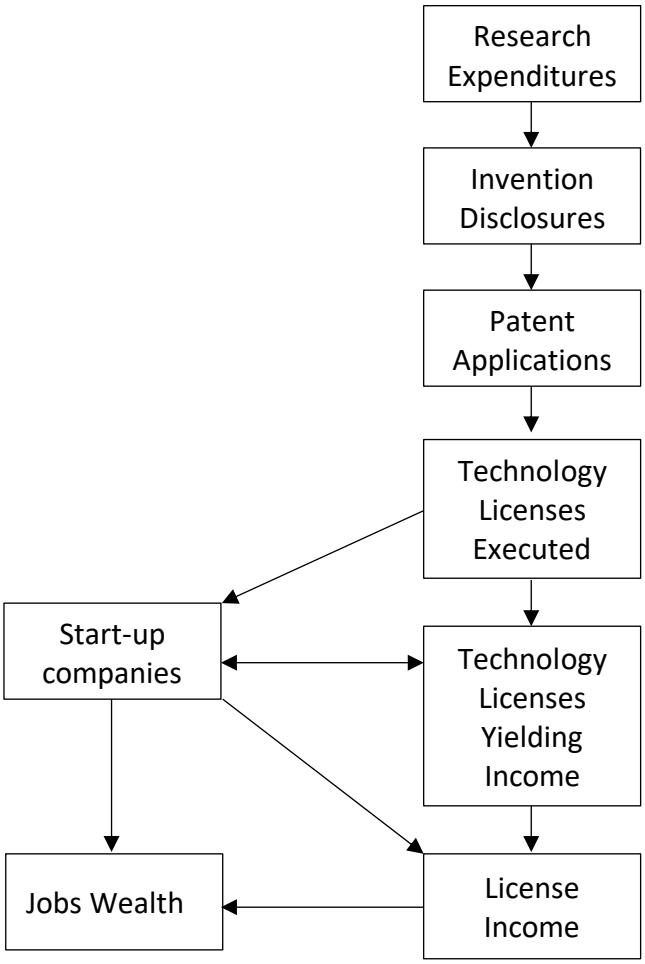

Figure 1. University Technology Transfer Process

(adapted from Friedman and Silberman, 2003)

Friedman and Silberman (2003) explain that with the enactment of the Bayh-Dole Act in the United States, all university research that recognises or discovers a commercial potential of an invention or new technology needs to be disclosed to the respective university's Technology/Knowledge Transfer Office (TTO or KTO). Upon disclosure, the TTO holds the responsibility of assessing the invention or new technology for patenting possibilities. Once the patent is applied for and awarded, the university will hold the intellectual property rights (IPR) of the invention. Consequently, licensing of inventions to other entities with commercialisation potential is considered. However, licensing may

also be considered without a patent. When the licensing agreement is secured and commercialisation is engaged, the entity will start to generate and transfer licensing income. However, nowadays, universities may also be interested in receiving licensing income in the form of equity positions. Realisation of royalties' income will be achieved after the patenting technology has been commercialised for several years.

The UM adopts a similar process to that highlighted by Friedman and Silberman (2003). Being the responsible unit for the UM's research commercialisation, CR&KTO highlights the knowledge transfer process as follows (University of Malta, n.d.):

Step 1 - Disclosure and Due Diligence: During this stage any invention, material, data, software or expertise (hereafter referred to as invention) with commercial potential is discussed with and disclosed to the CR&KTO (University of Malta, n.d.). After submitting a request through their website or email, an initial meeting is set between the individual(s) and CR&KTO. During this meeting an identification of the potential opportunities and the steps of the commercialisation process are discussed. Individuals disclosing the information of the invention are then required to fill in the invention disclosure forms which are then forwarded to and registered by CR&KTO. The unit will determine the intellectual property (IP) ownership status. In case of joint IP ownership including third parties, the unit will then negotiate terms respectively. The final step is then to complete and forward the revenue distribution form.

Step 2: Protecting the IP: Following a discussion of the IP protection strategies, the unit will check patenting possibilities for the invention (University of Malta, n.d.). Alternative

strategies such as copyright, trademarks, trade secret/confidentiality are considered in case the invention does not hold patenting possibilities. However, should patenting be eligible, the unit will discuss the patenting strategy with the individual(s). A patent application is drafted together with the patent attorney. Prior the application's filing, the draft is reviewed with the individual(s) and the patenting strategy is selected. The patent attorney is then informed and instructed to proceed with the submission of the application in accordance with the selected strategy. Its processing is monitored by the CR&KTO unit.

Step 3: Assessment: This stage involves assessing the invention's commercial potential; whereby any feasible applications, possible markets, competition, the research team and the required time and costs for the development are identified and considered (University of Malta, n.d.). Should the invention not hold commercial potential, alternative strategies are identified. An assessment of the commercialisation readiness of the invention and checking for its further de-risking is carried out. If de-risking is required, the unit will advise on possible measure that might include R&D funding, trials and tests. Once de-risking is affected, discussions of commercialisation options such as licensing or spin-outs are discussed.

Step 4: Execution: A commercialisation plan is drawn along with a marketing plan (University of Malta, n.d.). In the case of spin-offs, a business plan is assembled, the management team is selected and options for potential investments are considered. When finalised, the spin-off is negotiated and formed with guidance from the Malta University Innovation Portfolio (MUIP). Conversely, should licensing be the selected

commercialisation option, discussions and negotiations with interested parties are carried out. When the candidate is selected a licensing agreement is signed.

2.3.1 The marketing perspective of the commercialisation process

The knowledge transfer process adopted by the UM, highlights that the commercialisation execution step incorporates the drawing up on a marketing plan (University of Malta, n.d.). This section provides a detailed analysis of the commercialisation process from a marketing perspective.

Aarikka-Stenroos and Lehtimäki (2014) adopt a marketing view to provide differentiated definitions of commercialisation. They describe it as the instant when the innovation is disseminated and introduced to the market. They argue that it is a concurrent and mutually embedded process, which complements other activities of the innovation process, with the intent of marketing the innovation and translating it into a profitable product/service that is delivered to the market. As such, commercialisation deals with setting a strategic marketing plan for both the innovation's introduction to the market and its product/service lifetime (Chiesa & Franttini, 2011). However, this process might become very complex and challenging (Aarikka-Stenroos & Lehtimäki , 2014).

Being the last step of the New Product Development process, commercialisation is often considered to be a crucial, but most likely the least-managed step of this process (Armstrong & Kotler, 2005; Chiesa & Franttini, 2011). In fact, empirical research shows that most of the commercialised new products entering the market have a high failure

rate (Chiesa & Franttini, 2011). Followed by the debate of why commercialisations fail, Schilling (2005, as cited by Chiesa & Franttini, 2011) denotes that the performance and success of newly commercialised products is highly affected by the adopted commercialisation approaches. Such approaches must not to be viewed in isolation during this stage only; but rather in conjuction with other activities of the innovation process (Aarikka-Stenroos & Lehtimäki , 2014).

In their attempt to study the commercialisation process of radical innovations, Aarikka-Stenroos and Lehtimäki were able to identify common steps undertaken by six Finnish firms in their attempts of commercialising different radical innovative products (2014). Through their longitudinal case-study observations and cross-case analysis techniques, they were able to draw-up a dynamic commercialisation process model, summerised in Figure 2.

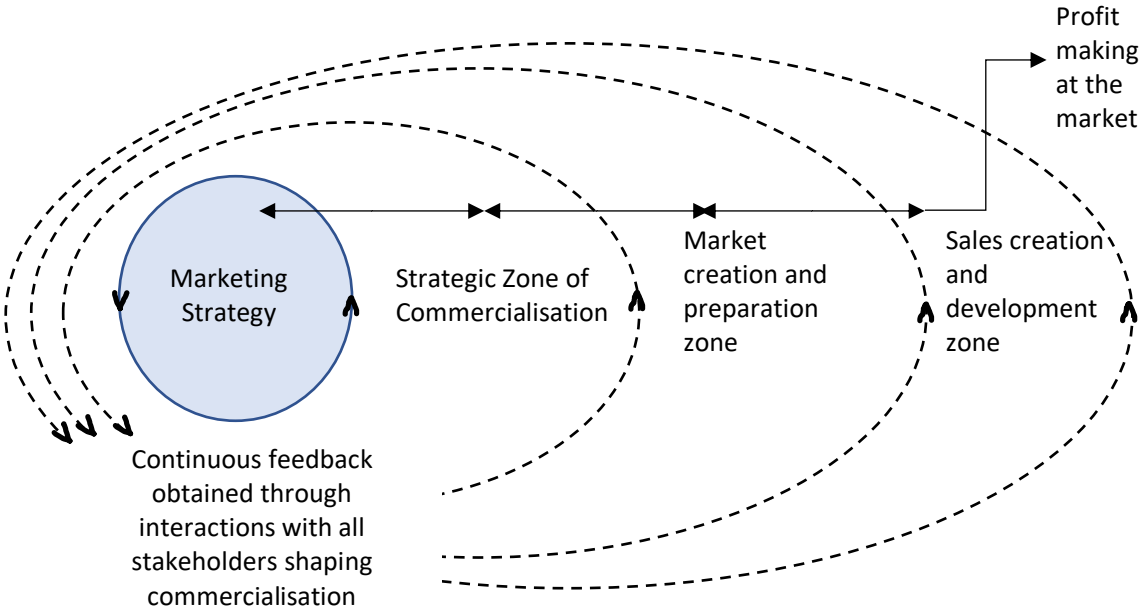

Figure 2. Dynamic Commercialisation Process Model

(adapted from Aarikka-Stenroos & Lehtimäki, 2014)

The marketing strategy affects and drives the marketing implementation towards commercialisation (Aarikka-Stenroos & Lehtimäki , 2014). As the commercialisation process moves between zones, the interactions with the various stakeholders involved in shaping commercialisation capture relevant feedback that ensure its success. Consequently, the commercialisation process is characterised by continuously reconsidering and adapting the marketing strategy, the process's activities and relevant decisions. Such activities and decisions vary across each zone and are highlighted in Table 4. Each of these activities and decisions is tested and revised until it proves to be successful. This line of thought is supported by Moore (1991), whereby he argues that a marketing strategy needs to be adjusted over the lifecycle of the product, to first meet the requirements of the early market and later on the requirements of the mainstream market.

Table 4. Zones, definitions and activities

(Aarikka-Stenroos & Lehtimäki , 2014)

Zone	Aims	Activities and Decisions
Strategic	Developing a successful strategy for commercialisation	Stakeholders' identification; identifying the benefits of the innovative product from a consumer's perspective; developing knowledge about the market

Zone	Aims	Activities and Decisions
Market creation and preparation	Create and modifying the target market's behaviour to react favourably towards innovation	Building trustworthiness; Connect and initiate relationships with stakeholders; Communicate and demonstrate the benefits of the commercialised product/service; Build awareness; Educate the market
Sales creation and development	Generation and improvement of sales	Create, increase and gradually grow sales by striking first deals with stakeholders; Obtain customer references; Organise stakeholders to contribute towards commercialisation

2.3.1.1 Marketing-related challenges in the commercialisation process

The commercialisation process does not come without challenges. According to the study conducted by Aarikka-Stenroos and Lehtimäki (2014), the process in itself faces a variety of challenges (summarised in Table 5) which are encountered across the three different zones. Such challenges arise from: a. technical incoherence in the commercialising entity and the market; b. incoherent customer needs and behaviours; and c. marketing incoherence in ecosystems and product categorisations. They argue that even though the order of such challenges is not standardised between firms, the settlement of primary ones need to be tackled before overcoming subsequent challenges.

Table 5. Challenges identification per zone and their relationships

(Aarikka-Stenroos & Lehtimäki , 2014)

Zone	No	Challenge	Definition and Ideal Solutions	Relationship with other challenges
Strategic Zone of Commercialisation	1	Selecting the appropriate strategy under uncertain conditions	The challenge of re-adapting the strategy or adopting a resilient stance to its current strategy after the first sales encounters. Involvement of stakeholders from an early stage can help in overcoming this barrier.	Base challenge; Informant to Challenges 2, 4, and 6.
	2	Understanding the perspective of the customer	Understanding what drives customer value by adopting a positive stance towards interaction, transparency and ability to adapt according to the customers suggestions. Furthermore, this involves identifying what marketing efforts are required to make a valuable proposition to the customer.	Subsequent to challenge 1; Informant to Challenges 3, 5, and 6.

Zone	No	Challenge	Definition and Ideal Solutions	Relationship with other challenges
Market Creation and Preparation Zone	3	Building credibility for the innovative product and the commercialising entity	The novelty of the product/service (and sometimes even the entity) is characterised with various views and opinions that create different perceptions of credibility. This challenge can be overcome through partnering, networking, providing scientific evidence and ability for testing, awards, obtaining customer referrals, educating the customer or using established brands.	Subsequent to challenge 2; In parallel with challenge 4; informant to challenges 5 and 6.
	4	Obtaining the support of the stakeholders and network	The challenge of entering or creating a new network of stakeholders and acquiring their support through formal or informal relationships or partnering. Building a good relationship with them might benefit the commercialising company in several ways such as: offer help to cope with	Subsequent to challenge 1; in parallel with challenge 3 and 5; Informant to challenges 3, 5 and 6.

Zone	No	Challenge	Definition and Ideal Solutions	Relationship with other challenges
Market Creation and Preparation Zone			legislations; provide market information; adapting a different viewpoint towards alternative solutions; support through complementary offerings; and educating the customers and thus help in creating a market for the innovative product.	
	5	Overcoming the barriers and facilitating innovation adoption	In case of radical innovative products, innovation adaption requires changes in the stakeholders (especially the customers) attitudes, behaviours or processes. After identifying such barriers, the commercialising entity can overcome them through building awareness, benefits identification, providing instructions and education amongst other factors.	Subsequent to Challenge 2 and 3; In parallel with challenge 4; Informant to challenge 6.

Zone	No	Challenge	Definition and Ideal Solutions	Relationship with other challenges
Sales creation and development zone	6	Generating sales at the early majority market	The challenge related to creating sales at the early majority market and accelerating to the majority market might require revisiting or readapting the initial strategy. As identified in previous sections of this chapter, the commercialisation process is characterised by testing concepts and probing between stages. Thus, it is highly likely that the initial strategy requires revision as the entity starts exploring the market with the sale of the innovative product.	Final challenge subsequent to the settlement of challenges 1, 2, 3, 4, and 5.

2.4 Stakeholders of the commercialisation process

Considering the importance of obtaining feedback from stakeholders involved in the commercialisation process, an identification of these stakeholders is essential (Aarikka-Stenroos & Lehtimäki , 2014).

One of the main stakeholders of the commercialisation process is the market (Moore, 1991). At first the market is composed of innovators and early adopters who filled with enthusiasm to try new products and services, provide feedback to pave the way for its success. Being low in number, innovators are those individuals who aggressively pursue new technology products/services, sometimes even before the launch of a formal marketing program. Their pursuit is driven by the need and satisfaction of being the first to explore the features of a new product. Therefore, obtaining their favour is essential for the commercialising entity as through their testimonials they reassure other customers about the products performance. These are followed by a group of early adopters who are also driven by the need to purchase new product concepts. Unlike innovators, these customers are not interested in the features of the product but are rather apprehensive by the benefits they reap. Their decisions to buy are not usually based upon references; however, they tend to prefer relying on their personal perceptions. Once again this is also considered to be vital to the commercialising entity as it provides further reassurance to other customers to that of innovators.

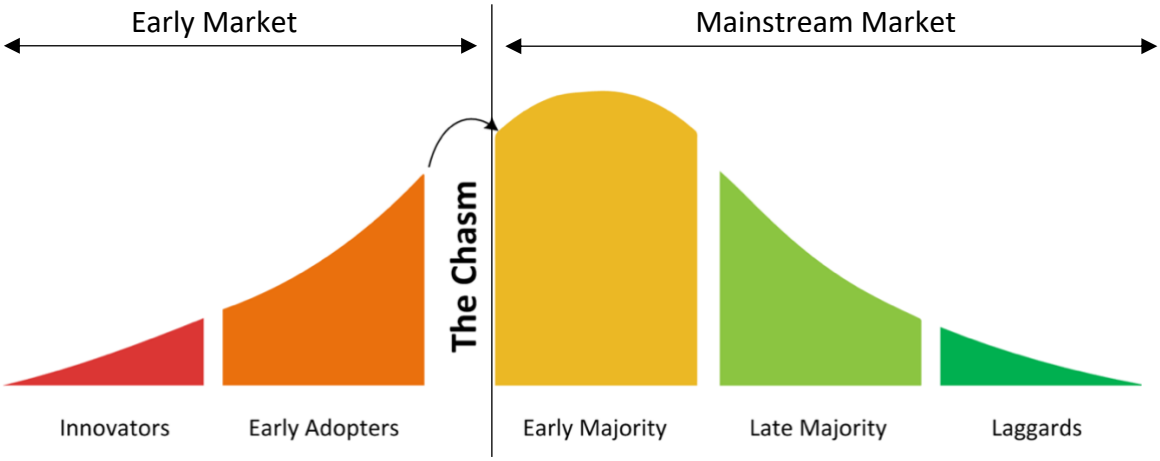

Figure 3. Innovation Adoption Curve

(adapted from Harden, 2018 and Moore, 1991)

As shown in Figure 3, once the market is somewhat established and its characteristics determined, it then moves along into other categories of customers (Moore, 1991). These categories forming the mainstream market of the innovative product are denoted as early majority, late majority and laggards. The characteristics of each of these customers is summarised in Table 6. The chasm depicted in Figure 3 is the period where the early market is reviewing the innovative product and the mainstream market is in a waiting state, considering its feasibility in accordance to their needs and wants.

Table 6. Definitions of Mainstream Market categories in the innovation adoption cycle (Moore, 1991)

Mainstream Market categories for innovation adoption	Description
Early Majority	Driven by practicality, this category of the market tends to wait for other customers well-established reviews on the innovative product before deciding on its purchase. Due to their number, winning this category is important for the commercialising entity as it start realising substantial profits from its product/service as it leads its way into the product growth stage.
Late Majority	Similar to the early majority group, this segment of the market usually waits for further customer reviews. However, due to their technology-related concerns their waiting is somewhat extended to a longer period. They only purchase the product/service when it is considered as a standard and when they are sure they can obtain support in its consumption. The commercialising entity is likely to realise the benefits of this segment during the late stage of the product/service lifecycle.

Mainstream Market categories for innovation adoption	Description
Laggards	This is the last market segment adopting an innovation. They are usually characterised as having no personal or economic reason of buying the product/service. Purchase is only affected in situations where this innovation is embedded in another product.

Other possible stakeholders in the commercialisation process are distributors, complementors and legislators (Aarikka-Stenroos & Lehtimäki , 2014). Apart from contributing to the marketing strategy, these can help the commercialising entity by facilitating the deliverance of innovative-product related knowledge, creating demand through push or pull mechanisms, sustaining the entity's strategy and achieving the desired target market results.

All these stakeholders of innovations have been summarised in the Quintuple Helix model (Franc & Karadžija, 2019). This model, fostered by the EU, points out the following stakeholders of innovation and thus, its commercialisation:

1. Educational system: which includes academia;
2. Economic system: which includes the industry, organisations, services and banks;
3. Political system: incorporating the legislative framework of the country or region;

4. Civil System: incorporating the public society and media culture; and,
5. Environmental system.

All these systems interact together for the betterment of society, achieved through knowledge sharing and development of innovative solutions.

