AFRICA UNIVERSITY

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PATENTING OF RESEARCH OUTPUTS IN THE UNIVERSITY OF ESWATINI

By

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A DISSERTATION SUBMITTED IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE DEGREE OF MASTER IN INTELLECTUAL PROPERTY IN THE FACULTY OF PEACE, LEADERSHIP AND GOVERNANCE

2021

Abstract

The research was conducted with the aim of assessing the status with regards to patenting of research outputs at the University of Eswatini (UNEWSA). The data collection instrument (questionnaire) used in the study was designed to capture information on the awareness level of the respondents in matters of Intellectual Property (IP) governance in the country and on the IP subject in general. The other two major components captured during the data collection were to establish the existing patenting opportunities as well as the challenges that hinder the patenting with accompanying solutions to improve the situation. A total of thirty participants from different departments which were categorized into sciences (21) and non-sciences (9) responded to the questionnaire. The study results showed that the level of awareness of IP was higher among the sciences than the non-sciences. The awareness of the IP governing institutions and national laws was generally lower than the awareness on the IP subject across all the study disciplines. About 86% of the respondents in the sciences indicated that their research outputs were patentable and only 33% of the respondents in the non-sciences category gave the same response. However, when asked if they had registered patents, only 14% and 11% of the respondents indicated that they had registered patents in the sciences and non-sciences, respectively. The issue of lack of funds was highlighted by 80% of the respondents in the two groups combined who indicated that there were no funds to support IP matters and for conducting quality research in the university. The other challenge that was identified to be a major bottleneck on the patenting of research outputs at the UNESWA included; weak linkages between the industry and the university. Major conclusions drawn were that there is a high level of awareness on the IP subject but not on the institutional and policy framework at the national level. It was also concluded that the existing potential for patenting research outputs is high. Areas that have to be attended to improve the situation in as far as patenting research include IP awareness especially of the national legal framework, improving the funding mechanisms to improve the quality of research and to strengthen the linkages between the university and the industry.

Key Words: Patenting Research Outputs; Intellectual Property Awareness; Patenting Opportunities; Patenting Challenges and Areas of Improvement; University of Eswatini

Declaration

I declare that this dissertation is my original work except where sources have been cited and acknowledged. The work has never been submitted, nor will it ever be submitted to another university for the award of a degree.

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Acknowledgments

First and foremost, I thank God for the opportunity and ability to undertake my studies up to this level. It is surely by His grace. To Him be all the glory. My heartfelt gratitude goes to my supervisor, Dr Byson C. Sabola for patiently and diligently guiding me throughout the compilation of this dissertation. My gratitude also goes to my co-supervisor Professor Robson Mafoti for his valuable contribution in the compilation of this dissertation. I am also sincerely grateful to Mr George Mandewo MIP co-ordinator and lecturer at the College of Business, Peace, Leadership and Governance (CBPLG), Africa University, for tirelessly motivating me when I was many times on the verge of giving up on the course. The WIPO academy, supported by the Japan Funds in Trust from the Government of Japan, is acknowledged for financing my studies. I thank the Government of Eswatini for nominating me to enrol for this course. The office of the Registrar in the University of Eswatini (UNESWA) is thanked for granting me the opportunity to conduct my studies within the university. The entire UNESWA community is acknowledged for their support during data collection. My colleagues at the Department of Agricultural Research and Specialists Services (former employer) and at Ubombo Sugar Ltd (present employer) are all acknowledged for their support and encouragement. Special thanks go to my bosses Mr Similo G. Mavimbela and Mr Muzi E. Dlamini at DARSS and Ubombo for their support while I was studying alongside performing my work duties. Entire family members, especially my wife Gugu, my daughters Siyandiswa and Sinenkhosi, my mother S.E. Dlamini, my sisters and brothers for the continuous support and encouragement through my entire academic journey. You all have been the best.

Dedication

This dissertation is dedicated to the two institutions; Ubombo Sugar Ltd and the Department of Agricultural Research and Specialists Services, Ministry of Agriculture for providing enabling environments for me to pursue the studies alongside performing my work responsibilities.

Like other pieces of work of this nature which I have done before, this dissertation is also dedicated to my grandmother Mrs S.D. Tfwala and my farther Mr N.N. Tfwala, who most unfortunately are both no more. They laid the foundation for me to travel all possible miles in the area of academics and hence the dedication also goes to them.