Additionally, one may find other stakeholders who are specific to the commercialisation of academic research. These are:

a. IP Owners and IP creators;
b. IP attorneys;
c. Funding bodies; and
d. Technology Transfer Offices (Knowledge Commercialisation Australasia, n.d.).

The purpose and role of funding bodies and technology transfer offices will be discussed in subsequent sections of this chapter.

2.5 Barriers and Facilitators to Commercialising Academic Research

Those undertaking the commercialisation of academic research might encounter a number of barriers and facilitators throughout this process (Hughes and Kitson, 2012; Lam, 2011; Muscio, 2010; O'Gorman et al., 2008; Pohlmann et al., 2022). This section will identify the barriers and facilitators of commercialising academic research as highlighted in the literature.

2.5.1 Barriers to commercialising academic research

Pohlmann et al. (2022) conducted a systematic literature review to identify the barriers that hinder academic research from being transferred to the industry. By identifying these barriers, the researchers aimed to recognise the inbound and outbound strategies of how academic research results can be transferred to the industry; and consequently, offer guidelines to better develop TT processes. The review included studies published on the topic between 2015 and 2020. 67 articles met the inclusion criteria. The university's organisational culture has long been known to restrict commercialisation (Louis, et al., 1989). In fact, it has been listed by Pohlmann et al. (2022) to be the most common barrier towards commercialisation of academic research. This was followed by issues arising from university and industry 's infrastructure and technological capacity. The human resources element and the dual nature of the TT competencies follow suit. A more detailed explanation of these barriers can be found in Table 7.

Table 7. Barriers to Commercialising Academic Research

(Pohlmann, et al., 2022)

Barrier	Further explanation
Organisational Culture	The overly bureaucratic TT procedure and the fragmented organisational structure that is supported by a knowledge-generation academic culture rather than a culture of TT, result in demotivation of academics to engage in TT and thus provide disapproval of university-industry relationships.

Barrier	Further explanation
Issues arising from the university and industry 's technological capacity and infrastructure	Technologies are not always ready to be commercialised, as they are still in their early stages or very complex. Thus, the need of their simplification before entering the market is required. Consequently, companies require proof (preferably tested) of technological functionality before engaging in TT with universities. Moreover, a lack or low level of industry absorption capacity lead to cognitive distancing towards universities, even though they might be in geographical proximity.
Human Resources	Firstly, academics are mostly more confident in the academic environment rather than in the market. On the other hand, TTOs experience high staff turnover due to lack of qualified personnel.
Dual Nature of the TTs competencies (academic vs business)	The dual nature of TTOs confuses the representatives of both the academy and business industry.

Renault (2006) concluded that 71% of academics held on to the ideologies about academic commercialisation which they had obtained through their graduate education. At the Doctoral School within the UM, an optional workshop is offered to Doctoral researchers which provides an introduction to entrepreneurship and commercialisation of IP, which instils commercialisation culture in PhD students

(University of Malta, 2023). This is provided in collaboration with the Centre for Entrepreneurship and Business Incubation (CEBI) which was developed to educate and support UM graduates in establishing successful Knowledge-Based and Knowledge-Intensive business endeavours (University of Malta, n.d.).

Academics who hold traditional academic values are more likely to influence their colleagues' ambition to engage in commercialisation. In environments where peers accept commercialisation, academics have a higher probability of commercialising academic research (Haeussler & Colyvas, 2011). Despite that commercialisation might be valued within the academic environment, academics might feel inclined to prioritise publication over commercialisation (Carayol, 2004; Renault, 2006). This is due to the university's rewarding system which prioritises publications as a basis for awarding promotions leading academics to rapidly publish their findings (Carayol, 2004; David, 1998).

Another organisational barrier to commercialisation has been noted to be the operation of tenure systems adopted by various universities, including the UM (Haeussler & Colyvas, 2011; Renault, 2006). This system incorporates an external review process based on the contributions made by the academic throughout his employment. At this stage, the employment of the academic is not secured, and an indefinite employment contract is only adopted post-tenure. This might instil fear in pre-tenure academics to commercialise since they have not yet secured their position within the academic institution (Bercovitz & Feldman, 2008; Haeussler & Colyvas, 2011; Stuart & Ding, 2006).

O'Gorman, Byrne and Pandya (2008) highlight other barriers to academic research commercialisation. In their qualitative study conducted in Ireland, the researchers aimed to identify: (a) the reasons why scientists opt to generate returns to new knowledge via entrepreneurship; (b) the methods of recognising the market potential of their knowledge; (c) how and if the industry holding market-knowledge learns about the scientists' new knowledge; and (d) the functions TTOs play in facilitating the commercialisation process. During their case analysis the following points were noted:

i. The availability of funds to conduct academic research played an important role in developing the scientists' research agenda and their involvement in commercialisation;
ii. Lack of university support arising from IP ownership issues and failure of university promotion structures in recognising commercial activities;
iii. The commercialisation process created time-related pressure between its necessities and the scientists' contribution to academic duties;
iv. Uncertainties in relation to sacrificing the scientists' academic career to transition into working in the formed companies;
v. The scientists' inclination towards traditional academic roles and rewards structures;
vi. Non-alignment of the scientists' personal goals and the commercialisation-associated benefits;
vii. The requirement of prior knowledge to flow in the research activities;
viii. Lack of networking with the market;
ix. Lack of market-knowledge and market-experiences;
x. Inaccessibility of resources such as customers;

xi. Investors unawareness of the technological innovation and its benefits lead to no or under-investment;

xii. Scientists had to push the innovation to the market by seeking external contacts that hold market knowledge.

Hughes and Kitson (2012) studied the perceived constraints on interactions between academic and business in the United Kingdom. Their analysis involved identifying perceived reasons of academicians that prevented interactions with external organisations and the perceived interaction-related constraints of academics involved in commercialisation. Both the latter and the former identified that the top two perceived constraints relate to the academic's inability in meeting all university responsibilities due to lack of time; and, the institution's administrator's bureaucracy and inflexibility. They also coincide in the last two barriers, being cultural differences and others. All the remaining perceived limitations were ranked differently in both scenarios. While the former perceives inadequate rewards for interactions and insufficient resources devoted by their institution to activities with external organisation as the following top barriers; the latter argue that the investing company is unwilling to meet the full costs of the interaction and lacks resources to manage the collaboration. Other perceived barriers obtaining a ranking percentage higher than 25% and arising from interaction-related constraints of academics involved in commercialisation are:

i. insufficient rewards for interactions;

ii. insufficient resources devoted by their institution to activities with external organisation;

iii. agreement issues with the investing companies such as IP;

iv. weak skills of university administrators in the context of marketing, technical and negotiating;

v. struggle in finding partners; and,

vi. differences in timescale.

Amidst these identified barriers and the bureaucratic procedures of university process in terms of commercialisation, one must not forget the challenges arising from the marketing-perspective of the commercialisation process highlighted in previous subsections of this chapter (Aarikka-Stenroos & Lehtimäki , 2014). In order to alleviate or overcome some of these barriers, whether perceived or experienced, universities have developed initiatives that can potentially encourage academics to engage in commercialising their research. TTOs are an example of these university initiatives (Muscio, 2010; O'Gorman, et al., 2008).

2.5.2 Facilitators to commercialising academic research

Despite the fact that commercialisation of academic research is not embraced universally, it has drastically risen over the last few decades, and this is due to a number of incentives which facilitate academic entrepreneurship (Renault, 2006).

Lam (2011) listed financial rewards as one of the motivators for academics to engage in commercialising academic research. However, the literature is in disagreement about the efficacy of these incentives, with some studies reporting positive effects (Baldini, 2010; Friedman & Silberman, 2003) and others questioning their significance (Del Barrio-

Castro & Garcia-Quevedo, 2009; Friedman & Silberman, 2003). This might be due to the fact that sharing of royalties is already legally enforced in many countries. The availability of effective TTOs in academic institutions has been associated with increased commercialisation; however, to overcome such issues TTOs might take additional measures (Phan & Siegel, 2006). An Austrian study revealed 3 additional measures which are implemented (Backs, 2012). Firstly, financial bonuses which are given in addition to traditional royalties from commercialisation. Secondly, non-financial measures such as increased sabbatical leave and decrease in teaching load (Arvanitis, et al., 2008; Bradler, et al., 2016). Lastly, the organisation of events which often include training and expert advice (Backs, 2012).

The density and competitiveness between universities has also been noted as a facilitator of commercialising academic research, while environments with less competition are less likely to engage in commercialisation (Goldfarb & Henrekson, 2003; Henrekson & Rosenberg, 2001). Consequently, academics with commercialisation experience are more likely to work in academic institutions with a high intensity of commercialisation (Azoulay, et al., 2007). Moreover, academics who have never engaged in commercialisation are more likely to pursue commercialisation if they co-author with academics who have previously commercialised. Furthermore, academics with no commercialisation experience have a 25% higher probability of engaging in commercialisation if they co-author with industrial researchers.

The importance of industry support and collaboration is another facilitator as it can guide academics to identify potential opportunities for commercialisation (Agrawal &

Henderson, 2002; Ozgen & Baron, 2007). Moreover, D'Este and Perkmann (2011) identify a number of benefits of engaging with the industry which include: access to funding; access to materials, research expertise and equipment; information on problems the industry faces; industry feedback on their invention; access to industry-research; and networking. The aforementioned benefits are all essential for academics to develop innovations which are needed by the industry and thus might result in successful commercialisation.

2.6 The role and functions of TTOs as facilitators to commercialising academic research

Since the late 1990s, European and US countries have seen a drastic increase in the number of TTOs being established within universities and/or public research institutions (Muscio, 2010). While the role of TTOs has been substantially viewed as a way of accessing university innovations and a method of establishing and maintaining university-industry relationships, its contribution toward TT has also been debated.

Reference to the research carried by O'Gorman, et al. (2008), it was noted that:

i. TTO officers and incubator managers acted as intermediaries by educating and informing potential investors of the new knowledge, thus encouraging industry-university ties;
ii. Scientists benefitted from TTO functions such as those in relation to business planning, advice, accessing of university resources, development programs and workshops;

iii. TTO influenced scientists to develop new firms;

iv. From the viewpoint of the scientists, TTOs served as a counterbalance to the university's incentives and policies that pushed against commercialisation.

As mentioned in Table 7, Pohlmann et al. (2022) argue that the dual-function of TTOs negatively impacts TT, as parties seem to confuse its role despite the fact that TTOs adopt various strategies aimed at reducing the cognitive distance between them. However, this boundary-spanning role between the researchers and the industry allows inbound and outbound flows of open innovation. Outbound strategies allow both parties to augment their technical capabilities; while, the inbound strategies improve research funding from external businesses. Additionally, the researchers also note that through inbound strategies the barrier of investors unawareness on innovate university technologies and their benefits is reduced. Consequently, this increases the industry's absorptive capacity and encourages their investment in infrastructure and resources. On this basis, Pohlmann et al. (2022) suggest that the university's management exploit the TTOs dual-nature to put such strategies in practice which could improve the efficacy of TT. In their proposal, they identify potential inbound and outbound strategies to overcome or mitigate the hinderances of TT.

2.6.1 The role and function of CR&KTO as a TTO

Being the responsible unit for commercialisation, CR&KTO functions as the UM TTO. While its main purposes are to assist academics, members of staff and students in the commercialisation process and, manage and maintain university-industry relationships,

its role as TTO extends to other responsibilities. These responsibilities are highlighted and carried out in accordance to the University's Intellectual Property Policy, which also falls under the remit of this unit (University of Malta, 2014). Further to the responsibilities associated with the commercialisation process (refer to Section 2.3), the unit also engages in:

a) ensuring that the institution has access to or owns expert knowledge transfer services, including consultants on IP protections, financial, commercial, and legal issues, in addition to professionals with technical backgrounds;
b) raising awareness and offering training to instil skills in the areas of IP and knowledge transfer and their management; and
c) helping scientists in identifying potential national schemes to obtain commercialisation funds (University of Malta, n.d.).

2.7 Funding Opportunities in the Local Scenario

O'Gorman, et al. (2008) highlighted that funding is one of the major determinants in influencing academics to engage in commercialising their research. To overcome this obstacle, some governments or institutions are offering funding schemes that are aimed at facilitating research, enabling product development and testing, improving the technology readiness level and implementing commercialisation (O'Gorman, et al., 2008; O'shea, et al., 2008).

The Malta Council for Science and Technology (MCST) offers a wide range of funding opportunities that tap into this area (The Malta Council for Science & Technology, 2023).

Typical examples are the FUSION Technology Development (TDP) and Commercialisation Voucher (CVP) programmes; and, the Go-to-Market Accelerator and Loan Assistance programmes. Table 8 provides a brief description of the purpose of each of these funding programmes.

Table 8. Brief description of the Fusion and Go to Market Programmes offered by MCST

Funding Program	Description
FUSION Technology Development Programme	This programme provides state finances to scientists who are interested in developing their Research and Innovation proposal into prototypes (The Malta Council for Science & Technology, 2022). Additionally, this will better help in determining whether the innovation has the potential of being commercialised and transferred to the market.
FUSION Commercialisation Voucher Programme	This programme provides funds to scientists who wish to advance and develop their technical and non-technical concepts into potential products and services that can be commercialised and accepted by the market (The Malta Council for Science and Technology, 2022). The programme is specifically intended for aspiring FUSION TDP applicants as to provide them with a basis for project proposal and validation.
Go-to-Market Programme	This programme helps conclude the development of the new technology and thus leads to introducing the product/service

Funding Program	Description
	to the market (The Malta Council for Science & Technology, 2022). Being split into two separate programmes, the Go-to-Market programme offers: A. applicants with the ability to validate their development and optimise it to the market through the Accelerator programme; and, B. a means to address market failures through the Loan Assistance programme.

Malta Enterprise is another Maltese entity involved in providing funding opportunities that are specifically targeted towards start-up companies (Camilleri, 2023). Even though, as an entity the UM cannot apply in its own name, any spin-out companies formed by university academics can still benefit from these types of funding schemes.

University proof of concept projects that are based on university research and start-up companies might also be eligible in applying for the TAKEOFF Seed Fund and Maritime Seed awards (University of Malta, n.d.). These awards help in transferring an idea or technology from its early stages to the market.

2.8 Commercialisation Skills

Commercialisation skills were highlighted as one of the barriers to commercialisation academic research by Hughes and Kitson (2012), these fall within the remit of CR&KTO.

The Conference Board of Canada and the Centre for Business Innovation identify that the commercialisation of new or improved products, processes or service, require individuals to have the right skills, attitudes and behaviours in order to reach the market and obtain maximum value (The Conference Board of Canada, n.d.). An identification of these skills in the context of TT was provided through research conducted in Europe by Mom, et al. (2012). Their findings show that IPR and legal skills (hard skills) are very important to professionals engaging in TT. However, the authors also indicated that soft skills are required. These soft skills, their definitions and implications are being highlighted in the Table 9.

Table 9. Definition and Implication of TT-associated soft skills

(Mom, et al., 2012)

Skill	Definition	Implication on TT
Communication	Involves the transmission of ideas, signals, or information by speech, behaviour, writing, or other means.	The collaboration between transfer parties is reliable on the actor's ability to communicate with one another. Differences in the skills base, culture and language can negatively impact communication between parties.

Skill	Definition	Implication on TT
Networking	Involves the ability of establishing and sustaining contact with various social networks with the intent of encouraging knowledge creation and transfer.	This skill is important to build strong ties with other stakeholders and thus, find possibilities in transferring the new technologies through the established social networks. However, successful TT requires an element of trust between parties.
Negotiating	The skill of establishing synergy between parties to alter perceptions that will help in settling conflict, deciding on action plans, negotiating for an individual or mutual advantage, or creating outcomes to entertain different concerns.	Together with other skills, such as domain and legal knowledge skills, and the understanding of various national and international behaviours, norms, values and attitudes, negotiating skills can be successful.

Skill	Definition	Implication on TT
Commercial Awareness	The skill of having business environment knowledge to take strategic decisions and recognise potential technology-related commercialising opportunities.	Identifying opportunities and taking decisions that boost the return on investment (ROI).
New Business Development	The strategic skills that provide economic business growth.	Helps in assessing all available options for TT and their effectiveness on its economic success.

The importance of such skills varies depending on the work context (i.e. spin-off, R&D collaborations etc.). The research also identified the professional's organisational position and associated activities have an effect on the significance of specific skills. As such, the researchers propose that TT professionals are aware of the required skills they need to develop on the basis of their position and activities they perform.

2.9 Conclusion

After thoroughly reviewing the literature, it is evident that commercialisation is a complex process that engages in several tasks (Friedman & Silberman, 2003 Parker & Zilberman, 1993). This process includes various stakeholders who influence the success

of commercialising university research (Aarikka-Stenroos & Lehtimäki, 2014; Franc & Karadžija, 2019; Knowledge Commercialisation Australasia, n.d.; Moore, 1991). Although scant, the available literature identified a number of barriers impeding academic research commercialisation (Aarikka-Stenroos & Lehtimäki, 2014; Hughes and Kitson, 2012; O 'Gormann et al., 2008; Pohlmann et al., 2022). The literature acknowledges that the most common barrier relates to the organisational structure and culture of universities (O'Gormann et al., 2008; Pohlmann et al., 2022). Moreover, the literature has also started to identify the facilitators of this commercialisation; however, there is a lack of agreement on these facilitators – particularly relating to TTOs (Muscio, 2010). Consequently, these merit further research in the field. To date, no local research has been conducted on the commercialisation of academic research and its barriers and facilitators. In view of this, the present study aims to begin to fill in the gaps in research by identifying the barriers and facilitators that local academics face when commercialising their research. The methodology that will be adopted in the present study will be discussed in the following chapter.

Chapter 3: Methodology

3.1 Introduction

Following the reviewing of available literature, this chapter will focus on the methodology adopted in this research. This chapter defines the main research questions, delineates the rationale behind the selected research methodology, highlights the target population and target sample size, and sampling technique. The data collection method is then presented along with its limitations, followed by a discussion on the relevant analytical tools. Subsequently, the chapter delves into the ethical considerations, and reliability and validity of the research method.

3.2 The Research Questions

This research aimed to explore the current procedures adopted by the University of Malta in terms of commercialising academic research and innovation while identifying ways of how these can be seamlessly improved. In this regard, the main research question can be articulated as follows:

How can the current procedures adopted by the University of Malta in commercialising research and innovation be amended to make the process more seamless?

This research question was achieved through answering the following questions:

1. What are the barriers faced in the commercialisation of research and innovation at the University of Malta?
2. What are the key factors in facilitating the commercialisation of research and innovation at the University of Malta?
3. How can the University of Malta facilitate the process of commercialising research and innovation?

3.3 Research Design

Identifying the current procedures within the UM and attempting to gain insight of the barriers and facilitators that its local academics perceive and/or experience when commercialising research and innovation required that the study follows an exploratory nature (Saunders, et al., 2007). This nature progressively narrows down the initial broader views of the current situation as it specifically points towards the most relevant barriers and facilitators that hinder and/or facilitate the commercialisation process. Consequently, it provided a basis for determining what efforts the University can take to attempt to seamlessly improve its current processes in commercialisation of research and innovation.