List of Acronyms and Abbreviations

ACE	Advisory Committee on Enforcement
ARIPO	Africa Regional Intellectual Property Organisation
AU	Africa University
AUREC	Africa University Research and Ethics Committee
COMESA	Common Market for Eastern and Southern Africa
EAC	East African Community
GR	Genetic Resources
IGC	Intergovernmental Committee
IP	Intellectual Property
IPR	Intellectual Property Right
ITF	Infocomm Training Framework
MIP	Master in Intellectual Property
MUIPP	Moi University Intellectual Property Policy
NGOs	Non-Governmental Organizations
OAPI	African Intellectual Property Organization
OAU	African Union
PCT	Patent Cooperation Treaty
R&D	Research and Development
SADC	Southern African Development Community
SCCR	Standing Committee on Copyright and Related Rights
SCP	Standing Committee on Patents
TBI	Technology Business Incubator
TK	Traditional Knowledge
TMO	Technology Management Office
TRIPS	Trade Related aspects of Intellectual Property Rights
UNESWA	University of Eswatini
UPOV	Union for the Protection of New Varieties of Plants
USA	United States of America
WIPO	World Intellectual Property Organisation

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CHAPTER 1 INTRODUCTION

1.1 Introduction

This chapter discusses the importance of intellectual property (IP) management in relation to the interests of the inventors to gain remuneration from their creations and the general public to access the benefit of using the creations or services from them. The contrast of IP management and its development in the developed world and the developing world will also be brought to the fore. The perceptions of the public with regards to the generation of information by institutions of higher learning and the potential role of IP management of the new information to contribute to the economic development of these institutions will be highlighted. Finally, the statement of the problem in the research area will be highlighted. This will point out what is being done in the University of Eswatini (UNESWA) with regards to IP protection of the research outputs with particular focus on patents. This statement will then lead to the research objectives which will be addressing specific research questions.

1.2 Background to the study

According to the World Intellectual Property Organization (WIPO) (2004) IP can be defined as the legal rights accrued from intellectual activity in different fields such as industry, science, literary and arts. The management of IP then refers to the administration and organization of IP matters, which basically include any immaterial assets that may have some commercial value for the institution or individuals that created it. This may also include those assets possessing future potential exploits for marketing. The management of IP matters requires a centralized organization which is

tasked with the responsibility to oversee and exploit the commercialization of IP rights. The importance of the management of IP rights is concerned with striking a balance between the contrasting interests of the inventors' ownership and control over their inventions against the rights of the public to have access and to utilize those immaterial assets (Strom, 2002). The importance of IP right protection has increased tremendously worldwide such that most IP offices have not been able to timeously process the drastically increased application numbers for these rights (McGinley, 2008). It is already accepted globally that the role of IP management has a pivotal role in economic development and growth especially in the context of nowadays knowledge driven economies (Jain & Sharma, 2006; Nunes Gimenez, Machado Bonacelli & Carneiro, 2012).

The management of IP including how it is relayed to the populace and utilized becomes paramount for the inventions to contribute meaningfully to the economic development. IP laws give profit and ownership incentives to the inventors or creators of inventions and simultaneously ensure that the general public is not deprived from accessing and benefitting from the protected works or creations (Eppinger & Vladova, 2013). Among other industries and institutions, universities are among the major generators of innovations and new knowledge and thus have that particular potential to benefit through IP management over and above the implementation and usage of the inventions themselves.

The universities and other institutions of higher learning are regarded as the powerhouses of generating new inventions (Jain & Sharma, 2006). The generation and dissemination of new knowledge and inventions is pivotal to the operation and existence

of every university. The challenge remains discovering how these interventions can be converted into assets and gain optimal profits and economic growth for the public and the institutions themselves especially in the area of IP management. This is despite the fact that many universities are now aware of the benefits of commercializing IP rights from research outputs (UK Intellectual Property Office & Smith, 2011). There is an acute need to streamline the management of IP rights into the missions and visions of these institutions for maximum benefits from the inventions created by their staff and students.

The management of IP rights has long been in norm in the developed world. However, the same cannot be said for the developing countries like in Africa where IP management has been a contested topic for prolonged time (Oddi, 1987; Sell, 1995), and in some instances it is regarded as a means to prohibit the small industries and disadvantaged groups to partake in the economy (Bromfield & Barnard, 2009). The Kingdom of Eswatini is also among these countries where instilling the practices of IP management has been slow over the years. The institutions of higher learning, as prime developers of inventions are therefore identified as strategic entry points to gain an insight of IP management status, and to establish gaps and opportunities to promote IP Management practices in the country in general. The University of Eswatini (UNESWA) has been identified as the most relevant institution to investigate and gain insights on the IP status in the institutions of higher learning within the Kingdom of Eswatini. The field of IP is also very broad; therefore the target niche for investigation selected for the present study is that of patents.