This deductive approach to the study was supported by the survey research strategy, which sought to answer the who, what and where questions and attempted to obtain quantification of such variables (Saunders, et al., 2007). As a research strategy, it

enabled the researcher to choose from a range of data collection techniques that vary from questionnaires to structured interviews and offer the researcher with control over the research process. However, the survey strategy can be very time consuming in:

a. selecting the appropriate representative sample,
b. designing the data collection tool,
c. ensuring a good response rate, and
d. analysing the results.

It also imposes a limit on the number of questions the researcher can ask when designing the data collection tool.

The time limit factor imposed on this study shows that this research follows a cross-sectional approach; whereby a specific phenomenon is studied at a specific time (Saunders, et al., 2007). This approach continued to support the selection of the aforementioned research strategy.

3.4 Hypotheses Formulation

A deductive research approach requires the researcher to establish a set of hypotheses that are derived from theory and which are eventually accepted/reject on the basis of the data collected (Saunders, et al., 2007). These hypotheses propose, test and examine the relationship between variables generated by the literature against the results obtained from the study. Figure 4 highlights the steps for a deductive research approach, and which were adopted in this research.

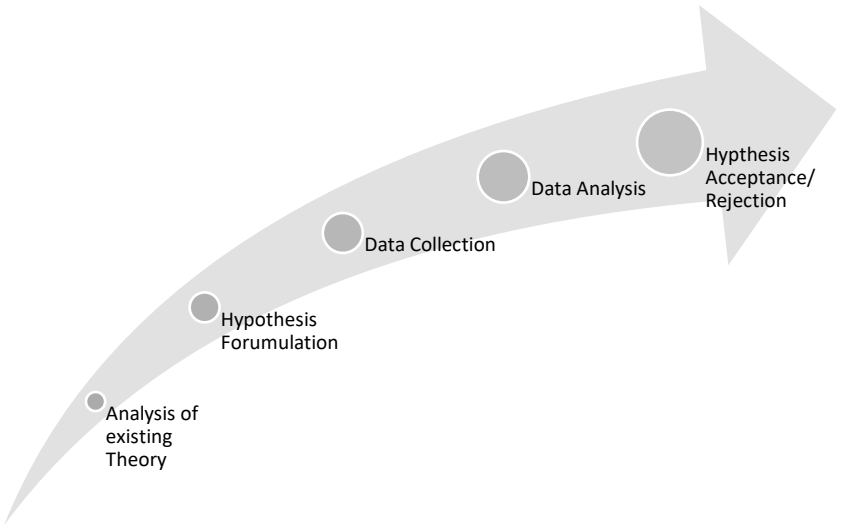

Figure 4. Deductive Approach Process

(Adapted from Sirisilla, 2023)

Consequently, the hypotheses for this research were as follows:

Hypothesis 1: The University of Malta's research and commercialisation infrastructure and mechanisms are well structured and easily identifiable by its academics.

Hypothesis 2: The University of Malta's academics perceive and/or find the University's infrastructural offices as motivators and facilitators of commercialising academic research and innovation.

Hypothesis 3: The University of Malta's academics prioritise research and commercialisation over other academic duties.

3.5 Sample Selection

According to the annual report published by the UM for the year 2021, the total number of staff working at this institution amounts to 1,650 personnel (University of Malta, 2021). This number includes Resident Academics, Visiting Teaching staff, Post-docs, research staff; and, managerial, administrative, technical and support staff. The number of academics employed at the UM draws more relevance for the purposes of this study. During the scholastic year of 2020/2021, the number of Resident Academics employed by the UM totalled to 982 personnel, of which 392 personnel are Females and 590 personnel are Males.

Given that to date, the annual report for the year 2022 has not been made available on the University's webpage, the above-quoted figures were considered as the estimate number of academics employed by the institution.

3.5.1 Rationale for Sample Selection

Over the five-year period between 2019 and 2023, the University's CR&KTO office registered a total of 81 disclosures of which only 37 are considered active (Camilleri, 2023). Table 10 below provides a detailed analysis of the number of disclosure CR&KTO received from different Faculties or Institutes throughout this duration. Furthermore, it provides an indication how many of these disclosures were engaged (portrayed under the 'Active' column) or assessed as inappropriate (represented under the 'Inactive' column) for the commercialisation process.

Table 10. Disclosures by Faculty/Institute

(Camilleri, 2023)

	Year of Disclosure					Total	Current Status	
Faculty	**2019**	**2020**	**2021**	**2022**	**2023**	**Disclosures**	**Active**	**Inactive**
Faculty of Medicine & Surgery	6	2	2	0	0	10	6	4
Centre for Biomedical Cybernetics	0	1	0	0	0	1	1	0
Centre for English Language Proficiency	0	1	0	0	0	1	0	1
Centre for Molecular Medicine and Biobanking	3	0	0	1	0	4	1	3
Faculty for the Built Environment	0	3	1	2	0	6	3	3
Faculty of Dental Surgery	0	1	0	0	0	1	0	1
Faculty of Engineering	6	7	8	6	0	27	11	16

	Year of Disclosure					Total	Current Status	
Faculty	**2019**	**2020**	**2021**	**2022**	**2023**	**Disclosures**	**Active**	**Inactive**
Faculty of Health Sciences	0	4	2	0	0	6	3	3
Faculty of Information & Communication Technology	2	2	1	1	1	7	3	4
Faculty of Science	3	1	0	2	0	6	2	4
Institute for Sustainable Energy	2	3	2	0	0	7	6	1
Institute of Aerospace Technologies	2	1	0	0	0	3	1	2
Institute of Digital Games	1	0	0	0	0	1	0	1
Institute of Earth Systems	0	0	1	0	0	1	0	1
Totals	**25**	**26**	**17**	**12**	**1**	**81**	**37**	**44**

Based on the data presented in Table 10, it was deduced that the Faculty of Engineering held the highest number (27 in total) of disclosures for commercialisation of academic research and innovation at the UM during the period as registered by the CR&KTO. Inevitably, this suggested that academics working at the Faculty of Engineering are

highly likely to have engaged, are engaging or intend to engage in the commercialisation of academic research and innovation, thus, making them the ideal participants for this research study. Such exposure enabled the researcher to gain more insightful descriptions during the gathering of results, as participants were assumed to hold more expertise relative to this study. This rationale was backed-up by a number of studies which also confirm that applied fields of research such as Engineering are more likely to engage in commercialisation of academic research (Bekkers & Bodas Freitas, 2008; Bozeman & Gaughan, 2007; D'Este & Perkmann, 2011; Ponomariov, 2008).

3.5.2 Sample Size

In view of Section 3.5.1, the number of potential participants for this study amounted to a total of 64 academics employed by the UM and who specifically work at the Faculty of Engineering which is composed of six main departments, being:

- Department of Electrical Engineering,
- Department of Mechanical Engineering,
- Department of Electronic Systems Engineering,
- Department of Metallurgy and Materials Engineering,
- Department of Industrial and Manufacturing Engineering; and
- Department of Systems and Control Engineering.

Additionally, it is important to note that the participants vary in their academic roles within the faculty. These academic roles differ between Professor, Associate Professor, Senior Lecturer, Assistant Lecturer, Visiting Lecturer and Casual Lecturer.

3.5.3 Sampling Technique

Based on the reasons mentioned in the previous section, a purposive sampling technique was considered to be the most suitable technique for this study. Purposive sampling is a non-probability sampling technique that enables the researcher to use his/her own sound judgement to establish the sample on the basis of their appropriateness to reach the research goals and to answer the research question(s) (Saunders, et al., 2007). Appropriateness is determined on the basis of the sample's knowledge, experience and characteristics, amongst other possible criteria, making them the ideal candidates for the research study (Etikan, et al., 2016). However, even though this sampling technique is considered as ideal for a small sample size and case study research, it often does not give a statistical representation of the entire population (Saunders, et al., 2007).

Consequently, the rationale behind selecting this sampling technique was that the sample held the required knowledge and experience when it comes to the topic of commercialising academic research and innovation. On this basis, they were considered to be the ideal candidates in answering the research questions mentioned in Section 3.1.

3.6 Data Collection Method

Online questionnaires were used as the data collection method for this research. The formulation of this tool was informed by the available literature on the topic, the current procedures at UM, and the information about the various funding programmes offered

by local funding bodies. Such information has been presented in Chapter 2 of this study. In view of the current lacuna on the research topic in the Maltese scenario, the collection of primary data was required. A more detailed discussion on the data collection method is being provided hereunder.

3.6.1 Online questionnaires

The term questionnaire holds various definitions which arise from the nature of the questionnaire which can either be self-administered by participants or else administered by the researcher (Saunders, et al., 2007). For the purposes of this research, the former was used in an online format. This design was selected based on the types of questions being asked and the respondents' characteristics. Considering the workload of academics and their role's inflexibility, such a tool was deemed as appropriate to use as it allowed the researcher to reach the respondents conveniently (Wright, 2005; Saunders, et al., 2007).

The appropriateness of this tool was further justified on the basis of respondents' reachability. Using the already-established UM staff database which is administered by the Marketing, Communications and Alumni's office, following the institution's Human Resources approval, facilitated the researcher's ability to reach the targeted sample while respecting the anonymity of participants. Further justifications for selecting this data collection method were the following:

a) The design of online questionnaires allowed the researcher to customise the logical sequence of questions in accordance to their relevance towards the

participants' experience in commercialisation of academic research and innovation;

b) The design of the data collection tool allowed the researcher to ask both close-ended and open-ended questions, thus allowing for more depth and flexibility in the respondents' answers;

c) Sending the questionnaires through the Marketing, Communications and Alumni's office, ensured that the questionnaire was only sent to the targeted sample;

d) The online questionnaire allowed the research to obtain a larger response rate in a shorter period of time;

e) The researcher's influence on participants was reduced as the data collection tool does not allow direct contact between both the researcher and participants; and

f) In view of this anonymity, participants might have felt more at ease to answer honestly and truthfully (Saunders, et al., 2007).

3.6.1.1 Questionnaire Design

Table 11 highlights how the questions for the online questionnaire were drawn from previous literature discussed in Chapter 2. The online questionnaire was then developed using the SurveyMonkey platform which allowed the researcher to use logical sequence customisation of questions; and, variation of open-ended and close-ended questions. Furthermore, this platform allowed the researcher to use diverse alternatives designs for close-ended questions, which vary from category, grid, and rating methods

(Saunders, et al., 2007). Using such methods permitted the researcher to capture the more detailed opinions and views of participants relative the topic of each question. Consequently, this provided the opportunity for the researcher to obtain further insight on the topic. Additionally, the results obtained can thus be easily categorised during response analysis. A copy of the final questionnaire design is provided in Annex D.

Table 11. Questionnaire design on the basis of literature

Question Number	Source
1	Nil
2	Bercovitz & Feldman, 2008; Casper & Murray, 2005; Haeussler & Colyvas, 2011; Perkmann, et al., 2013; Stuart & Ding, 2006.
3	Azoulay, et al., 2007; Bercovitz & Feldman, 2008; Ding, et al., 2006; Haeussler & Colyvas, 2011; Whittington, 2009.
4	Based on UM's Faculty of Engineering structure
5	Bercovitz & Feldman, 2008; Haeussler & Colyvas, 2011; Renault, 2006; Stuart & Ding, 2006.
6	Based on the academic's experience
7	Based on UM's structure
8	Based on UM's and Funding Programme's structure
9	Azoulay, et al., 2007; Bercovitz & Feldman, 2008; Ding, et al., 2006; Haeussler & Colyvas, 2011; Whittington, 2009.
10	Nil

Question Number	Source
11	Aarikka-Stenroos and Lehtimäki, 2014; Azoulay, et al., 2007; Bercovitz & Feldman, 2008; Carayol, 2004; Casper & Murray, 2005; David, 1998; Del Barrio-Castro & Garcia-Quevedo, 2009; Friedman & Silberman, 2003; Goldfarb & Henrekson, 2003; Haeussler & Colyvas, 2011; Henrekson & Rosenberg, 2001; Hughes and Kitson, 2012; Louis, et al., 1989; Mom, et al., 2012; O'Gorman, et al., 2008; Parker & Zilberman, 1993; Pohlmann, et al., 2022; Renault, 2006; Stuart & Ding, 2006.
12	Based on UM's and Funding Programme's structure
13	Based on UM's and Funding Programme's structure
14	Based on the academic's experience
15	Aarikka-Stenroos and Lehtimaki, 2014.
16	Chiesa and Franttini, 2011.
17	Nil
18	Aarikka-Stenroos and Lehtimäki, 2014; Azoulay, et al., 2007; Bercovitz & Feldman, 2008; Carayol, 2004; Casper & Murray, 2005; David, 1998; Del Barrio-Castro & Garcia-Quevedo, 2009; Friedman & Silberman, 2003; Goldfarb & Henrekson, 2003; Haeussler & Colyvas, 2011; Henrekson & Rosenberg, 2001; Hughes and Kitson, 2012; Louis, et al., 1989; Mom, et al., 2012; O'Gorman, et al., 2008; Parker & Zilberman, 1993; Pohlmann, et al., 2022; Renault, 2006; Stuart & Ding, 2006.
19	Mom, Oshri and Volberda, 2012; The Conference Board of Canada, n.d.

Question Number	Source
20	Aarikka-Stenroos and Lehtimäki, 2014; Agrawal & Henderson, 2002; Arvanitis, et al., 2008; Azoulay, et al., 2007; Backs, 2012; Bercovitz & Feldman, 2008; Bradler, et al., 2016; Carayol, 2004; Casper & Murray, 2005; D'Este and Perkmann, 2011; David, 1998; Del Barrio-Castro & Garcia-Quevedo, 2009; Friedman & Silberman, 2003; Goldfarb & Henrekson, 2003; Haeussler & Colyvas, 2011; Henrekson & Rosenberg, 2001; Hughes and Kitson, 2012; Lam, 2011; Louis, et al., 1989; Mom, et al., 2012; O'Gorman, et al., 2008; Ozgen & Baron, 2007; Parker & Zilberman, 1993; Phan & Siegel, 2006; Pohlmann, et al., 2022; Renault, 2006; Stuart & Ding, 2006.
21	Armstrong & Kotler, 2005; Based on the process followed by CR&KTO at the UM.
22	Aarikka-Stenroos and Lehtimäki, 2014; Hughes and Kitson, 2012.
23	Aarikka-Stenroos and Lehtimaki, 2014.
24	Aarikka-Stenroos and Lehtimäki, 2014; Hughes and Kitson, 2012.
25	Hughes and Kitson, 2012; O'Gorman, et al., 2008.
26	Based on the European Innovation Scoreboard (EIS).
27	Arvanitis, et al., 2008; Backs, 2012; Bercovitz & Feldman, 2008; Bradler, et al., 2016; Carayol, 2004; David, 1998; European Innovation Scoreboard (EIS); Franc & Karadžija, 2019; Haeussler & Colyvas, 2011; Hughes and

Question Number	Source
	Kitson, 2012; Lam, 2011; O'Gorman, et al., 2008; Renault, 2006; Phan & Siegel, 2006; Stuart & Ding, 2006.
28	Arvanitis, et al., 2008; Backs, 2012; Bercovitz & Feldman, 2008; Bradler, et al., 2016; Carayol, 2004; David, 1998; European Innovation Scoreboard (EIS); Franc & Karadžija, 2019; Haeussler & Colyvas, 2011; Hughes and Kitson, 2012; Lam, 2011; O'Gorman, et al., 2008; Renault, 2006; Phan & Siegel, 2006; Stuart & Ding, 2006.
29	Louis at al., 1989
30	Arvanitis, et al., 2008; Backs, 2012; Baldini, 2010; Bradler, et al., 2016; Bercovitz & Feldman, 2008; Carayol, 2004; David, 1998; Friedman & Silberman, 2003; Haeussler & Colyvas, 2011; Hughes and Kitson, 2012; Lam, 2011, O'Gorman, et al., 2008; Phan & Siegel, 2006; Pohlmann, et al., 2022; Renault, 2006; Stuart & Ding, 2006.
31	Based on the UM's structure
32	Based on the UM's structure and definitions highlighted on the UM's website which are summarised in Table 3
33	Based on the UM's structure and definitions highlighted on the UM's website which are summarised in Table 3
34	Based on the UM's structure and definitions highlighted on the UM's website which are summarised in Table 3

Question Number	Source
35	Based on the UM's structure and definitions highlighted on the UM's website which are summarised in Table 3
36	Based on the academic's experience
37	Based on the academic's experience
38	Aarikka-Stenroos and Lehtimäki, 2014; Azoulay, et al., 2007; Bercovitz & Feldman, 2008; Carayol, 2004; Casper & Murray, 2005; David, 1998; Del Barrio-Castro & Garcia-Quevedo, 2009; Friedman & Silberman, 2003; Goldfarb & Henrekson, 2003; Haeussler & Colyvas, 2011; Henrekson & Rosenberg, 2001; Hughes and Kitson, 2012; Louis, et al., 1989; Mom, et al., 2012; O'Gorman, et al., 2008; Parker & Zilberman, 1993; Pohlmann, et al., 2022; Renault, 2006; Stuart & Ding, 2006.
39	Arvanitis, et al., 2008; Backs, 2012; Bradler, et al., 2016.
40	Arvanitis, et al., 2008; Agrawal & Henderson, 2002; Backs, 2012; Baldini, 2010; Bradler, et al., 2016; Bercovitz & Feldman, 2008; Carayol, 2004; D'Este and Perkmann, 2011; David, 1998; Friedman & Silberman, 2003; Haeussler & Colyvas, 2011; Hughes and Kitson, 2012; Lam, 2011, O'Gorman, et al., 2008; Ozgen & Baron, 2007; Phan & Siegel, 2006; Pohlmann, et al., 2022; Renault, 2006; Stuart & Ding, 2006.
41	Arvanitis, et al., 2008; Backs, 2012; Bradler, et al., 2016.

3.6.1.2 Pilot Study

Prior to the actual study, a pilot study was carried out with three academics to test that: a. the questionnaire design was appropriate and able to reach the targeted objectives; b. followed the correct logical sequence; c. each question structure was correct and understandable; and, d. appropriate in terms of completion time. The feedback obtained from this pilot study, did not identify any foreseeable issues with the questionnaire and therefore, no changes were made. The data collected from the pilot study was not included in the main study.

3.6.1.3 Limitation of Data Collection Tool

One of the major limitations identified for this data collection tool pertains to response rates. The respondent's inability to find time to complete the online questionnaire; their personal choice to ignore or delete the email sent to them; and/or, the possibility of missing the email owing to the overwhelming number of emails in their inbox, would affect the response rates (Howard, 2023). Consequently, this will impact the research's ability to reach the required responses.

Another limitation that was identified is the online questionnaire completion time. Research shows that online questionnaires that take between 10 to 15 minutes tend to obtain better response rates (Bhaskaran & LeClaire, 2010). However, the lack of research on the topic in the local context required that the questionnaire explores the topic in greater detail, at the cost of a longer completion time (approximately 15 to 20 minutes

to complete). Albeit the pre-identification of survey's completion time in the information letter being forwarded to participants (refer to Annex B), it could still lead to high questionnaire abandonment rates.

Considering that reaching the targeted sample was subject to the Human Resources approval and the questionnaire being distributed through the UM's Marketing, Communications and Alumni's office also limited the researcher's ability to influence the survey distribution timing (Bhaskaran & LeClaire, 2010). As a result, the survey was distributed on the 9th May 2023 which fell within the busiest academic period. This may have had an adverse effect on the response rate.

3.7 Data Analysis Methodology

The interpretation and analysis of the results obtained from the online questionnaire were carried out as follows:

a. For close-ended questions: the data obtained from close-ended questions was inputted on the IBM SPSS version 28 platform, a widely used statistical analysis software. This helped in building descriptive statistics that summarise and define the characteristics of the selected dataset (Hayes, et al., 2023). Charts and tables were produced using Microsoft Excel.
b. For open-ended questions: the data obtained from open-ended questions was analysed using content analysis. Content analysis helped in identifying and categorising common themes and concepts from the responses obtained (Luo, 2019).

3.8 Ethical Considerations

In accordance to UM's ethical guidelines highlighted in the university's Research Code of Practise and the Research Ethics Review Procedure, the following ethical measures were carried out:

a. Ethical approval was sought from the faculty's research ethics committee. This ensured that the present study abided to the university's ethical code and procedures.

b. any conflicts of interest held by the researcher on this study were identified, reviewed and approved by the FREC committee.

c. to ensure participants anonymity no personal information was sought throughout the questionnaire. Additionally, the online survey questionnaire was distributed solely through the UM's Marketing, Communications and Alumni's Office after having sought the institution's Human Resources approval to carry out the research with its academic employees within the Faculty of Engineering. Any reminders were also sent through the same office;

d. an information letter was prepared and sent along with the questionnaire, whereby it explained in detail the purposes and intentions of this research study. This information letter was forwarded to all participants and included the link to the questionnaire. A copy of this information letter is provided under Annex B.

e. participant's consent was obtained through a consent form which was constructed in line with the GDPR regulations and included a number of consent statements. This featured as an introduction to online questionnaire, whereby voluntary consent was granted by the participants prior to filling out the questionnaire upon clicking the "Yes" option. Participants who wished not to partake in this research study were allowed to do so without any repercussions. A copy of the consent form and the consent statements can be found under Annex C.

f. the questionnaire allowed participants to withdraw their participation at any time in completing the questionnaire.

g. No inducements, rewards or compensation was offered to ensure non-biased responses.

h. Data was stored in an encrypted folder and will be erased within a period of one year following the successful completion of the research study.

3.9 Reliability and Validity

Reliability can be defined as the ability of other researcher to reproduce the study being conducted to produce similar results (Breakwell, et al., 2012). On the other hand, validity relates to the accuracy of what is being measured.

For the purposes of this research, both previous chapters and this chapter provide a detailed explanation of the research process and rationale being adopted for this study. This includes the establishment of the research question(s), hypothesis, definition of the sample size and the data collection instrument, the pilot test as well as the identification of data analysis. This information allows other researchers with the ability to easily replicate this study and confirm the results obtained.

Additionally, the pilot testing that was carried out confirmed the appropriateness of the questions asked and metrics used for the collection of data through the online questionnaire relative to the research topic. Some test questions were also inputted in the online survey to ensure the respondents' knowledge, specific to the research and commercialisation offices at the UM. Such questions required respondents to select the most appropriate definition that describes the purpose/job of these particular units.

3.10 Chapter Summary

The main research question for this study attempted to identify possible ways in which current UM procedures pertaining to commercialisation of research and innovation can be transformed seamlessly. An exploratory nature and a deductive approach support a survey research strategy for which online questionnaires were deemed as an appropriate data collection instrument. Based on 5-year statistical data on the UM's faculties attempts for commercialisation of research and innovation, identified the Faculty of Engineering as being the top performer. Thus, a purposive non-probability

sampling technique was considered appropriate. Various ethical, reliability and validity considerations were taken into account throughout the research design and implementation. Descriptive statistics and content analysis were identified to be the appropriate methods for data analysis obtained through close-ended and open ended questions respectively. The latter will be presented in the next chapter.

Chapter 4: Results

4.1 Introduction

Chapter 4 describes the results obtained from the online questionnaires which were distributed to academics employed within the Faculty of Engineering using a purposive sampling technique. The dissemination of the online questionnaire occurred between the 9th of May 2023 and lasted until the 14th of July 2023.

Data obtained from close-ended questions was inputted into SPSS which facilitated its analysis. Bar charts and tables were produced using Microsoft Excel to facilitate the understanding of these findings. Additionally, open-ended questions were analysed using content analysis.

The results will be presented as follows:

- demographic data,
- participation in academic research and its commercialisation,
- barriers and facilitators of commercialising academic research, and
- knowledge and recommendations related to the university's infrastructure to support academic research.

4.2 Demographic Data

A total number of 64 academics within the Faculty of Engineering were given an equal opportunity to participate in this study. 17 participants answered and submitted the online questionnaire giving a response rate of 27%. There were 13 males (76.47%) and 4 females (23.53%).

4.2.1 Age of the respondents

Question 2 asked participants to select their age range. 17.65% (n=3) were between 31 and 40 years, 29.41% (n=5) were between 41 and 50 years, 41.18% (n=7) were between 51 and 64 years, while the remaining 11.76% (n=2) were over 65 years (see figure 5).

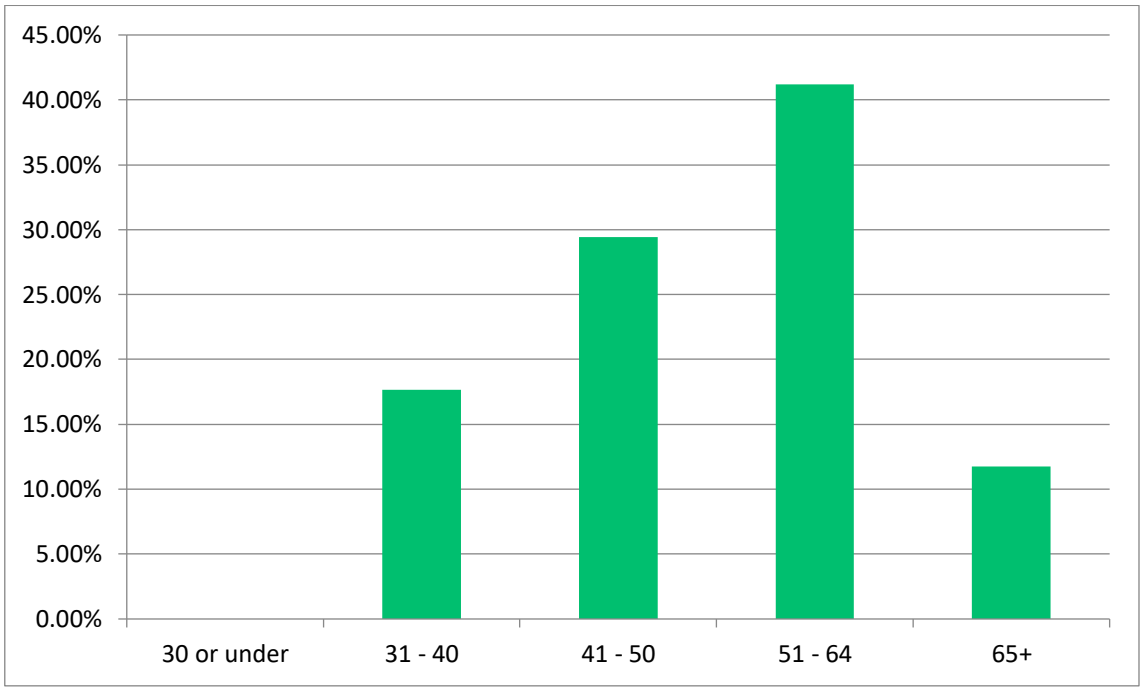

Figure 5. The age of respondents

4.2.2 Department which the respondents belong to

Question 4 asked academics to indicate which department they belonged to. A total of 23.53% (n=4) belonged to the Department of Mechanical Engineering, 23.53% (n=4) belonged the Department of Metallurgy and Materials Engineering, 11.76% (n=2) belonged to the Department of Electronic Systems Engineering, 11.76% (n=2) belonged to the Department of Industrial and Manufacturing Engineering and 5.88% (n=1) belonged to the Department of Systems and Control Engineering. None of the participants were from the Department of Industrial Electrical Power Conversion. The remaining 23.53% (n=4) of participants said they belonged to a department which was not listed (see figure 6).

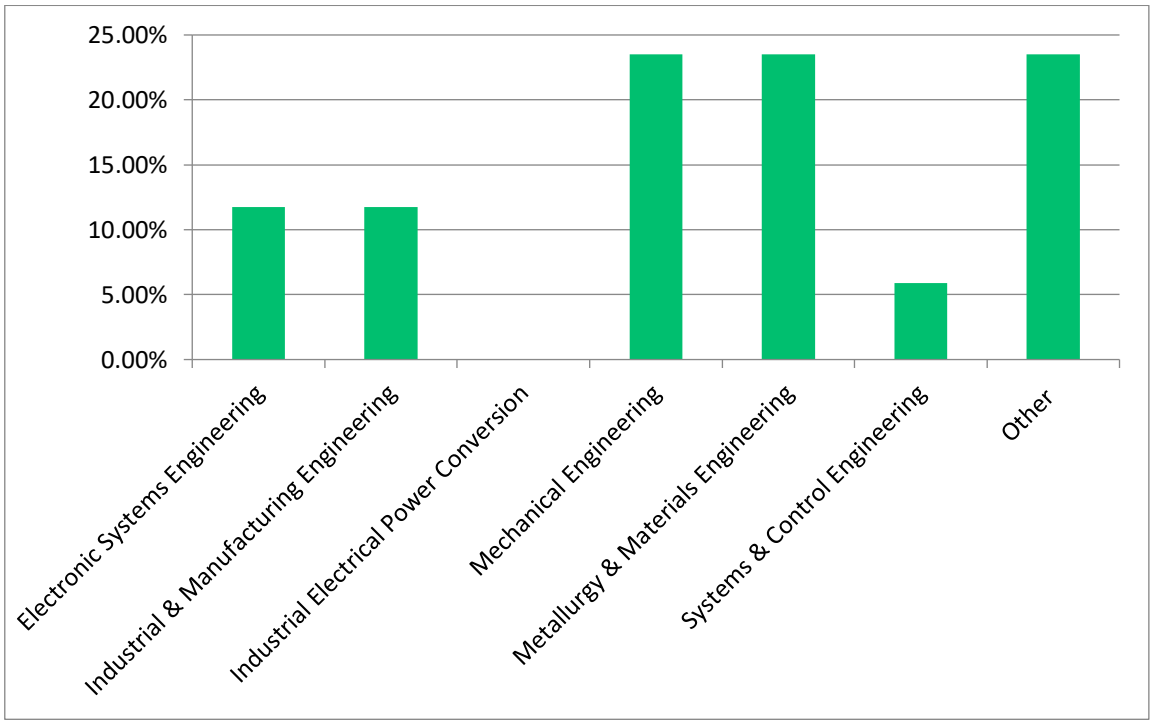

Figure 6. Department to which respondents belonged to

4.2.3 The Respondents' role within the University of Malta

Question 5 required academics to indicate their role within the UM. 47.06% (n=8) stated that they were Associate Professors, 29.41% (n=5) stated that they were Professors, 11.76% (n=2) stated that they were Lecturers, 5.88% (n=1) stated that they were Assistant Lecturers, and the remaining 5.88% (n=1) stated that they were Senior Lecturers. None of the participants were Casual or Visiting Lecturers (see figure 7).

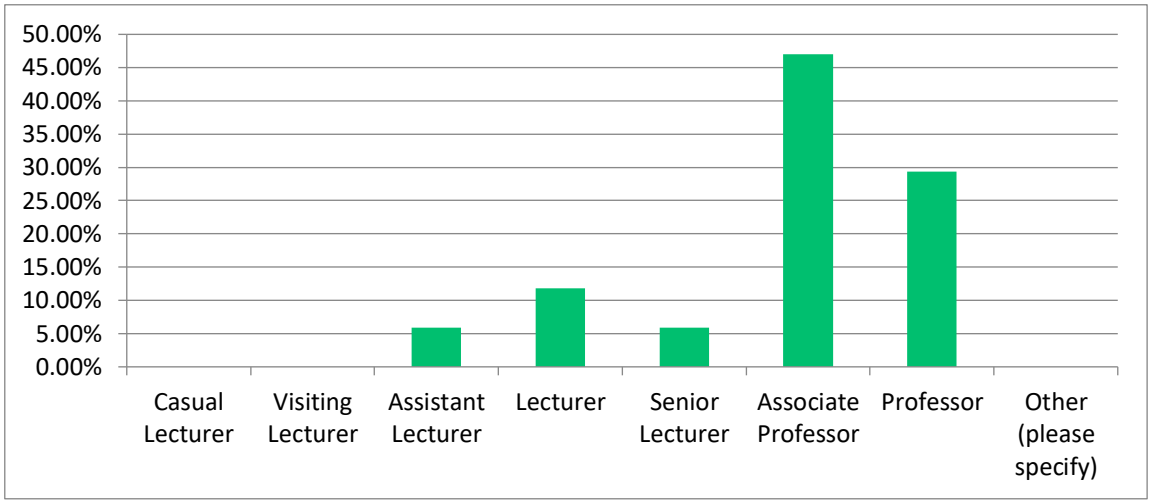

Figure 7. Respondents' role within the UM

4.3 Participation in Academic Research and its commercialisation

4.3.1 Previous Participation in Innovation-Related Academic Research

Question 6 asked participants to state whether they had ever participated in innovation-related academic research. A total of 88.24% (n=15) stated they had participated in innovation-related academic research, while the remaining 11.76% (n=2) had not. Table 12 illustrates these results in terms of gender.

Table 12. Previous participation in innovation-related academic research by gender

Answer Choices	Yes	No
Male	84.62% (n=11)	15.38% (n=2)
Female	100% (n=4)	0% (n=0)

4.3.2 The University's role in previous Innovation-Related Academic Research

Question 7 asked participants who had previously participated in innovation-related academic research regarding the UM's role. A total of 86.67% (n=13) stated that UM occupied the role of Lead Partner, while the remaining 13.33% (n=2) stated that UM occupied the role of Secondary Partner (see figure 8).

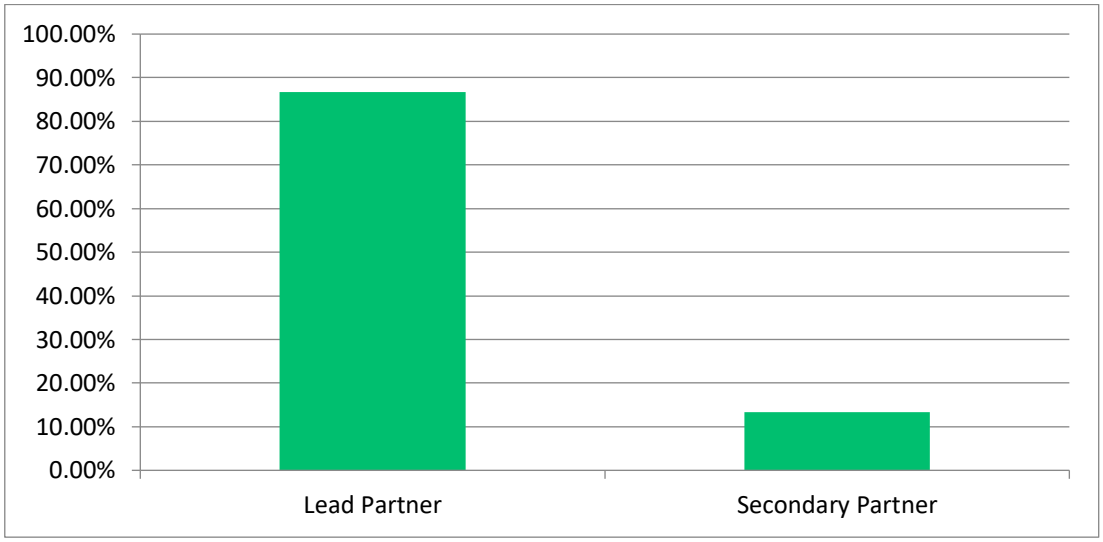

Figure 8. The UM's role in innovation-related academic research

4.3.3 The Respondents' Role in Innovation-Related Academic Research

Question 8 asked participants who had previously participated in innovation-related academic research to indicate their role within the project. A total of 80% (n=12) stated that they were Principal Investigators while 6.67% (n=1) held a Top Management role and 6.67% (n=1) held a Senior Research role. The remaining 6.67% (n=1) stated that they occupied a role which was not listed. None of the participants held a Middle Management role (see figure 9).

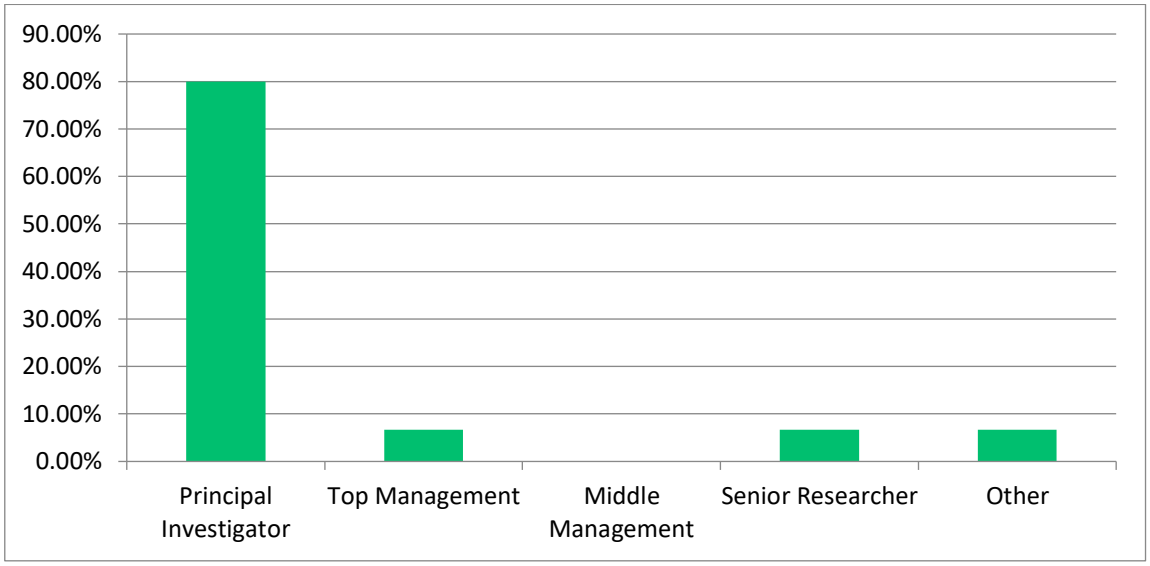

Figure 9. The respondents' role in innovation-related academic research

4.3.4 Previous participation in Commercialisation of Academic Research

Question 9 asked participants who had previously participated in innovation-related academic research whether they had proceeded with commercialisation. A total of 66.67% (n=10) stated that they had participated in the commercialisation of academic

research, while the remaining 33.3% (n=5) had not. Table 13 illustrated responses in terms of gender.