1.3 Statement of the Problem

Research is a continuous process in institutions of higher learning through student dissertations and research projects conducted by the teaching staff in collaboration with the industry or other researchers. Inventions require investment in research and development. Such an investment can be very high and costly. It is therefore crucial for individuals and institutions to protect their inventions in order to reap optimally from their investments through remuneration that can be accrued from sale or usage of the creations. The usage of IP protection for research inventions among the institutions of higher learning in the Kingdom of Eswatini is not known, and thus the potential benefits and means of improving the status quo are also unknown. Records at the national IP office of the Kingdom of Eswatini revealed that there were no patents from the university research outputs or other institutions of higher learning are registered with the national IP office in the Kingdom of Eswatini (N. L. Matsebula, personal communication, January 20, 2021). The Kingdom of Eswatini is one of the 20 member states of ARIPO and is also party to the Harare Protocol which mandates the ARIPO Office to grant patents and register industrial designs on behalf of contracting member states. The ARIPO patent filing statistics from 2016 to 2020 show that very few applications originated from the ARIPO member states (Table 1.1). Only 77 out of the 3897 patent applications representing 2% originated from the ARIPO member states. Of the 77 patent applications, only one application representing 1.3% originated from the Kingdom of Eswatini and was not filed by the University of Eswatini.

Table 1.1: ARIPO patent filing statistics from 2016 to 2020

Year	2016	2017	2018	2019	2020	TOTAL
Total number of patent applications	697	747	831	868	754	3897
Number of Patent Applications originating from ARIPO Member States	17	13	21	17	9	77
Number of Patent Applications originating from Eswatini	0	0	0	0	1	1
Percentage of Patent Applications originating from UNESWA	0	0	0	0	0	0

Source: ARIPO Secretariat

Universities especially in developing countries are fundamental to the success of any modern knowledge-based economy as they generate intellectual property, discoveries and innovations which must be patent protected because of their economic value in the marketplace (Raffoul & Brion, 2011). Unfortunately, as detailed in Table 1.1, use of the patent system has not been used by the University of Eswatini.

1.4 Purpose of the Study

The purpose of the study was to assess the status of patenting research outputs in the UNESWA with a view to establishing the factors that contribute to the non-use of the patent system by the University of Eswatini.

1.5 Objectives of the study

The specific objectives of the study were to;

1) Establish the level of intellectual property (IP) knowledge within the UNESWA,

2) Identify patenting opportunities of the research outputs in UNESWA,

3) Investigate the reasons why researchers at the UNESWA were not registering patents of their research outputs.

4) Explore ways of promoting the use of patents to protect research outputs at UNESWA

1.6 Research Questions

The main research question was “what is the status of patenting research output in institutions of higher learning in the Kingdom of Eswatini?”

Specific research questions were;

1) What is the level of knowledge existing on intellectual property within the departments of UNESWA?

2) What are the existing opportunities for patenting research output at UNESWA?

3) Why are the researchers at UNESWA not patenting their research outputs?

4) What can be done to improve the patent protection status of research outputs at UNESWA?

1.7 Significance of the Study

The study brought about insights of the gaps, opportunities and strengths of the intellectual property management at UNESWA, and other institutions of higher learning in the Kingdom of Eswatini. The potential contribution of IP in the economic growth of these institutions will be identified and strategies for achieving that recommended. Remedies to address the existing challenges of IP management and in particular patenting of research outputs were identified and recommended.

1.8 Delimitation of the Study

The investigation explored all possible avenues of patenting research outputs within the UNESWA. This was across all the faculties and departments regardless of the disciplinary differences. Modifications on the data collection tools (questionnaire) while collecting the data were done but only when necessary and with great caution that it did not change the concepts as approved in the stage of proposal defence.

1.9 Limitation of the Study

The study was only done in the three campuses of the UNESWA, and not all the universities and colleges that exist in the country. This was due to the cost and time limiting factors as the institutions are located all over the country. Not all the staff members within the departments were involved in the study but all departments were represented.

CHAPTER 2 REVIEW OF RELATED LITERATURE

2.1 Introduction

In numerous institutions, the component of research and development (R&D), strategic plans, and legislative frameworks are characteristically fragmented. As a result, these institutions are left out in the creation and exploitation of the economic value of IP (Fisher III & Oberholzer-Gee, 2013). This chapter focusses on the theoretical framework around IP management in institutions of higher learning, the history of intellectual property management, an overview of intellectual property management and the legislative frameworks at both regional and international levels.

2.2 Theoretical Framework

The study was based on the natural right, which is also referred to as the labour theory. This theoretical framework, as described by Locke (1985) is based on the principle that whatsoever the human body has worked and produced belongs to the owner that has produced it. The argument was that what the human has extracted from what naturally existed and produced something new, that new outcome is then owned by the creator. Locke (1985) further argued that the new addition to what naturally existed excludes the common right or natural right of others to the new product. It being the product of one's "labour" renders it unequivocally a property of the labourer and therefore no other man but him can claim the rights over it.

2.3 Relevance of Theoretical Framework to the Study

The universities or higher learning institutions are always regarded as centres of excellence in many ways. These institutions operate generally in two major ways amongst others. First there is teaching and learning by the lecturing staff and the students respectively. In this process and discussions that emanate thereof there are some new insights discovered in the different study disciplines. These are normally used to enrich and improve the study material over the years. The second area which these institutions are expected to explore extensively is the area of research. This is also done via the student research projects and also via research programs which the university staffs perform for or in collaboration with the industry and normally funded by the industry interested in the results or outputs of the study.