Table 13. Previous participation in commercialisation of academic research by gender

Answer Choices	Yes	No
Male	90.91% (n=10)	9.09% (n=1)
Female	0% (n=0)	100% (n=4)

Categorising these results by age, the following results were obtained:

a. 100% (n=4) of the participants who had previously participated in innovation-related academic research and falling within the age bracket of 41 – 50 responded that they had proceeded with their participation in commercialisation of academic research;
b. 100% (n=2) of the participants who had previously participated in innovation-related academic research and falling within the age bracket of 65+ responded that they had proceeded with their participation in commercialisation of academic research;
c. 50% (n=3) of the participants who had previously participated in innovation-related academic research and falling within the age bracket of 51 - 64 responded that they had proceeded with their participation in commercialisation of academic research, while the remaining 50% (n=3) did not;
d. 66.67% (n=2) of the participants who had previously participated in innovation-related academic research and falling within the age bracket of 31 - 40

responded that they had not proceeded with their participation in commercialisation of academic research, while the remaining 33.33% (n=1) responded affirmatively.

e. None of the participants who had previously participated in innovation-related academic research pertained to the age bracket of 30 or under.

These results are summarised in Table 14.

Table 14. Previous participation in commercialisation of academic research by age

Age Bracket	Yes	No	Total
30 or under	00.00% (n=0)	00.00% (n=0)	00.00% (n=0)
31 – 40	33.33% (n=1)	66.67% (n=2)	20.00% (n=3)
41 – 50	100.00% (n=4)	00.00% (n=0)	26.67% (n=4)
51 – 64	50.00% (n=3)	50.00% (n=3)	40.00% (n=6)
65+	100.00% (n=2)	00.00% (n=0)	13.33% (n=2)

Additionally, categorising these results by the respondents' role within the UM, generated the following results:

a. 75.00% (n=3) of the participants occupying the role of full Professors had previously participated in innovation-related academic research and also engaged in its commercialisation, while the remaining 25.00% (n=1) did not;

b. 66.67% (n=4) of the participants occupying the role of Associate Professors had previously participated in innovation-related academic research and also engaged in its commercialisation, while the remaining 33.33% (n=2) did not;

c. 100% (n=1) of the participants occupying the role of a Senior Lecturer had previously participated in innovation-related academic research and also engaged in its commercialisation;
d. 100% (n=1) of the participants occupying the role of an Assistant Lecturer had previously participated in innovation-related academic research and also engaged in its commercialisation;
e. 100% (n=2) of the participants occupying the role of Lecturers had previously participated in innovation-related academic research but did not engage in its commercialisation;
f. None of the participants occupying the roles of Casual Lecturers and Visiting Lecturers had previously participated in innovation-related academic research, consequently, none of them participated in its commercialisation.

Table 15 summarises these results.

Table 15. Previous participation in commercialisation of academic research by respondents' role at the UM

Respondents' role occupied at the UM	Yes	No	Total
Casual Lecturer	00.00% (n=0)	00.00% (n=0)	00.00% (n=0)
Visiting Lecturer	00.00% (n=0)	00.00% (n=0)	00.00% (n=0)
Assistant Lecturer	100.00% (n=1)	00.00% (n=0)	07.14% (n=1)
Lecturer	00.00% (n=0)	100.00% (n=2)	14.29% (n=2)
Senior Lecturer	100.00% (n=1)	00.00% (n=0)	07.14% (n=1)
Associate Professor	66.67% (n=4)	33.33% (n=2)	42.86% (n=6)
Professor	75.00% (n=3)	25.00% (n=1)	28.57% (n=4)

4.3.5 Consideration of future participation in innovation-related academic research

Question 10 asked participants who had never participated in innovation-related academic research whether they would consider participating in such research in the future. All of the participants (100%, n=2) stated that they would consider participating in innovation-related academic research.

4.3.6 The University's role in the commercialisation of academic research

Question 12 asked participants who had previously engaged in the commercialisation of academic research what role the UM occupied in the process. 87.5% (n=7) stated that

the UM was a Lead Partner, while the remaining 12.5% (n=1) said that UM was a Secondary Partner (see figure 10).

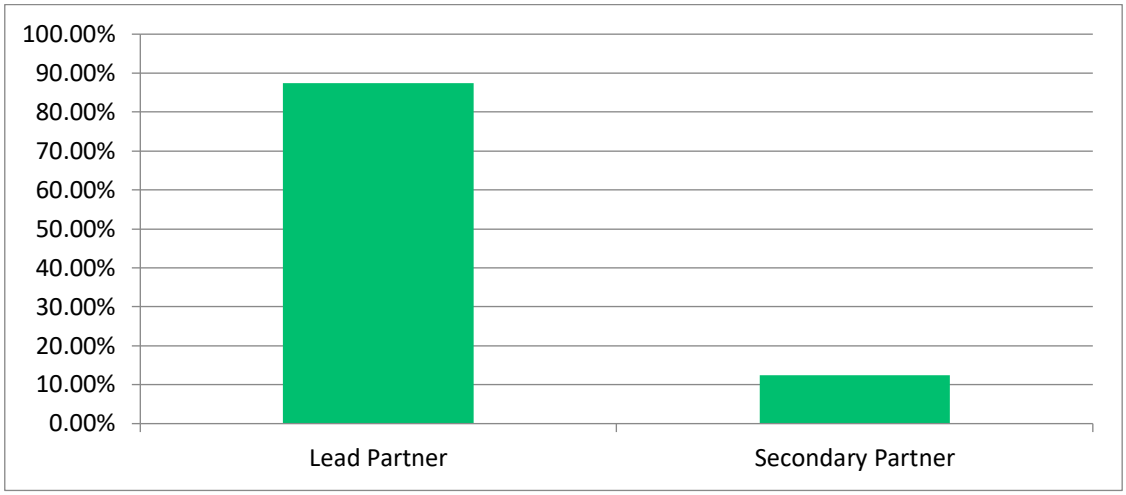

Figure 10. The UM's role in the commercialisation of academic research

4.3.7 The respondents' role in the commercialisation of academic research

Question 13 asked participants who had previously participated in the commercialisation of academic research to specify their role in the commercialisation of academic research. A total of 62.50% (n=5) stated they occupied a role of Principal Investigator, 12.5% (n=1) occupied the role in Top Management, 12.5% (n=1) occupied a role of Senior Research and the remaining 12.5% (n=1) specified that they occupied another role which was not listed. None of the respondents occupied the role of Middle Management (see figure 11).

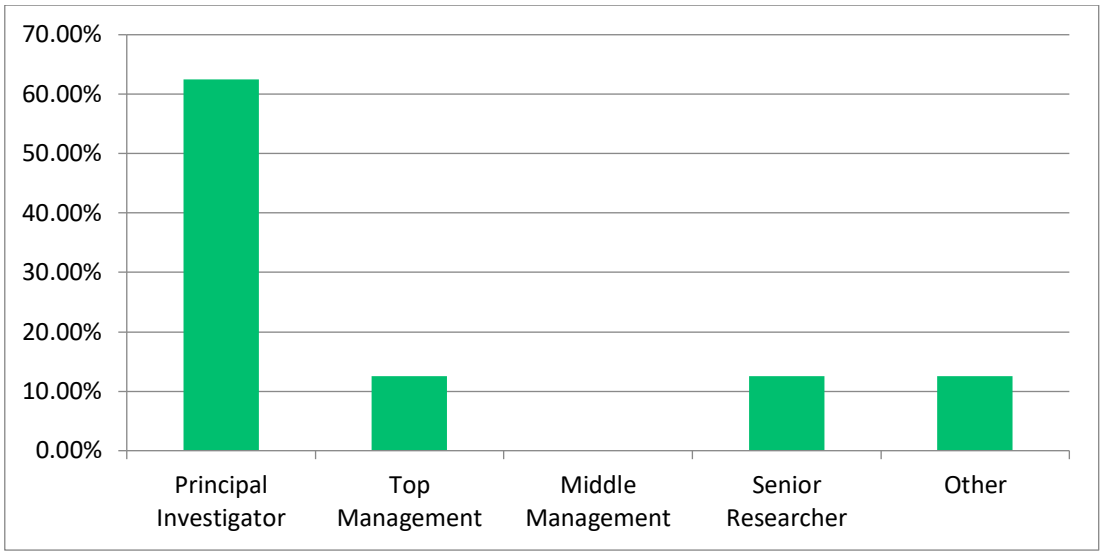

Figure 11. The respondents' role in the commercialisation of academic research

4.3.8 The Respondents' level of involvement in decisions related to the commercialisation of academic research

Question 14 asked participants who had previously participated in the commercialisation of academic research to specify their level of involvement in the decisions related to the commercialisation process. A total of 62.5% (n=5) specified that they were very highly involved, 25% (n=2) specified that they had high involvement, and the remaining 12.5% (n=1) stated that they had medium involvement. None of the participants indicated having minimal or no involvement (see figure 12).

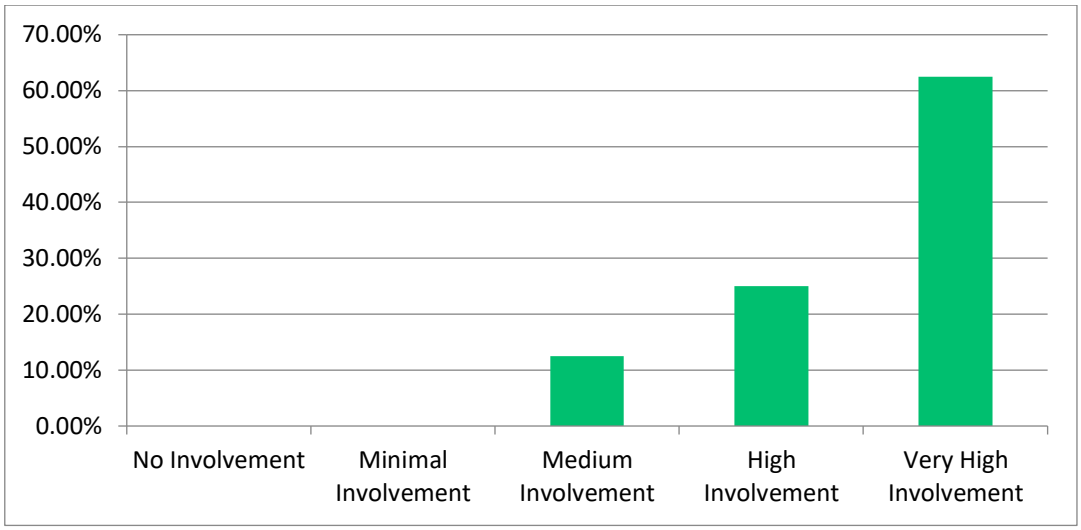

Figure 12. The respondents' level of involvement in decisions related to the commercialisation academic research

4.3.9 Success of the commercialisation of the innovation

Question 16 asked participants to identify whether or not they believed that the commercialisation of the innovation was successful. A total of 75% (n=6) stated that in their opinion commercialisation of the innovation was not successful, while the remaining 25% (n=2) stated that they believed that commercialisation of the innovation was successful.

4.3.10 Consideration of future participation in the commercialisation of academic research

Question 17 asked participants who had participated in innovation-related academic research but had not yet participated in the commercialisation process whether they would consider doing so in the future. A total of 80% (n=4) replied that they would

consider participating in the commercialisation of academic research in the future, while the remaining 20% (n=1) said that they would not consider participating in the commercialisation of academic research in the future. The latter stated that:

"*The administrative bureaucracy is extensive, although it is a good idea and a culmination of the results of your research, the (personal) gains achieved do not exceed the time and effort devoted to completed the commercialisation process*". (Associate Professor)

4.4 Barriers and Facilitators of Commercialising Academic Research

4.4.1 Challenges encountered by respondents during their involvement in commercialising academic research

Question 15 gave participants a list of seven potential challenges which they might have encountered during their involvement in commercialising academic research. The most common challenge encountered by the participants was "Building credibility for the innovative product (and, if applicable the commercialising entity)" (87.5%, n=7). Table 16 shows these findings.

Table 16. Challenges encountered by respondents during their involvement in commercialising academic research

Challenges	Yes	No
Selecting the appropriate strategy	75.00% (n=6)	25.00% (n=2)
Understanding the perspective from a customer point of view	37.50% (n=3)	62.50% (n=5)
Building credibility for the innovative product (and, if applicable the commercialising entity)	87.50% (n=7)	12.50% (n=1)
Developing networks with stakeholders (stakeholders here refer to the industry, financial entities, political entities, customers and other public stakeholders including media and environmental-related stakeholders)	37.50% (n=3)	62.50% (n=5)
Building and obtaining stakeholder support	37.50% (n=3)	62.50% (n=5)
Changing stakeholders' attitudes and behavioural processes to overcome barriers and facilitate innovation adoption	50.00% (n=4)	50.00% (n=4)
Generating market sales	62.50% (n=5)	37.50% (n=3)

4.4.2 Barriers hindering the commercialisation of academic research

Question 38 was an open-ended question asking participants to identify other barriers hindering the commercialisation of academic research. Nine themes from eight

responses were identified. The lack of funding was the most prominent theme in the findings. Table 17 summarises these themes.

Table 17. Barriers to commercialising academic research

Themes	Count
Lack of funding	5
Lack of institutional support	3
Prioritisation of publications over commercialisation	2
Lack of appreciation	2
Lack of staff	2
RSO turnover	1
Commercialisation is a novel concept at UM	1
Commercialisation is fragmented	1
Time constraints	1

Question 39 asked participants to suggest ways of overcoming the barriers to commercialising academic research. From the list of suggestions, eight themes were identified. The most prominent theme was that more funding is needed to support the commercialisation of academic research. Other prominent themes relating to human resources were identified. These included the need for more permanent Research Support Officer (RSO)s contracts and an increase in personnel working within the units supporting innovative research and its commercialisation. Table 18 summarises the identified themes.

Table 18. Recommendations to overcome the barriers of commercialising academic research

Themes	Count
Support to obtain funding for commercialisation of academic research	3
Competitive and permanent contracts for RSOs	2
Increase in personnel within the units supporting the commercialisation of academic research (RSSD, PSO, CR&KTO, and RIDT)	2
Retaining skilled RSOs	1
Setting realistic targets	1
Decrease lecturing load for academics engaged in commercialisation	1
Centralisation of RSSD, PSO, CR&KTO and RIDT	1
Government funding for commercialisation of academic research	1

4.4.3 Key factors facilitating the commercialisation of academic research

Question 40 was an open-ended question which asked participants to identify the key factors facilitating the commercialisation of academic research. Six themes were derived from the participants responses. The most common facilitator was the collaboration between the industry and academia. Table 19 summarises the emergent findings.

Table 19. Facilitators of commercialising academic research

Themes	Counts
Industry collaboration	3
Adequate funding	2
High quality researchers	2
Adequate support	1
Equipment availability	1
Legal support	1

Question 41 asked participants to suggest ways of how these facilitators can be improved. Four themes were identified and are summarised in Table 20.

Table 20. Recommendations to improve the facilitators of commercialising academic research

Themes	Count
Engaging professionals with a successful track record in commercialisation	1
Make existing resources available (ex. Equipment)	1
Remove bureaucratic procurement procedures	1
Directory of academic interested in commercialisation available to the industry	1

4.4.4 The skills required to carry out innovation-related academic research and its commercialisation

Question 19 was an open-ended question which asked the participants' opinion on the skills required to carry out innovation-related academic research and its commercialisation. From the content analysis eight skills were identified. Table 21 illustrates these results.

Table 21. Skills required to carry out innovation-related academic research and its commercialisation

Skills	Responses
Communication Skills	50.00% (n=7)
Networking Skills	57.14% (n=8)
Negotiating Skills	92.86% (n=13)
Commercial Awareness Skills	92.86% (n=13)
New Business Development Skills	85.71% (n=12)
Technological Skills	7.14% (n=1)
Research Skills	7.14% (n=1)

4.4.5 The required key motivating factors for the commercialisation of academic research

Question 20 was an open-ended question which asked the participants' opinion on the key factors required to encourage the commercialisation of academic research. From 12

responses, four themes were derived. The most common factor encouraging commercialisation of academic research was Organisational Support. This included financial and human resources, incentives for academics (financial rewards, prioritising commercialisation over publications), and support from the CR&KTO. Another important theme was Collaborating with the Industry. Table 22 describes the emergent themes.

Table 22. Factors encouraging the commercialisation of academic research

Themes	Count
Organisational Support	8
Industry Collaborations	5
Realistic about success rate	1
Partner support	1

4.4.6 The process of idea generation, screening, development and testing before commercialisation

Question 21 was an open-ended question asking participants to identify ways of how ideas are generated, screened, developed and tested before they are commercialised. From 11 responses, four themes related to idea generation, four themes related to screening, four themes related to development and two themes related to testing. Table 23 describes these emergent themes.

Table 23. Generation, Screening, Development and Testing of ideas

Stages	Themes	Count
Idea Generation	Problem Solving	4
	Industry Collaboration	2
	Research	2
	Student Collaboration	1
Screening	Darwin's theory of survival	2
	Market Applicability	2
	Funding body	1
	Preliminary Research	1
Development	Funding	3
	Recruitment of qualified personnel	2
	Perseverance	1
	Overcoming bureaucratic processes	1
Testing	Solution to problem	1
	Readiness for market	1

4.4.7 The respondents' view on the consideration of marketing-related factors in the commercialisation process

Question 22 asked all participants on their views of whether or not marketing-related factors are being considered in the commercialisation process. 57.14% (n=8) of the

respondents stated that such factors are not considered in the commercialisation process, while the remaining 42.86% (n=6) responded affirmatively.

Question 23 asked the participants to select from a list of four marketing factors which were considered in the commercialisation process. All respondents (100%, n=5) have identified that the commercialisation process considers both the customers' needs and wants; and, pricing strategies. 60% (n=3) have identified that promotional strategies were considered in the commercialisation process, while 40% (n=2) identified that place-related strategies were also considered (see figure 13).

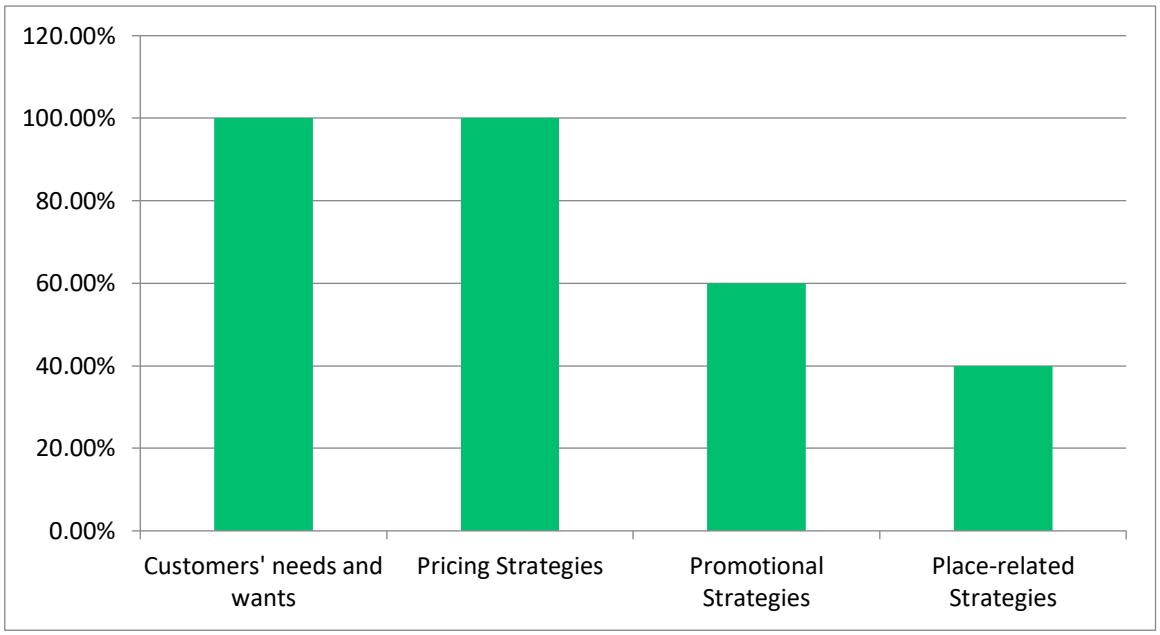

Figure 13. The respondents' identification of which marketing-related factors are being considered in the commercialisation process

Question 24 asked participants who held the view that marketing-related factors are considered in the commercialisation process to rate the level of consideration such marketing-related factors are considered during the commercialisation of academic research carried out by the UM. Table 24 summarises the results.

Table 24. The respondents' rating on the level of consideration marketing-related factors are given during the commercialisation of academic research carried out by the UM

Marketing-related factors being considered in the commercialisation process of academic research at the UM	No consideration	Minimal Consideration	Medium Consideration	High Consideration	Very High Consideration
Customers' needs and wants	00.00% (n=0)	00.00% (n=0)	20.00% (n=1)	60.00% (n=3)	20.00% (n=1)
Pricing Strategies	00.00% (n=0)	00.00% (n=0)	60.00% (n=3)	20.00% (n=1)	20.00% (n=1)
Promotional Strategies	00.00% (n=0)	20.00% (n=1)	60.00% (n=3)	20.00% (n=1)	00.00% (n=0)
Place-related Strategies	00.00% (n=0)	20.00% (n=1)	80.00% (n=4)	00.00% (n=0)	00.00% (n=0)

4.4.8 The respondents' view on whether the UM is taking the necessary steps to procure funding for the research, development and commercialisation of innovative academic research

Question 25 asked the respondents' whether the UM is taking the necessary steps to procure funding for the research, development and commercialisation of innovative academic research. A total of 53.85% (n=7) stated that the UM does not take the necessary steps, while the remaining 46.15% (n=6) stated that it does (see figure 14).

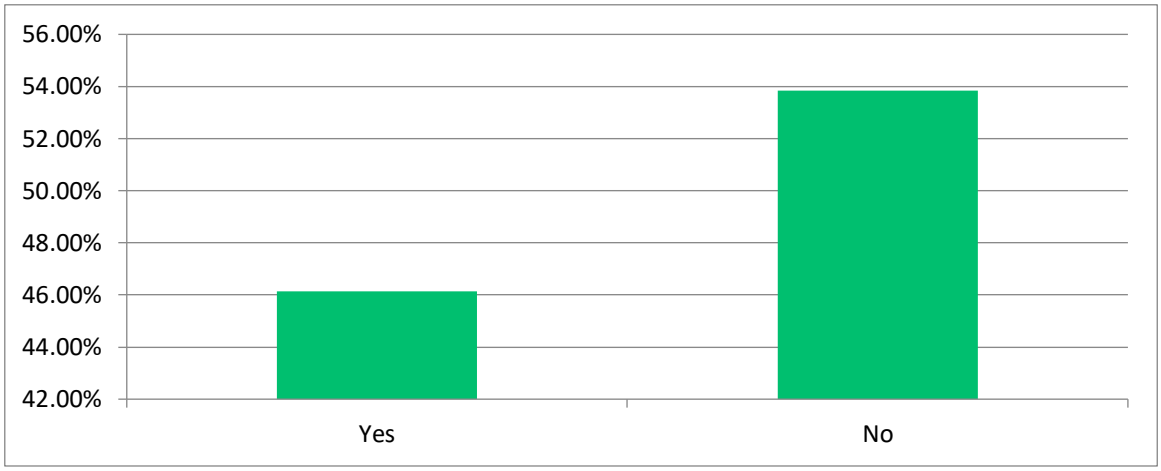

Figure 14. The respondents' view on whether the UM takes the necessary steps to procure funding for the research, development and commercialisation of innovative academic research

4.4.9 The respondents' view on whether the legal frameworks of the Nation support the commercialisation of innovation

Question 26 asked for the participants' opinion on whether they think that the Nations' legal frameworks support the commercialisation of innovation. A total of 69.23% (n=9)

stated that the Nation's legal frameworks do support the commercialisation of innovation, while the remaining 30.77% (n=4) stated that it does not (see figure 15).

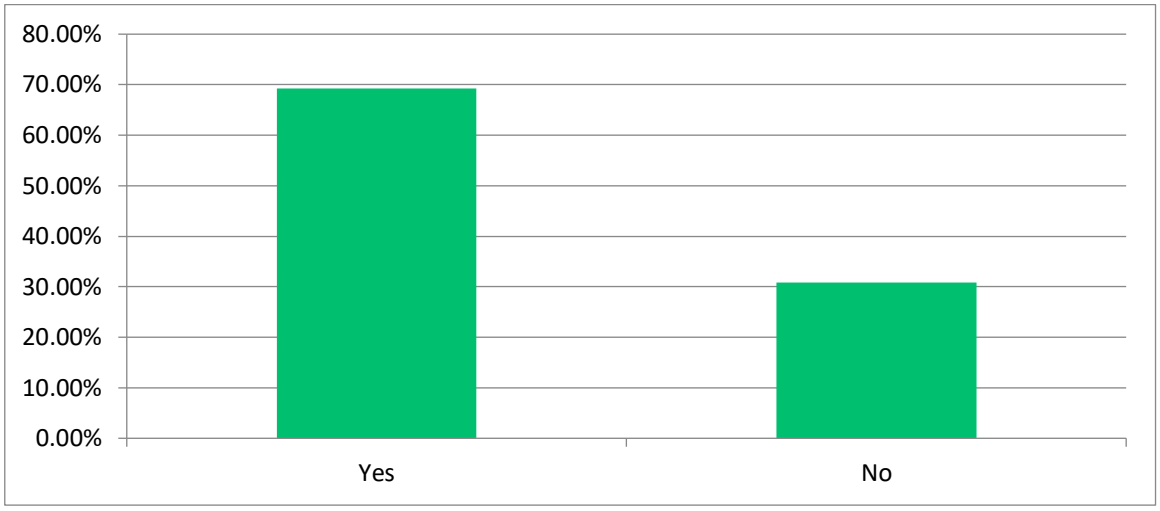

Figure 15. The respondent's view on whether or not the Nation's legal frameworks support the commercialisation of innovation

4.4.10 The respondents' view on whether the legal frameworks and policies of the UM support the commercialisation of innovation

Question 27 asked for the participants' opinion on whether the UMs' legal frameworks and policies support the commercialisation of innovation. 69.23% (n=9) responded affirmatively, while the remaining 30.77% (n=4) stated the UM's legal frameworks do not support the commercialisation of innovation (see figure 16).

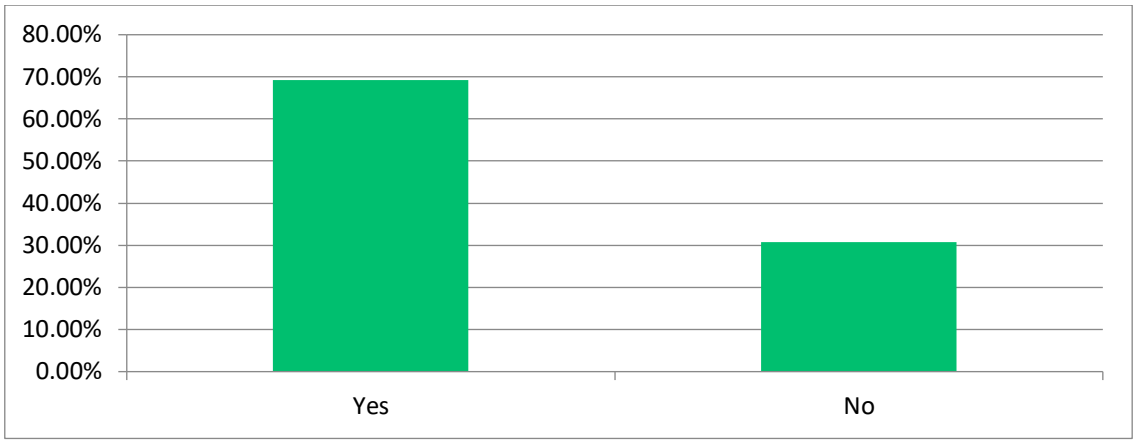

Figure 16. The respondents' view on whether the legal frameworks and policies of UM support the commercialisation of innovation

4.4.11 The respondents' view on the extent to which they think that the legal frameworks and policies of the Nation and the UM support the commercialisation of innovation

Question 28 asked for the respondents' view on the extent to which they think that the legal frameworks and policies of the Nation and the UM support the commercialisation of innovation. Table 25 summarises the results.

Table 25. The respondents' view on the extent to which they think that the legal frameworks and policies of the Nation and the UM support the commercialisation of innovation

	No consideration	Minimal Consideration	Medium Consideration	High Consideration	Very High Consideration
National	00.00% (n=0)	23.08% (n=3)	53.85% (n=7)	15.38% (n=2)	07.69% (n=1)
UM	07.69% (n=1)	15.38% (n=2)	53.85% (n=7)	15.38% (n=2)	07.69% (n=1)

4.4.12 The respondents' view on the ways the UM engages in the transferring of its commercialised knowledge to the industry

Question 29 asked the respondents to identify and rate from a list the ways that the UM engages in the transferring of its commercialised knowledge to the industry. Table 26 and Figure 17 show the results.

Table 26. The respondents' view on the ways the UM engages in the transferring of its commercialised knowledge to the industry

	No Engagement	Minimal Engagement	Medium Engagement	High Engagement	Very High Engagement
Externally Funded Research Projects	00.00% (n=0)	23.08% (n=3)	30.77% (n=4)	30.77% (n=4)	15.38% (n=2)
Relationships between the UM and the industry	07.69% (n=1)	38.46% (n=5)	30.77% (n=4)	23.08% (n=3)	00.00% (n=0)
Consultation Services	07.69% (n=1)	30.77% (n=4)	38.46% (n=5)	23.08% (n=3)	00.00% (n=0)
Establishment of Spin-off Companies	15.38% (n=2)	30.77% (n=4)	23.08% (n=3)	30.77% (n=4)	00.00% (n=0)
Licensing of research	07.69% (n=1)	30.77% (n=4)	46.15% (n=6)	15.38% (n=2)	00.00% (n=0)
Patenting of Research	00.00% (n=0)	30.77% (n=4)	23.08% (n=3)	30.77% (n=4)	15.38% (n=2)
Other	00.00% (n=0)	00.00% (n=0)	00.00% (n=0)	00.00% (n=0)	00.00% (n=0)

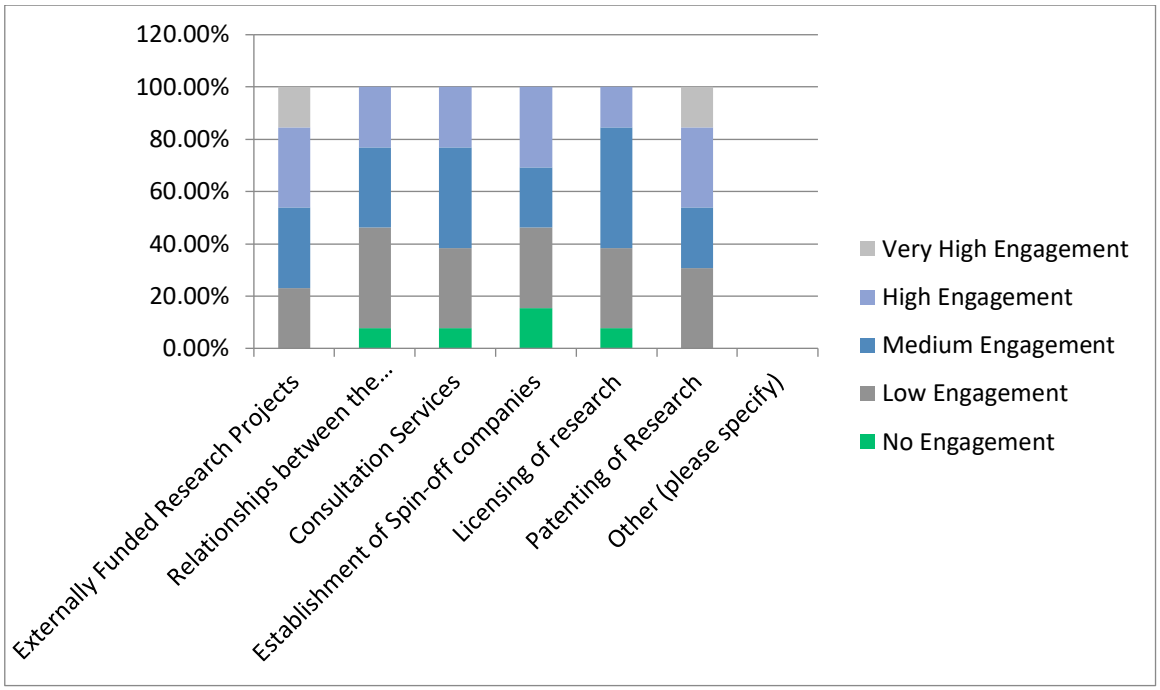

Figure 17. The respondents' view on the ways the UM engages in the transferring of its commercialised knowledge to the industry

4.4.13 The respondents' view on the UM having the required tools and resources to support innovation and its commercialisation

Question 30 asked the respondents to rate their views on whether the UM has the required tools and resources to support innovation and its commercialisation. The rating was given from 0 for 'Inadequate tools and resources' to 5 for 'Excellent tools and resources'. Table 27 shows the results for four of these tools.

Table 27. The respondents' view on the UM having the required tools and resources to support innovation and its commercialisation

Research Tools and Resources	0 – Inadequate tools and resources	1	2	3	4	5 – Excellent tools and resources
Research Infrastructure	00.00% (n=0)	15.38% (n=2)	23.08% (n=3)	00.00% (n=0)	46.15% (n=6)	15.38% (n=2)
Research Mechanisms	07.69% (n=1)	15.38% (n=2)	23.08% (n=3)	23.08% (n=3)	23.08% (n=3)	07.69% (n=1)
Investment in Personnel training and development	07.69% (n=1)	30.77% (n=4)	30.77% (n=4)	30.77% (n=4)	00.00% (n=0)	00.00% (n=0)
Innovation-oriented culture	23.08% (n=3)	23.08% (n=3)	23.08 (n=3)	30.77% (n=4)	00.00% (n=0)	00.00% (n=0)

Participants were also asked for other UM tools and resources required to support innovations and its commercialisation which were not included in the list. The two participants who elaborated on this question stated that only publications are rewarded, and that commercialisation is not.

4.5 Knowledge and recommendations related to the university's infrastructure to support academic research

4.5.1 The respondents' awareness on the function of the university's research infrastructure offices to support academic research

Question 31 asked respondents on their awareness of the university's research infrastructural offices designed to support academic research. Being provided with the list of the four offices (i.e. RSSD, PSO, CR&KTO, and RIDT) all respondents (100%, n=13) responded that they are aware of all of these offices.

Questions 32 to 35 asked participants to select the appropriate function of each of these offices. 30.77% (n=4) selected the correct function for the RSSD office; 84.62% (n=11) selected the correct function for PSO; 100% (n=13) selected the correct function for CR&KTO; and 92.31% (n=12) selected the correct function for the RIDT office. Tables 28 to 31 highlight the separate results for the RSSD, PSO, CR&KTO and RIDT respectively. The correct functions of each of these offices has been highlighted in Table 3.

Table 28. The respondents' perceived function of RSSD

Function	Results
To offer support to all University units carrying research in terms of obtaining funds access and writing their proposal.	30.77% (n=4)
To assist the commercialisation process of knowledge elicited from research; to manage Intellectual Property owned by the UM; and, to support academic collaborations with the industry.	00.00% (n=0)
To obtain funding from private and corporate entities with the aim of exploiting university research and its commercialisation.	15.38% (n=2)
To offer guidance and support to resident academics participating in externally-funded research at proposal stage and its implementation.	53.85% (n=7)

Table 29. The respondents' perceived function of PSO

Function	Results
To offer support to all University units carrying research in terms of obtaining funds access and writing their proposal.	15.38% (n=2)
To assist the commercialisation process of knowledge elicited from research; to manage Intellectual Property owned by the UM; and, to support academic collaborations with the industry.	00.00% (n=0)
To obtain funding from private and corporate entities with the aim of exploiting university research and its commercialisation.	00.00% (n=0)

To offer guidance and support to resident academics participating in externally-funded research at proposal stage and its implementation.	84.62% (n=11)

Table 30. The respondents' perceived function of CR&KTO

Function	Results
To offer support to all University units carrying research in terms of obtaining funds access and writing their proposal.	00.00% (n=0)
To assist the commercialisation process of knowledge elicited from research; to manage Intellectual Property owned by the UM; and, to support academic collaborations with the industry.	100% (n=13)
To obtain funding from private and corporate entities with the aim of exploiting university research and its commercialisation.	00.00% (n=0)
To offer guidance and support to resident academics participating in externally-funded research at proposal stage and its implementation.	00.00% (n=0)

Table 31. The respondents' perceived function of RIDT

Function	Results
To offer support to all University units carrying research in terms of obtaining funds access and writing their proposal.	07.69% (n=1)
To assist the commercialisation process of knowledge elicited from research; to manage Intellectual Property owned by the UM; and, to support academic collaborations with the industry.	00.00% (n=0)
To obtain funding from private and corporate entities with the aim of exploiting university research and its commercialisation.	92.31% (n=12)
To offer guidance and support to resident academics participating in externally-funded research at proposal stage and its implementation.	00.00% (n=0)

4.5.2 The respondents' utilisation of the services provided by RSSD, PSO, CR&KTO, and RIDT

Question 36 asked participants' whether they had utilised the services provided by the UM's research infrastructural offices as highlighted in Table 3. 92.31% (n=12) have utilised the services of RSSD while the remaining 7.69% (n=1) have not. 100% (n=13) of the respondents utilised the services offered by PSO. 84.62% (n=11) have utilised the services of CR&KTO while the remaining 15.38% (n=2) have not. 23.08% (n=3) have utilised the services of RIDT while the remaining 76.92% (n=10) have not. These results are represented in Table 32.

Table 32. The respondents' utilisation of the services of RSSD, PSO, CR&KTO, and RIDT

Research Infrastructural Office	Yes	No
Research Support Services Directorate (RSSD)	92.31% (n=12)	7.69% (n=1)
Project Support Office (PSO)	100.00% (n=13)	0.00% (n=0)
Corporate Research and Knowledge Transfer Office (CR&KTO)	84.62% (n=11)	15.38% (n=2)
Research Innovation and Development Trust (RIDT)	23.08% (n=3)	76.92% (n=10)

4.5.3 The respondents' recommendations to improve the services provided by RSSD, PSO, CR&KTO, and RIDT

Question 37 asked participants to provide recommendations to improve the services provided by RSSD, PSO, CR&KTO and RIDT. From 8 responses, seven themes were identified. The two most prominent themes were the need for increased support from proposal stage up to commercialisation, and the need to increase the number of employees working within these units so that better support can be offered. Table 33 describes the emergent themes.