These research findings are in essence the works of the hands of the university personnel which makes the labour theory to be relevant for the present investigation focusing on the intellectual property management of the research outputs within the institutions of higher learning in the Kingdom of Eswatini. The UNESWA, which is the largest institution of higher learning in the Kingdom of Eswatini in terms of the diversity of courses offered as well as the enrolled number of students, was used as a case study in this dissertation.

2.4 History of Intellectual Property and Patents

The emergence of the IP rights was during the early mercantilist period as a strategy for nations to come together and magnify their economic power through the establishment of manufacturers and facilitating and promoting marketing monopolies. That was when

the term “patent” which originated from the Latin word *patere* which directly means to be open was referring to an open letter of privilege from the ruling administration or government to practise an open art (Merges, 1997).

The first ever patent was enacted by the Venetian Senate in the United States in the year 1474 and it provided the creator of any new and ingenious device which was just modified to be more efficient such that it could be used and operated easier and a license of 10 years was granted to practice the invention. Other nations bought the patenting idea from then and began issuing some limited forms of monopoly for selected inventions in their territories. Literary works of different authors and publishers also followed suit, and by doing so they started massive promotions in the areas of innovation and literature (Merges, 1995). The created powers of monopoly to spur innovation to the creators of the inventions could be detrimental to the implementation of those inventions, but they were in actual fact necessary to foster the generation of new ideas to the advancement of technology (Menell, 1999). This also allowed the creators of the inventions to recover the costs and accumulate a little bit of some profits from the intellectual investments.

Bentham (1839) took the argument to the cost recoveries and demarcation to both the inventors and the imitators. His argument was that any invention that is created by man can be imitated by the whole world within a short period of time. Therefore, his argument was that indeed there was a need to protect the inventors at least for a fixed period of time to recover the costs of investment. His argument was that without this control, the imitators could easily dominate the inventors in the markets such that the value for inventing could not be rewarded fully which would in a way hinder the

progress in developing new inventions. Menell (1999)also supported the justification of monopolizing the reward of an invention to the inventors basing his arguments that indeed if a system does not award inventors the opportunity to control their creations it could result in some form of rivalry in others waiting for other to invent and then they just benefit and would also hamper the progress of inventing new things.

According to WIPO (2004) it was on July 14, 1967 that the Convention was held in Stockholm and concluded on the establishment of the WIPO. This convention was then entered into force in 1970, initially constituting two secretariats: one for industrial property and the other for copyright. Article 2 of the convention provided that IP shall include rights related to the following:

i) Literary, artistic works and scientific work,

ii) Artists' performances, phonographs, as well as broadcasts,

iii) All fields of human creation,

iv) Discoveries in science,

v) Industrial designs,

vi) Trademarks, service marks and commercial names and designations'

vii) Protections against unfair competition and

viii) All other rights accrued from intellectual practice in the fields of science, literary and arts.

In the present era, characterized by open innovation situations, IP management especially patents are also vital for the recruitment of cooperating business counterparts for the purposes of collaborative research and development as well as cooperative market and sales activities. The other advantage of IP management is that institutions

have begun to discover new channels of generating revenue from the sale of IP licenses as opposed to the inventions themselves (Scheffer & Rehn, 2007; Eppinger & Vladova, 2013).

2.5 Intellectual Property Management Concepts

2.5.1 Background on intellectual property management

The rising attention towards the fields of patenting influenced institutions to be professionalism their strategies IP strategies and IP management principles. Presently, patents are no longer used only in the traditional way as the used to in terms of only limiting others from imitating, but also in more systematic way to get revenue from the intangible assets (Bessen, 2004). More than just instruments to control market entry, they have evolved to be for example used in gaining options in licensing negotiations and patent suits, or together with the power to access new markets (Agarwal, Ganco & Ziedonis, 2009; Ziedonis, 2004). When an institution has a patent protection on an article, the competitors for that article or product must make some improvement of the product which can then enable patenting of the improvement (Agarwal et al., 2007). On the other hand, independent patents that give complete freedom to operate without any requirements to have other patents are the most required as even dependent patents of small improvements are beneficial as they can be used for cross-licensing, at least according to Agarwal et al. (2007). In addition, institutions can advertise their patent portfolio of product, process and application patents for enhancing their reputations as creative institutions and in the process attract new and retain existing clients, employees and investors and hence economic improvement and sustainability.