Table 33. Recommendations for the improvement of RSSD, PSO, CR&KTO and RIDT

Themes	Count
Increase in support from proposal stage to commercialisation	3
Increase in number of employees	3
Increase in efficiency	1
Dedicated Commercialisation Unit	1
Centralisation of these units	1
Consistency of quality of support	1
Teamwork between academics and units	1

4.6 Research Hypothesis

Although research hypotheses were formulated as presented in Section 3.4, these could not be tested due to the low response rate. Nevertheless, these present a point of departure for future research.

4.7 Conclusion

This chapter presented the findings from the online questionnaires distributed to all academics engaged within the Faculty of Engineering, and sought to identify the barriers and facilitators of commercialising academic research. Furthermore, it sought to identify recommendations to make the process of commercialising academic research more seamless with the aim of increasing its uptake and success rates within the UM.

The most common barriers faced by academics during the commercialisation process included: building credibility for the innovative product; lack of funding; and lack of institutional support. Conversely, collaboration with the industry and the availability of adequate funding were the most common facilitators. Recommendations made by academics to make the process of commercialising academic research more seamless included: institutional support to obtain funding for commercialisation, and better conditions for RSOs which would increase their retainment and their participation in the commercialisation process.

These findings will be discussed in light of the available literature in Chapter 5.

Chapter 5: Discussion

5.1 Introduction

This quantitative cross-sectional study attempted to identify the barriers and facilitators encountered by academics from the Faculty of Engineering within the UM during the commercialisation of academic research; and subsequently proposing recommendations and changes to the current procedures adopted by the UM in commercialising research and innovation to make the process more seamless. In light of this, this chapter will discuss the most predominant findings from this research presented in Chapter 4 in comparison with the findings from the previous literature which were presented in Chapter 2.

5.2 Demographics of academics participating in the commercialisation of academic research and innovation

The data obtained from the present study was predominated by male academics who accounted for over 75% of the total sample. A reason for this might be that commercialisation of academic research is traditionally more associated with males than females. In fact, over 90% of male academics who had previously participated in innovation-related academic research participated in commercialisation activities. While none of the female academics who previously participated in innovation-related academic research engaged in its commercialisation. This finding coincides with those

from previous literature (Azoulay, et al., 2007; Bercovitz & Feldman, 2008; Ding, et al., 2006; Haeussler & Colyvas, 2011; Whittington, 2009).

Findings pertaining to age were less conclusive (Perkmann, et al., 2013). Academics aged between 41 and 50, who had previously participated in innovation-related academic research, all pursued commercialisation. This might indicate that these academics were more accustomed to norms of commercialisation in academia (Bercovitz & Feldman, 2008). Despite that previous literature suggested that more established academics were more likely to engage in the commercialisation of academic research due to their experience and connections, the findings from the present study were mixed (Casper & Murray, 2005; Haeussler & Colyvas, 2011; Stuart & Ding, 2006). Although all academics aged 65+ who had previously engaged in innovation-related academic research engaged in commercialisation activities, only half of the academics aged between 51 and 64 had pursued commercialisation. The reason for the latter might be due to more traditional norms of academic values instilled in these academics during their education during which commercialisation was less common (Renault, 2006). Moreover, academics ages 65+ might have fewer lecturing hours, and could focus more on conducting research and its commercialisation.

The findings of impact of seniority on commercialisation of innovation-related academic research were clearer. More established academics were more likely to engage in commercialisation activities with Associate Professors' and Professors' engagement predominating commercialisation activities which equated to 67% and 75% respectively; this coincides with previous findings (Casper & Murray, 2005; Haeussler & Colyvas, 2011;

Stuart & Ding, 2006). Apart from their connections made through years of experience, the reason for this might be that Associate Professors and Professors are more professionally established and their academic role is more secure (Bercovitz & Feldman, 2008; Haeussler & Colyvas, 2011; Stuart & Ding, 2006). Conversely, academics on pre-tenure contracts might be more cautious in pursuing commercialisation. However, Associate Professors and Professors are at the top of the academic hierarchy and thus, they are less likely to be pre-occupied with publishing to obtain promotions and have the time to focus more on commercialisation activities (Carayol, 2004; David, 1998).

5.3 Barriers to commercialising academic research and innovation

5.3.1 Introduction

The importance of commercialising academic research and innovation has been noted in the literature, and in recent years universities have started becoming more aware of this, as can be seen from their increasing engagement in this phenomenon (Binkauskas, 2012; Parker & Zilberman, 1993). The data from the present study supports this statement as from the 88.24% total of academics who had previously participated in innovation-related academic research, 66.67% expressed that they had proceeded with its commercialisation, despite the complex process that it involves (Friedman & Silberman, 2003; Parker & Zilberman, 1993). While 80% of those who had not yet participated in commercialisation of academic research stated, that they would like to do so in the future.

From the academics that had endeavoured in commercialisation of academic research, a mere 25% stated that they believed that commercialisation was successful, which coincides with previous data which shows that the latter is associated with high failure rates (Chiesa & Franttini, 2011). The lack of successful commercialisation has been partly attributed to the adopted commercialisation approaches and its associated pitfalls (Schilling, 2005 as cited by Chiesa & Franttini, 2011), which further confirms the importance of the present study.

5.3.2 Lack of funding

Lack of funding was the most common barrier hindering the commercialisation of academic research experienced by academics in the present study. This is in conformity with previous findings from O'Gorman, et al. (2008) who highlighted that the availability of funds played a vital role in academics involvement in commercialisation. This lack of funding is further worsened by the investing company's unwillingness to cover the full costs of commercialisation.

Despite the various funding assistance programmes available locally through entities such as MCST, the present findings suggest that the steps taken by UM to procure such funding are questionable (The Malta Council for Science & Technology, 2023; The Malta Council for Science & Technology, 2022; The Malta Council for Science & Technology, 2022; The Malta Council for Science and Technology, 2022). This indicates that although funds might be available, the inability of UM to secure these funds continues to impede commercialisation, despite RSSDs role in carrying research in obtaining funds access

(University of Malta, n.d.). Consequently, a more sustainable effort by UM to tap into these funding opportunities is merited.

For funding to be awarded, high level proposals need to be drafted, in fact participants expressed the need for increased support at proposal writing stage. Even though UM's RSSD also specialises in supporting academics in writing such robust proposals (University of Malta, n.d.), only 30.77% of the participants were aware of RSSDs correct function, despite the majority stating that they had previously made use of their services. This shows that training for academics about the roles of RSSD is needed, together with a more holistic collaboration between academics and these units.

Notwithstanding this, even if these efforts are made, these funds are not always guaranteed due to the high number of funding applications submitted, in comparison to the amount of funds available for distribution. As emphasised by the present findings, this highlights the importance of the government's financial investment to support academic institutions to engage in academic research and its commercialisation, especially if no other funding can be obtained (Hughes & Kitson, 2012; O'shea, et al., 2008).

5.3.3 Organisational Culture

Participants noted that commercialisation is a novel concept at UM which might impede commercialisation activity due to academics holding on to draconian ideologies relating to the traditional roles of universities (O'Gorman, et al., 2008; Renault, 2006). Moreover,

the study concluded that 71.4% of the participants felt that innovation-oriented culture with the UM is inadequate to some extent or other. This might instigate academics to confine to more traditional duties in which they feel more confident such as lecturing which is given higher importance by the university (O'Gorman, et al., 2008; Pohlmann, et al., 2022). Furthermore, participants stated that engaging in commercialisation is time-consuming and thus creates a dilemma in prioritising between pursuing commercialisation and contributing to their academic duties (O'Gorman, et al., 2008). This is worsened by the local organisational culture supporting traditional academic roles, which pressures academics to feel obliged to focus on the latter. Conversely, in environments where commercialisation is more accepted, the likelihood of academics engaging in commercialising academic research is increased (Haeussler & Colyvas, 2011).

The novelty of commercialisation at UM is mirrored in its rewarding system which prioritises publications over commercialisation. This further demotivates academics from commercialising academic research in order to obtain ranking promotions (Carayol, 2004; David, 1998; Hughes & Kitson, 2012; O'Gorman, et al., 2008; Renault, 2006). Moreover, UM's rewarding system might also be the reason why less established academics who have been engaged on a pre-tenure basis refrain from engaging in commercialisation since their position within the UM is not yet secured (Bercovitz & Feldman, 2008; Haeussler & Colyvas, 2011; Renault, 2006; Stuart & Ding, 2006). An organisational change in the rewarding system might alleviate this barrier not only by giving academics added incentives to commercialise, but also by instilling a change in

mentality about the university's role in society, potentially increasing commercialisation activity and success.

Another prominent barrier to commercialisation is the lack of institutional support. The present findings coincide with those of previous literature which highlighted that TT procedures are overly bureaucratic and fragmented (O'Gorman, et al., 2008; Pohlmann, et al., 2022). In addition to being a barrier to academics engaging in commercialisation, the present findings indicate that this might also discourage academics who had never engaged in commercialisation from doing so. The findings also suggest that this bureaucracy and fragmentation can be decreased through the centralisation of RSSD, PSO, RIDT and CR&KTO, which gives academics a "one-stop shop" for all academic research and commercialisation related processes. Centralisation decreases confusion amongst academics about the different roles of these offices, and facilitates all related processes, making it more streamlined and thus saving academics time which can be focused on other important duties.

5.3.4 Human Resources

The present study found that TTOs have a lack of human resources and require more staff to be able to deal with the demands of their services. Consequently, such insufficient human resources devoted by the academic institution decreases the TTOs ability to engage in activities with external organisations, thus further impeding commercialisation (Hughes & Kitson, 2012). Therefore, there needs to be an increase in

personnel within all the units supporting the commercialisation of academic research to ensure smoother and more streamlined operations.

Pohlmann, et al. (2022) identified human resources issues such as high staff turnover particularly in TTOs as one of the barriers to commercialising academic research. Locally, high staff turnover was identified in relation to Research Support staff (RSOs) since they are traditionally employed on a definite contract basis for the duration of the research project. Therefore, despite having worked closely on developing the innovation, their contracts are terminated prior to commercialisation, leaving academics having to fend for themselves. In view of this, participants highlighted the importance of retaining skilled RSOs within the Faculty by offering more financially enticing financial packages, and more stable working contracts. This will not only allow RSOs to support academics in the commercialisation phase, but also to retain their skills, knowledge and experience for future endeavours.

5.3.5 Barriers related to marketing

Although the marketing strategy effects and drives the marketing implementation towards commercialisation, more than half of the participants expressed that marketing related factors were not being considered in the commercialisation process (Aarikka-Stenroos & Lehtimäki , 2014). This might pose a barrier to academics seeking to commercialise, as marketing plays an essential role in the success of commercialisation. In fact, marketing helps in building credibility for the innovation which was deemed by participants in the present study as the most common challenge faced (87.50%).

Selecting the appropriate marketing strategy (75%) was the second most commonly encountered challenge. Its importance has been highlighted as it is detrimental to the entire commercialisation process since it impacts and drives its implementation (Aarikka-Stenroos & Lehtimäki , 2014). If the appropriate marketing strategy is not selected, the rates of commercialisation failure are increased and market sales are not generated. Thus, it is unsurprising that generating market sales was another challenge that academics faced.

5.4 Facilitators to commercialising academic research and innovation

5.4.1 Organisational Support

Organisational support which included financial support from the academic institution for commercialisation was amongst the most predominant key motivating factors and facilitators for the commercialisation of academic research in the present study. This is unsurprising given that the most common barrier experienced by academics in commercialising academic research and innovation was the lack of funding (O'Gorman, et al., 2008).

Despite the disagreement in the literature about the efficacy of financial rewards for academics who engage in commercialising academic research (Baldini, 2010; Del Barrio-Castro & Garcia-Quevedo, 2009; Friedman & Silberman, 2003), the present findings coincide with Lam (2011) as participants expressed that financial rewards act as

motivators for commercialisation. Additionally, participants also mentioned non-financial measures for academics engaged in commercialisation such as a decrease in teaching load as one of the facilitators. Such measures not only motivate academics to engage in commercialisation of academic research but decreases time constraints by giving them allocated time for commercialisation. This coincides with previous literature which provides non-financial measures in addition to financial bonuses as a way of supporting and rewarding academics when partaking in commercialisation (Arvanitis, et al., 2008; Bradler, et al., 2016).

The benefits of adequate support from TTOs such as CR&KTO has been emphasised in the literature and has been associated with a number of benefits including educating potential investors, encouraging industry-university ties, supporting academics in business planning and providing access to university resources such as equipment (O'Gorman, et al., 2008; Phan & Siegel, 2006). Participants highlighted the need for consistency of quality support provided by these units. Consistent support of quality facilitates commercialisation of academic research; however, this can only be provided with sufficient human resources and training offered to personnel working within these units due to the known staff shortages and high employee turnover (Hughes & Kitson, 2012; Pohlmann, et al., 2022).

5.4.2 Industry Collaborations

Industry collaboration was identified by participants in the present study as both a motivating factor for commercialisation and a key facilitator. This coincides with previous literature which highlighted the importance of industry support and collaboration which helps academics to identify potential commercialisation avenues (Agrawal & Henderson, 2002; Ozgen & Baron, 2007). Moreover, collaborating with the industry increases academics knowledge of real-world problems to which they can develop solutions through their research, gives them access to in-kind resources including materials and equipment, and gives them access to funding. The latter has been constantly mentioned as the greatest barrier to commercialising academic research, thus through such collaborations funding issues may be alleviated.

5.4.3 Commercialisation skills

Finally, participants identified a number of commercialisation skills that academics must possess in order to embark in successful commercialisation endeavours. These skills included communication, networking, negotiating, commercial awareness and new business development skills. These soft skills coincide with those presented by Mom et al. (2012) who emphasised their importance for academics in TT. The latter also mentioned the importance of hard skills such as IPR and legal skills. Although these were not mentioned by participants in the present study as important skills which academics engaging in commercialisation should have, they did mention that they require legal support which might indicate that they are not proficient in dealing with legal issues.

This suggests that academics require training on legal aspects that they may encounter while commercialising so that these skills can be harvested. In addition to the skills presented by Mom et al. (2012), the present study also identified the importance of technological and research skills for successful commercialisation.

5.5 Limitations of the present study

The study faced a number of limitations. Due to the delays in the approval required from the institution's Human Resources department, which was required for the Marketing, Communications and Alumni office to disseminate the online questionnaire, the first distribution of the questionnaire was done during examinations period. This period is known to be a busy time for academics and thus, the time available to respond to questionnaires is limited. In order to overcome this limitation, the questionnaire was distributed a total of three times to increase the likelihood of academics responding. Moreover, the duration of data collection was extended until mid-July. Nevertheless, the cut-off date for data collection was still within a busy period for academics as it was close to their deadlines for submitting examination and assessment marks. However, due to time constraints and the submission deadline of this dissertation, the data collection period could not be extended further.

The data collection period might have been one of the reasons for the response rate of 27% obtained in this research. Another potential reason for the slow response rate is that academics are either not interested in commercialisation or they have given up on commercialisation for one reason or another. In view of this, they did not feel the need

to reply to this questionnaire since the topic of the study did not appeal to them. Notwithstanding this, the results obtained are still valuable as they begin to give an indication of the current commercialisation practices and, the barriers and facilitators in the current commercialisation processes at the UM. Additionally, this response rate was not sufficient to test the hypothesis initially intended for this study and thus could not be done.

Chapter 6: Conclusion

6.1 Introduction

This research study was aimed at examining the barriers and facilitators that academics working at the UM find or perceive to find when engaging in the commercialisation of academic research. Such an analysis will help guide the current UM strategy in finding ways of how the process of commercialising academic research can be facilitated and thus, made more seamless. The conclusion chapter of this research study will summarise the key findings of this research in relation to these research aims and questions, while discussing their value and contribution. It will also list recommendations for practice and future research.

6.2 Summary of the research study and key findings

In view of the lacuna existing on the research topic of commercialising academic research within the local scenario and the novelty of its concept at the UM, this study analysed the barriers and facilitators of commercialising academic research with the aim of suggesting ways to facilitate its relevant process to make it more seamless. Adopting a deductive and cross-sectional approach, an online questionnaire was constructed on the basis of the present literature available on the topic and conducted with academics employed within the Faculty of Engineering. This sample was selected based on the number of commercialising disclosures disclosed by the Faculty with the CR&KTO unit

over the period of the past five years and backed-up by the rationale provided by the literature that confirms that applied fields of research such as Engineering are more likely to engage in commercialisation of academic research (Bekkers & Bodas Freitas, 2008; Bozeman & Gaughan, 2007; Camilleri, 2023; D'Este & Perkmann, 2011; Ponomariov, 2008).

The findings suggest that lack of funding is the main barrier hindering the commercialisation of academic research. This barrier is heightened by the: unwillingness of the investing companies to cover the full costs of commercialisation; and, the inability of UM to secure these funds despite their availability. Other barriers include the organisational culture which still favours publications over commercialisation, lack of institutional support, lack of human resources and inadequate marketing strategies.

Moreover, the facilitators suggested by the findings are organisational support, industry collaborations, and possessing the necessary commercialisation skills. These facilitators give academics engaging in commercialisation activity the necessary tools, support, knowledge and funding to increase commercialisation success.

6.3 Recommendations for practice

Based on the findings of the present study, the following recommendations for practice have been put forward.

- Centralisation of RSSD, PSO, RIDT and CR&KTO into a “one-stop” shop

  Rationale: By implementing the centralisation of these units will aid academics by decreasing the confusion between the different roles of these offices, and facilitates all related processes, making it more streamlined and less bureaucratic, thus saving academics time which can be focused on other duties. Additionally, it streamlines the communication between all offices to provide an integrated view on the research and commercialisation process.

- Rewards and incentives that prioritise commercialisation of academic research

  Rationale: Financial and non-financial rewards including decreased lecturing hours and increased sabbatical leave has been associated with motivating academics to engage in the commercialisation of academic research.

- More permanent and competitive contracts for RSOs

  Rationale: offering more financially enticing financial packages, and more stable working contract will support academics in the commercialisation phase, but also to retain their skills, knowledge and experience for future endeavours.

- Better pre-tenure contracts which support commercialisation

  Rationale: Review processes to assess contributions made by the academic in pre-tenure stage should take into consideration engagement in commercialisation. This might motivate pre-tenure academics to engage in commercialisation of academic research and decrease their fear by rewarding their commercialisation efforts.

- Increase in human resources within the RSSD, RIDT, PSO and CR&KTO

  Rationale: An adequate number of employees within these units will ensure that workload is better distributed and thus, these employees will have more time to carry out their duties and offer their consistent high-quality support to academics.

- Government support in funding the commercialisation of academic research

  Rationale: Funding from external entities is not always guaranteed due to the high number of funding applications submitted. This highlights the importance of government financial investment to support academic institutions to engage in academic research and its commercialisation if not other funding can be obtained. Government support is especially important since it is known that university research and commercialisation lead to improved societal, economic and wealth generation.

6.3.2 Recommendations for education and training

Based on the findings of the present study, the following recommendations for education and training have been put forward:

- Instil commercialisation culture in university students

  Rationale: Academics often hold on to ideologies about academic research commercialisation which they had obtained through their education. By instilling a commercialisation-oriented culture in university students' potential future

academics and industry professionals will be more accustomed to engage in the commercialisation of academic research. Although some training is already being offered by the Doctoral School in conjunction with CEBI, most of these workshops are optional. A greater effort should be made to implement compulsory units for university students relating to commercialisation as early as from undergraduate level.