Due to inherence of limited resources and capability on administerial know-how, small enterprises need to identify alternative ways to survive with the threats imposed by the dynamic market setups on the one hand, while realigning themselves to also benefit from their own intellectual property assets on the other hand (Becker, Dammer, Howaldt, Killich & Loose, 2011). In the same vein, especially open innovation management offers small enterprises new opportunities, but also new problems in managing innovation. When engaging in open innovation, information leakage becomes a huge threat and companies are afraid of getting overtaken by their business counterparts. Based on this understanding, it has become crucial that companies must establish very well-balanced strategies which are somehow intertwined between both the closed and the open innovation scenarios. For the development of the necessary skills and practices, companies must first conquer their concerns and fears. Knowledge and IP management competences are important for the implementation and execution of the open strategies with success. The open innovation literature has revealed that the small enterprises normally prefer to receive information from other partners but they are reluctant to share their own (Bessen, 2004) and therefore it is important for them to have comprehensive IP strategies and activities to create, protect, administer and gain remuneration from IP to get some rewards from their innovation and still remain competitive in the market.

The main enabling factors in IP management are a well drafted strategy with accurate and adequate allocation of resources alongside a clear management plan (Cantrell, 2009).

IP strategies were originally identified through various means including their filing strategies with regards to the subject matter such as qualitative or quantitative), regional filing decisions such as national, multinational or global, and the general filing and enforcement practices such as defensive or aggressive (Eppinger & Vladova, 2013). Due to the increase in IP rights applications, the changing trend in IP management practices is characterized by a consequent change in the recognition of the value of intangible assets and IP (Parchomsky & Wagner, 2005). Again, with the change towards a more open innovation world, the strategies, licensing and sale of IP rights has become an integral sector of investment revenues (Lichtenthaler, 2008).

2.5.2 Intellectual Property Management Processes

There are basically five steps of the IP management process from the stage of discovering the existing IP opportunities within an organization (IP Audit) to the point of commercialising the IP assets (Incentives and Awards).

2.5.2.1 Intellectual Property Audit

The IP audit allows a nation, a university, an enterprise or an organization for R&D to examine its available set of IP and personnel resources. It is a common instrument employed by a private enterprise that is undergoing expansion or employed as an instrument in public policy development. Various means of IP audits are available and may take the form of a simple list of existing IP such as the number of patents and trademarks categorized according to residents and non-residents, list of techniques/ cultural industries that may be regarded as sources of IP, lists of research institutions

and datasets on licensing transactions and royalty revenues (Agarwal et al., 2007). It can also be a relatively more complicated analysis of dynamic changes in IP protection over a stipulated period of time and how such dynamics achieve or fail to achieve given economic and educational focus targets. This form of an audit can also involve data and statistical analysis on collective ventures and foreign investment involving IP, technology licensing at research centres, investment in R&D as well as assessments on personnel capacity building. An instrument to assess public policy on IP has been developed by WIPO for use by its Member States. This tool is in the form of an extensive questionnaire designed for use by policy makers in developing a national IP strategy. It also has some illustrations on the strategies implemented by the different Member States in critical components related to IP asset development and management. For instance, one section of this Audit Tool focuses on financing for IP asset development, lists questions, and provides examples. It is crucial to differentiate between IP audits conducted for the private sector and IP audits used as a tool in the public sector in the context of IP strategy (Lichtenthaler, 2008). The private sector audit tool focuses on specific patents, works of authorship, trademarks, licenses, etc. owned by the company and assists in assessing the strengths and threats of that portfolio of IP. The public sector audit tool on the other hand focuses on the policies and infrastructure available and needed on a national basis in order to use IP as a tool for economic growth, providing a factual and analytical basis for national IP strategy.

2.5.2.2 Strategy of IP Plans

Following the process of IP auditing, a documented IP plan forms a strategy for developing and managing IP over a stipulated time period. Like in the case of a business plan for a given investment, a strategic plan directs the national or regional path for the development and importation of personnel capital and IP as well as the guidelines to be followed for commercial exploitation of those given IP assets. The plan may be given in the form of a white paper, a recommendation by an advisory board, or another form of an analytical document. Sometimes there is no stand-alone IP strategy; instead there may be an innovation plan in which IP is part of. The plan may spell out strategic aims and objectives, mechanisms, policies, actions, costs and resources, together with linkages to other planning tools, such as development, economic and education plans. Numerous states have developed IP plans, economic plans with IP components, or multifaceted strategic plans that are independent while integrating education, technology, health, agriculture, commerce, IP and finance (Lichtenthaler, 2008).

Several other countries are still in the process of establishing IP and technology development plans with specified phases, objectives, activities and deliverables. Those plans are intended to address issues around education and funding, point out priority areas for research, needs for human resource development, and the anticipated outputs of research interventions. Sometimes these plans relate to a particular field or technological sector in line with the national priorities. As an example, in September 2002, the French-speaking nations of Africa, under the leadership of the African Intellectual Property Organization (OAPI), also adopted in Libreville, Gabon, a strategic

plan for IP development in connection with an initiative to strengthen traditional medicine.

2.5.2.3 Identifying Areas of Competitive Advantage

Countries that succeed in implementing IP asset development and management strategies select target areas in which their enterprises or research institutions are more likely to compete effectively, or which are at least in line with already identified national priorities and strengths. The process of defining the target areas may also prove to be very paramount for researchers and other forms of investments. In the Philippines for instance, the Department of Science and Technology has documented a list of twelve target sectors for science and technology development including IT, electronics, instrumentation and controls, photonics and space technology applications among other areas (Ernst, 2017). These areas form the basis for human resource development planning as well as R&D funding decisions.

2.5.2.4 Human Resource Development

Education remains a fundamental component of IP asset development. The training of upcoming professionals, as well as the in-service training of the working group of professionals, to develop and upgrade skills related to the target areas identified is a pivotal sector of national and regional IP policies and plans. If the capacity to educate scientists, technologists and creators in critical areas corresponding to the economic target areas where IP will be cultivated does not exist, then a strategic IP plan cannot be implemented in the actual sense.

Investing in tertiary education, with more emphasis in research and development especially in the target areas, is a prerequisite to IP asset development. The same can also be said about investing in primary and basic education is equally an essential foundation for IP asset development and development of any nation in general. A good example of an education policy that is in line with IP Policy can be that put in place by the government of Singapore, where the Infocomm Development Authority has developed the Infocomm Training Framework (ITF) that focuses on the needs of the various segments of the country citizens involved in the high technology industries referred to as information communication technologies. It is made of five levels of training to achieve specific needs for information communication skills. Infocomm Specialization – focuses on skills improvement to fast track the development of emerging, critical and specialized information communication skills that are urgently needed in the industry ((Eppinger & Vladova, 2013).

2.5.2.5 Incentives and Awards

The next very important element of IP strategic planning entails ensuring multifaceted rewards and support for IP asset development and marketing. These can include tax incentives, payments, patent application fees, venture funds for SMEs in target areas and financial rewards in private investments for inventors and creators. Numerous Member States give tax incentives for R&D and innovation activities. In Canada, for instance, the Ontario New Technology Tax Incentive permits corporate taxpayers a 100 percent immediate write-off of the eligible cost of IP acquisitions. In Jamaica, a reputable film producer is entitled to relief from income tax for a period not exceeding nine years from

the date of the first release of the motion picture (Eppinger & Vladova, 2013). More to that, there is an exemption from payment of import duty on equipment, machinery and materials for building studios or for use in motion picture production.

2.6 Patents Economic Development and Patents

Patents are probably the most important legal instruments for IPRs protection, through conferring the sole right to exclude others from economically exploiting the innovation for a limited time (20 years from the date of filing) to the inventor. For patentability qualification, an innovation must meet the criterion of being novel in the sense of not constituting part of an invention that has existed before or more generally of not being already in the public domain. A patentable innovation must also involve an inventive step; this means that it must not be obvious to a person with ordinary skills in the particular field of the patent application. The innovation also must be useful to the industry; in other words, it must provide a solution to a specific problem in at least one application. One major element of a patent application is the disclosure: the invention must be sufficiently described in detail in order to allow those skilled in the particular field to practice it (Langinier & Moschini, 2002).

Since private property is associated with the freedom of choice that constitutes the foundation of market economies (Barzel, 1997), it therefore seems evident that intangible assets associated with human inventiveness and creativity should benefit some legal positions similar to that given to the ownership of other more basic goods and services. However, this consideration does not always do justice to the several aspects of the economics of patents. There are at least two approaches that can be taken

to articulate a comprehensive discussion of this IP sector: a positive analysis and a normative one. From the positive perspective, one may want to know how patents, as currently implemented, affect the workings of the economic system. Finally the intention is to gain insights of how the existence of patents affects the distribution of resources to, and then the distribution of income arising from, creative activities. A positive economic framework can also be used to verify the question associated with the reason why patents came to exist. On the other hand, from a more normative view, one can explore whether the institution of patents is a desirable area of the economic system, and what are the characteristics of an ideal patent system. In the following sections, these economic questions are considered in more detail, with a focus on the conceptual and theoretical analyses.

2.6.1 Cost and Benefit Analysis of Patents

From an economic view, the most important characteristics of patents are that (i) they deal with new knowledge, as embodied in an innovative product or process, and (ii) they confer monopoly rights (limited) to the creator of an invention. New knowledge that enables the production of new products and/or processes certainly carries significant economic value, but it has some characteristics that make it problematic for the market system to handle properly (Langinier & Moschini, 2002). Actually, knowledge is an essential public good. Pure public goods have two basic attributes. First, they are non-rival in consumption, meaning that a person's use of a public good does not affect the amount of it that is available for others. Second, they are non-excludable, meaning that it is not possible to prevent individuals from enjoying the public good once it is

available. An example of a pure public good is national police force protection. It is clear that, absent intellectual property rights, most discoveries and inventions would exhibit public good attributes.