- Compulsory training for RIDT, RSSD, PSO, CR&KTO

  Rationale: This training will ensure that employees within these units are continuously updating their knowledge which will improve the quality of support given to academics engaging in commercialisation of academic research.

- Compulsory training for academics on the commercialisation of academic research

  Rationale: This training will ensure that academics are aware of the potential of commercialising academic research and the resources available to support them in this engagement.

6.4 Recommendations for future research

The novelty of the "commercialising academic research" concept in Malta leaves space for future research. As this research provided a baseline for the study of commercialising academic research in Malta, the following recommendations are being drawn:

a. A similar study can be conducted with other local higher educational institutions in order to identify any similarities and/or deviances that academics within such institutions face when compared to those working at the UM. This will help in informing the lacuna in the research topic which could provide a basis for a more general view of the present situation that could further inform National and academic policies towards the commercialisation of academic research.
b. A study of the local industry's readiness to utilise commercialised academic research is also merited. An identification of the barriers that the industry faces when collaborating with academic institutions for commercialisation potential could possibly provide additional recommendations on issues that need further investigation and that could potentially help in increasing and facilitating such collaborations.
c. A study of university students' knowledge and perceptions towards the commercialisation of academic research. This insight will give a better indication of the commercialisation culture being instilled in potential future academics and industry professionals and thus will determine their inclination to engage in commercialisation of academic research.

6.5 Conclusion

The present study aimed to identify the barriers and facilitators to commercialising academic research as experienced by academics from the Faculty of Engineering with the UM. Based on the quantitative findings of this study, it can be concluded that commercialisation is still not highly prioritised by the UM. This is evident from its draconian rewarding structure and inadequate support, which discourages academics from engaging in this process. In light of these findings, a number of recommendations for practice, education and training and future research have been made in hope of improving current practices and increasing the uptake of commercialisation of academic research and its success.

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Annex A: Authorisation Request Letter to the Director of HR to access participants

To the Director of Human Resources,

My name is *<researcher's name>* and I am a student reading for the Executive Master in Business Administration within the Faculty of Economics, Management and Accountancy at the University of Malta. In part fulfilment of my degree, I am required to submit a primary research project to address a business and management related issue.

The topic selected for my research project deals with identifying the current University of Malta (UM) -related barriers and facilitators associated with the commercialisation of academic research and innovation. The aim is that of providing insight about the success of the current UM procedures and strategy in relation to the commercialisation of academic research and innovation; and to provide potential suggestions as to how this can be improved.

This email is a request for the human resources' department authorisition with respect to the recruitment of participants for this study. This study is aimed to obtain data and insight from academics within the Faculty of Engineering (including any other Institutes/Departments/Centres in the area of Engineering) in relation to the commercialisation of academic research and innovation -related process and

procedures. Below you will find information about the study and what the involvement of the participants would entail, should you accept to provide your authorisation.

Should academic members of the Faculty (including Institutes/Departments/Centres in the area of Engineering) choose to participate, they will be asked to answer an online questionnaire through a link which will be provided. Following your approval, this link along with the information email will be sent to all eligible participants through the Marketing, Communications and Alumni Office. In this instance, they will be requested to read the information email, provide their informed consent for participating and to answer the online questionnaire. Answering the questionnaire will take them around 15 - 20 minutes. The aim of the questionnaire is to better guide the study to fill in the gaps currently present in policy and practice by identifying the barriers and facilitators of commercialising academic research and innovation at the University of Malta. The questionnaires are completely anonymous and participants will not be asked for any personal details which might reveal their identity.

Data collected will only be accessible to my supervisor and me. Data will be stored in a secure encrypted folder. All data will be erased after one year from the successful completion of the study.

Their participation in this study is entirely voluntary; in other words, they are free to accept or refuse to participate without needing to give a reason. They are also free to withdraw from the study at any time prior to the submission of data, without needing to provide any explaination and without any negative repercussions to them.

If they decide to participate, please note that there are no direct benefits to them, the Faculty/Institute/Department/Centre or the HR department. Their participation does not entail any known or anticipated risks.

A copy of this information sheet is being provided to you for future reference.

Thank you for your time and consideration. Should you have any questions or concerns, please do not hesitate to contact me by e-mail at *<researcher's email address>* or phone on + *<researcher's mobile number>* or my supervisor *<supervisor's name>* by e-mail at *<supervisor's email address>*. Should you agree to assist with the recruitment of participants for this study, please contact me via the same contact methods.

<Researcher's Signature>

Sincerely,

<Researcher's Full Name>

Annex B: Information Letter

Dear Academic,

I am *<researcher's full name>* currently reading for an Executive Master in Business Administration at the University of Malta within the Faculty of Economics, Management and Accountancy.

In part fulfilment of my degree, I am required to submit a primary research project to address a business and management related issue. The topic selected for my research project deals with identifying the current University of Malta (UM) -related barriers and facilitators associated with the commercialisation of academic research and innovation. The aim is that of providing insight about the success of the current UM procedures and strategy in relation to the commercialisation of academic research and innovation; and to provide potential suggestions as to how this can be improved.

May I kindly take this opportunity to invite you to complete this survey. This will take you approximately 15-20 minutes to complete. By providing your voluntary consent to participate in this research, please be assured that no personal information will be requested from your end that will jeopardise your good self in any way. All data being collected throughout this online questionnaire will be used for the sole purpose of this research study and will be deleted upon one year of completion of this study. No direct benefits or foreseen risks are identified by your participation. Moreover, please note that should you wish to withdraw your participation prior to the submission of your data,

you can do so without the need for explanations and negative repercussions. Further details in relation to your participation is available on the consent form page provided in the online survey. Should you wish to participate, kindly click the "Yes" tick box following the consent details. You can access the questionnaire by following this link: https://www.surveymonkey.com/r/XZJ7VZW

Should you wish to address any questions or concerns, kindly feel free to contact me or my supervisor on the details provided here under.

Whilst I take this opportunity to thank you in advance for your consideration, may I extend my best regards.

Yours faithfully,

<Researcher's Name>

Student for the Executive MBA

Email: *<Researcher's email address>*

<Supervisor's name>

Supervisor

<Supervisor's email address>

Annex C: Consent Form

I give my consent to voluntarily participate in the study conducted by *<researcher's full name>* in relation to his research project requirement in part fulfilment of his reading for the Executive Master in Business Administration (Executive MBA) provided by the Faculty of Economics, Management and Accountancy at the University of Malta. The purpose of the subsequent statements is to specify the terms of my participation in this research study.

- I have been given written/verbal information about the purpose of the study and all questions have been answered.

- I understand that I have been invited to participate in this questionnaire, in which the researcher will ask questions on my knowledge and/or experience as a University of Malta Academic in relation to the commercialisation of academic research and innovation.

- I also understand that I am free to accept, refuse or stop participation at any time without giving any reason prior to my submission. This will have no negative repercussions.

- I am aware that the questionnaire will take approximately 15 to 20 minutes to complete. I understand that the questionnaire is anonymous and no personal information revealing my identity will be requested of me. In view of

this, I am aware that once I submit the questionnaire I will not be able to rectify or erase my responses.

- I am aware that any data being collected by the researcher will be used solely for the purpose of this study.

- I am aware that the researcher and his supervisor are the only persons who have access to this anonymised data.

- I am aware that because the data collected is anonymised, my identity will not be revealed in the research outputs.

- I also understand that my participation will contribute to potential enhanced commercialisation-related University of Malta processes and procedures.

- I understand that there are no foreseeable risks and direct benefits involved in participating in this questionnaire.

- I am aware that I may contact the researcher or his supervisor via email on *<Researcher's email address>* / *<Supervisor's email address>* or the researcher's mobile *<researcher's email address>* for clarifications related to this research.

- I also understand that once the study is completed and results are published, personal data collected from myself will be retained for a maximum of one year, after which all provided data will be deleted in full.

- I understand that by agreeing to participate in this study, I am confirming that I am over 18 years of age.

- I have read and understood the points and statements. I have had all the questions answered to my satisfaction, and that by clicking the "Yes" tick box, I agree to participate in this study.

1. I agree to participate in this research:

   Yes □ No □

Please follow the instructions at the beginning of each section of the questionnaire. These will help you complete this questionnaire in the best way possible. Please answer all questions. There is no right or wrong answer. Your honest replies are very important!

Annex D: Online Questionnaire

1. I agree to participate in this research: ☐ Yes ☐ No

2. Please select your age-range: (Instructions: Select one of the below options)

    a. 30 or under ☐

    b. 31 – 40 ☐

    c. 41 – 50 ☐

    d. 51 – 65 ☐

    e. 65+ ☐

3. Select your gender. (Instructions: Select one of the below options)

    a. Male ☐

    b. Female ☐

    c. Other ☐

    d. Rather not specify ☐

4. Kindly select your department. (Instructions: Select one of the below options)

    a. Electronic Systems Engineering ☐

    b. Industrial & Manufacturing Engineering ☐

    c. Industrial Electrical Power Conversion ☐

    d. Mechanical Engineering ☐

    e. Metallurgy & Materials Engineering ☐

    f. Systems & Control Engineering ☐

    g. Other ☐

5. Kindly select your role at the University of Malta: (Instructions: Select one of the below options)

    a. Casual Lecturer ☐

    b. Visiting Lecturer ☐

    c. Assistant Lecturer ☐

    d. Lecturer ☐

    e. Senior Lecturer ☐

    f. Associate Professor ☐

    g. Professor ☐

h. Other ☐

6. Have you ever participated in innovation-related academic research?

☐ Yes ☐ No

7. *If yes is selected for Q6*: Kindly identify the University's role in this innovation-related academic research.

a. *Lead Partner* ☐

b. *Secondary Partner* ☐

8. *If yes is selected for Q6*: Kindly select your role in innovation-related academic research. (Instructions: Select one of the below options)

a. *Principal Investigator* ☐

b. *Top Management* ☐

c. *Middle Management* ☐

d. *Senior Researcher* ☐

e. Other ☐

9. *If yes is selected for Q6*: Have you ever participated in the commercialisation of academic research?

   Yes☐ No☐

10. *If no is selected for Q6:* Would you ever consider participating in innovation-related academic research?

    Yes☐ No☐

11. *If no is selected for Q10*: Kindly specify reasons why you have never considered participating in innovation-related academic research.

    _____

    _____

    _____

    _____

12. *If yes is selected for Q9:* Kindly select the University's role in the commercialisation of academic research.

    a. *Lead Partner* ☐

    b. *Secondary Partner* ☐

13. *If yes is selected for Q9*: Kindly select your role in the commercialisation process. (Instructions: Select one of the below options)

    a. *Principal Investigator* ☐

    b. *Top Management* ☐

    c. *Middle Management* ☐

    d. *Senior Researcher* ☐

    e. Other ☐

14. *If yes is selected in Q9*: Please select the level of your involvement in decisions related to the commercialisation of academic research. (Instructions: Select only one option)

No involvement	Minimal Involvement	Medium Involvement	High Involvement	Very High Involvement
☐	☐	☐	☐	☐

15. *If yes is selected for Q9:* Kindly identify whether you encountered any of the below challenges during your involvement in the commercialisation process. (Instructions: Select one option for each category)

Challenge	**Yes**	**No**
Selecting the appropriate strategy	☐	☐
Understanding the perspective from a customer point of view	☐	☐
Building credibility for the innovative product (and, if applicable for the commercialising entity)	☐	☐
Developing networks with stakeholders (stakeholder here refer to the industry, financial entities, political entities, customers and other public stakeholders including the media and environmental-related stakeholders)	☐	☐
Building and obtaining stakeholder support	☐	☐
Changing stakeholder's attitudes and behavioural processes to overcome barriers and facilitate innovation adoption	☐	☐
Generating market sales	☐	☐

16. *If yes is selected in Q9:* In your opinion or otherwise, was the commercialisation of the innovation successful?

    Yes☐ No☐

17. *If no is selected in Q9:* Would you ever consider participating in the commercialisation of academic research?

    Yes☐ No☐

18. *If no is selected in Q17:* Kindly specify reasons why you have never considered participating in the commercialisation process of academic research.

    _____

    _____

    _____

General Questions

19. In your opinion, what skills do you think are required to carry out innovation-related academic research and its commercialisation?

    _____

    _____

    _____

    _____

20. In your opinion, what are the required key factors encouraging the commercialisation of academic research?

_____

_____

_____

_____

21. How are ideas generated, screened, developed and tested before they are commercialised?

_____

_____

_____

_____

22. Do you think that marketing related factors are being considered in the commercialisation process?

Yes☐ No☐

23. *If yes is selected for Q22:* Kindly select the marketing-related factors being considered in the commercialisation process? (Instructions: Select all appropriate options)

    a. Customer's needs and wants ☐

    b. Pricing Strategies ☐

    c. Promotional Strategies ☐

    d. Place-related Strategies ☐

24. *If yes is selected for Q22*: How would you rate the level of consideration of these marketing-related factors during the commercialisation of academic research carried out by the University of Malta? (Instructions: Select one for each option)

Factor	**No Consideration**	**Minimal Consideration**	**Medium Consideration**	**High Consideration**	**Very High Consideration**
Customer's needs and wants	☐	☐	☐	☐	☐
Pricing Strategies	☐	☐	☐	☐	☐

Promotional Strategies	☐	☐	☐	☐	☐
Place-related Strategies	☐	☐	☐	☐	☐

25. In your opinion, do you think that the University of Malta is taking the necessary steps to procure funding for the research, development and commercialisation of innovative academic research?

    Yes☐ No☐

26. In your opinion, do you think that legal frameworks of the Nation support the commercialisation of innovation?

    Yes☐ No☐

27. In your opinion, do you think that the legal frameworks and policies of the University of Malta support the commercialisation of innovation?

    Yes☐ No☐

28. In your opinion, to what extent do you think are the legal frameworks and policies of the Nation and University of Malta supporting the commercialisation of innovation? Kindly rate accordingly. (Instructions: Select one for each option)

	No Support	**Minimal Support**	**Medium Support**	**High Support**	**Very High Support**
Nation	☐	☐	☐	☐	☐
University of Malta	☐	☐	☐	☐	☐

29. In your opinion, in what ways do you think the University of Malta engages the transferring of its commercialised knowledge to the industry? Kindly rate the below options accordingly. (Instructions: Select one for each option)

	No Engagement	**Low Engagement**	**Medium Engagement**	**High Engagement**	**Very High Engagement**
Externally Funded Research projects	☐	☐	☐	☐	☐
Relationships between the	☐	☐	☐	☐	☐

University and industry					
Consultation Services	☐	☐	☐	☐	☐
Establishment of Spin-off companies	☐	☐	☐	☐	☐
Licencing of research	☐	☐	☐	☐	☐
Patenting of Research	☐	☐	☐	☐	☐
Other: Please specify	☐	☐	☐	☐	☐

30. In your opinion, do you think the University of Malta has the required tools and resources to support innovation and its commercialisation? Kindly provide your answers by rating the following options. (Instructions: 0 – Inadequate tools and resources to 5 – Excellent tools and resources)

	0	**1**	**2**	**3**	**4**	**5**
Research infrastructure	☐	☐	☐	☐	☐	☐
Research mechanisms	☐	☐	☐	☐	☐	☐
Investment in personnel training and development	☐	☐	☐	☐	☐	☐
Innovation-oriented culture	☐	☐	☐	☐	☐	☐
Other (Please specify)	☐	☐	☐	☐	☐	☐

31. Have you heard of the below? (Instructions: Select one answer for each category)

Office	**Yes**	**No**
Research Support Service Directorate (RSSD)	☐	☐
Project Support Office (PSO)	☐	☐

Corporate Research and Knowledge Transfer Office (CR&KTO) ☐ ☐

Research Innovation and Development Trust (RIDT) ☐ ☐

32. Kindly select the appropriate role of the Research Support Service Directorate (RSSD). (Instructions: Only one answer can be selected)

☐ To offer support to all University units carrying research in terms of obtaining funds access and writing their proposal.

☐ To assist the commercialisation process of knowledge elicited from research; to manage Intellectual Property owned by the UM; and, to support academic collaborations with the industry.

☐ To obtain funding from private and corporate entities with the aim of exploiting university research and its commercialisation.

☐ To offer guidance and support to resident academics participating in externally-funded research at proposal stage and its implementation

33. Kindly select the appropriate role of the Project Support Office (PSO).

(Instructions: Only one answer can be selected)

☐ To offer support to all University units carrying research in terms of obtaining funds access and writing their proposal.

- ☐ To assist the commercialisation process of knowledge elicited from research; to manage Intellectual Property owned by the UM; and, to support academic collaborations with the industry.

- ☐ To obtain funding from private and corporate entities with the aim of exploiting university research and its commercialisation.

- ☐ To offer guidance and support to resident academics participating in externally-funded research at proposal stage and its implementation

34. Kindly select the appropriate role of the Corporate Research and Knowledge Transfer Office (CR&KTO). (Instructions: Only one answer can be selected)

- ☐ To offer support to all University units carrying research in terms of obtaining funds access and writing their proposal.

- ☐ To assist the commercialisation process of knowledge elicited from research; to manage Intellectual Property owned by the UM; and, to support academic collaborations with the industry.

- ☐ To obtain funding from private and corporate entities with the aim of exploiting university research and its commercialisation.

☐ To offer guidance and support to resident academics participating in externally-funded research at proposal stage and its implementation

35. Kindly select the appropriate role of the Research Innovation and Development Trust (RIDT). (Instructions: Only one answer can be selected)

☐ To offer support to all University units carrying research in terms of obtaining funds access and writing their proposal.

☐ To assist the commercialisation process of knowledge elicited from research; to manage Intellectual Property owned by the UM; and, to support academic collaborations with the industry.

☐ To obtain funding from private and corporate entities with the aim of exploiting university research and its commercialisation.

☐ To offer guidance and support to resident academics participating in externally-funded research at proposal stage and its implementation

36. Have you ever utilised the services of the following? (Instructions: Select one answer for each category)

Office	**Yes**	**No**
Research Support Service Directorate (RSSD)	☐	☐
Project Support Office (PSO)	☐	☐
Corporate Research and Knowledge Transfer Office (CR&KTO)	☐	☐
Research Innovation and Development Trust (RIDT)	☐	☐

37. Based on your experience, are there any recommendations you would like to give on the service provided by these units (i.e. Research Support Services Directorate (RSSD); Project Support Office (PSO); Corporate Research and Knowledge Transfer Office (CR&KTO); Research Innovation and Development Trust (RIDT)? Please identify these recommendations per unit. Should you wish not to provide any recommendations, kindly write “N/A”.

_____

_____

_____

_____

38. In your opinion, are there any other barriers are hindering the commercialisation of academic research? If yes, in short kindly identify these barriers.

_____

_____

_____

_____

39. In your opinion, how can the other barriers (if any) mentioned in question 38 be eliminated? (Instructions: Suggestions per barrier is required. In case no barriers were identifies in question 38, please leave these text box as blank)

_____

_____

_____

_____

40. In your opinion, are there any other key factors facilitating the commercialisation of academic research? If yes, in short kindly identify such facilitators.

_____

_____

_____

_____

41. In your opinion, how can the other key factors (if any) mentioned in question 40 be improved upon? (Instructions: Suggestions per facilitator is required. In case no facilitators were identified in question 40, please leave this text box as blank)

_____

_____

_____

_____