The problems that a competitive system has with public goods are readily apparent. An inventor may bear all the cost of an innovation, but everyone benefits (though possibly to varying degrees) from an invention, and therefore everyone has a chance to free ride on the innovative efforts of the creators. The inherent externalities associated with this class of public goods generate a market failure: a competitive market system may be expected to provide an inefficiently low level of innovations. IPRs in general and patents in particular, address this predicament by attacking the non-appropriability of knowledge that lies at the heart of this market failure. Specifically, by endowing innovators with property rights on their discoveries, patents are a legal means of affecting the excludability attributes of an otherwise pure public good.

The main economic benefits and costs of the patent system are intertwined with the nature of the market failure that it addresses, and to the second-best character of the solution that it provides. We begin the discussion of such effects along the taxonomy suggested by Mazzoleni & Nelson (1998).

2.6.1.1 Promotion of New Discoveries through Patents

Through endowing discoverers with property rights over the benefits of their efforts, patents affect the incentive to innovate and are likely to promote the rate of generating innovations. This increase is actually desirable, given that otherwise the market system may provide too little new knowledge. But by giving the patentee exclusive rights on the

exploitation of a unique economic good that is still non-rival in consumption, a patent creates a monopoly situation that negatively influence the smooth usage of new knowledge (Mazzoleni & Nelson, 1998).

Therefore a fundamental benefit of the patent system is the balancing between the benefits of encouraging additional innovative activities and the costs of forgoing the competitive provision of some goods and services. *Ex post*, that is, given that an innovation is available, a monopoly is not good from society's point of view since it limits uses of the new product and/or process. But the profit opportunity created by the monopolistic control of the innovation can be a powerful *ex ante* incentive, presumably enough to motivate R&D investments that would otherwise be neglected.

2.6.1.2 Knowledge Dissemination

Another advantage of patents is related to the need for disclosure. In many countries, the disclosure is done 18 months after the patent filing date or before. The importance of this feature is predicated on the fact that in the absence of patents, inventors can use trade secrets to protect their discoveries (Friedman, Landes, & Posner 1991). Through the provision of an incentive for disclosure, patents are made to contribute to a needed dissemination of scientific and technical information, enabling other researchers to avoid duplicating existing knowledge and making it simpler to develop more new innovations that build on existing state of the arts (even through "inventing around" a patent as well). It is necessary to note that the disclosure argument offers an economic role for patents, even for inventions that have already taken place, and as such it is quite different from the incentive role of patents due to the increased appropriability of R&D result.

2.6.1.3 Economic Innovation Resources and Efforts

As the discussions on the disclosure feature of patents highlight, an essential and useful effect of new knowledge is that it enables advancement in innovations and discoveries. Discoveries coming from basic research are usually of this kind, at times opening up completely new areas of research. The argument can be that patenting of such inventions can have useful social payoffs. This rationale is revealed in the so-called prospect theory of patents, which was initiated by Kitch (2002). This theory is based on the idea that broad, early property rights on key inventions allow a sequential pursuit of subsequent innovations and avoid wasteful innovation races. An analogy can be made to the practice of granting mineral claims on land where no discovery has yet been made, to avoid a wasteful mining of the prospect. Even though patents in such cases can obviously have positive efficiency results, it is also simple to see that broad, early patents can negatively impact further research, especially when the initial discovery has applicability in many uses. If the initial creator does not have a comparative research advantage or interest in pursuing some research directions, and licensing of the patented innovation to third parties is problematic, patenting can have adverse effects on the flow of subsequent innovations.

2.6.1.4 Technology Transfer and Commercialization

Even though the difficulty of licensing may decrease the need of exceedingly broad property rights, patents can actually play a important function in licensing and, generally in the spread of new knowledge. According to Arrow (1962), the pivotal insight here is the information nature of new knowledge and the distinct environment in the

determination of the demand for that information. To put a value on information a would-be purchaser needs to know the information first, but at that point, if the owner of the information does not have property rights on the information, the would-be buyer has no more incentive or reason to pay for it because he has it already. Patents, therefore, can play a paramount role in controlling transaction costs of licensing innovation and technology transfer.

A related but different function for patents as conduits of technology transfer has been revealed to rationalize the Patent and Trademark Laws Amendments of 1980, commonly known as the Bayh-Dole Act. The main components of this reform were to enable universities and other entities to patent, retain title to, and commercialize federally funded inventions; and, to allow federal agencies to grant exclusive licensing for their inventions.

Based on the notion that the principal function of patents is the provision of incentives for innovations that would not occur otherwise, it would be difficult to make an economic case for public institutions patenting discoveries that have been funded publicly and accomplished. Similarly, the function of patents in transferring information would be meaningful in this case, since public research institutions have minimal use for trade secrets, and because it is hard to improve on the dissemination of information achieved by simply publishing a discovery. However, the presumption revealed here is that numerous discoveries produced by publicly funded R&D, and in the public domain, may not be used in technological developments because, without an exclusive license backed up by patent rights, firms would not be interested in expensive development work needed to convert an invention into a new product. Minimal evidence exists to

validate this belief for the case of university patenting (Mowery, Nelson, Sampat, & Ziedonis, 2001). When it is difficult to assert property rights on development work, a patent on underlying innovations may enhance development and commercialization of new technologies.

2.6.2 The Economic Foundation of the Patent Law

Patents play a pivotal role in the economies of various sectors globally. The economic principles founding the patent system have always been difficult to understand, especially in the courts of law. Partially, the difficulty comes in two forms: first, that innovation is essentially the creation of information, which has different economic features from goods, and secondly, that the patent system, while successfully dealing with this initial challenge of the special nature of innovation, however leads to secondary economic challenges. And in part the mysterious nature of patent law has hidden the way in which patent law doctrines handles these secondary challenges. In this section, after describing the secondary economic challenges created by the patent solution to the information aspect of innovation, will show in detail how patent law has effectively, if often inarticulately, minimized the impact of these challenges (Dam, 2004).

It is essential to recognize the primary challenge that the patent system simplifies. This problem, often called the appropriability problem is that, if a firm or institution could not recover the costs of invention because the resulting information were available to all, then a much lower and indeed poor quality level of innovation could expected (Baird, 1993). In other words, the patent system limits others from enjoying the benefits

where they have not invested and by so doing promotes R&D investment in innovation. The patent law achieves this credible end by granting property rights in creations. In creating these property rights known as patents, however, secondary challenges are born and they can lead to market distortions. To illustrate as an example, it is often said that as patent law grants the owner of the patents the power to limit others from practicing the invention, a monopoly may be created, leading to restriction of production, a supracompetitive price, and what is called an efficiency or deadweight loss in economics (Dam, 2004).

It is the proposition of this section that patent law has employed an economic approach to minimize such potential distortions and inefficiencies. In most cases, this economic approach has been adopted without noticing. Even though the failure to use economic expressions has obscured the economic contribution made by the patent law, it must be recognized that the misuse of economic concepts can be a setback. For instance, the inclination to wave economic terms, particularly the talisman of the patent law approach over the alternative regulatory and legislative approaches to promoting innovation but rather to make clear the effectiveness of the approach used in patent law can most often be misunderstood.

Right from the start, it is crucial to consider the three main secondary economic problems that patent law must deal with in solving the primary appropriability problem. These three problems, which may for summarizing purposes be referred to as the monopoly, rent-seeking and inhibition of future innovation challenges are often presented under one heading or another as oppositions to patents. After examining the

nature and seriousness of these three problems, the discussion will turn to how patent law doctrine in fact reduces their practical impact (Dam, 2004).

2.6.2.1 The Monopoly Challenge

This problem captured probably excessive attention during the 1930s to the 1970s. It is based on the fact that the right to exclude may lead to a monopoly. True, it became common to pronounce that a patent is a monopoly (Craswell, 1995). However, it is always obvious that the right to limit another from "manufacture, use and sale" may give no significant market advantage, even when the patent covers a product that is already available in the market. Indeed, without the benefit of empirical research, it is totally credible to conclude that in most of the cases, no significant market advantage is created. it must be kept in mind that leading companies may obtain 1,000 or even more patents in a one year,(Picker, 1992) and yet many such firms are unlikely ever to obtain even a single monopoly in any market (Posner & Philipson, 1992). However, numerous patents, especially those that gain commercial success, do result in the owner of the patent enjoying economic rent. A patent that cuts the cost of making a product will permit the patent owner to enjoy economic rent. To substantiate, this statement assumes that other producers are not able to use the innovation to reduce cost, but that is exactly the aim of the power to exclude others from "manufacture, use and sale" granted by a patent right. The economic rent received by the patentee is often computed as the difference between the patentee's per unit costs and competitors per unit costs multiplied by the patentee's volume (Baird, 1993).

Economic rents are not unusual in the economy. They are enjoyed wherever an economic player has a cost power that competitors cannot match, for one reason or other such as legal reasons. A legal reason can be a form of regulatory limitation or a subsidy, originating for example from an industrial policy. But, rents may still arise from more natural causes. The advantage of superior location is a common example in real estate. Superior talent or natural gift in the arts and professional sports is another good example.

The idea of economic rent is a more crucial concept than monopoly for the analysis of patent law. In the typical patent case, production will either remain the same or increase compared to the pre-patent situation (Landes & Posner, 1993) Due to the invention, protected by the patent, the inventor has a cost advantage that allows him to make more money (economic rent) than his competitors. In that sense, there is no limitation of production and hence no monopoly. Indeed, if the assumption is that the innovation was open to all, then all producers would gain the same cost advantage and the economic rent would be lost; production would increase as cost fall, and in that sense one could say that the patent limits production and creates a deadweight loss. But even in this second scenario, it can be discerned that the term monopoly does not add any value to our understanding. In the first place, the R&D that created the invention might never have occurred if the incentive of patentability did not exist. Secondly, even if the invention had occurred, the inventor might have decided, assuming the circumstances permitted, to keep the invention as a trade secret, in which case calling the patent a monopoly makes an assumption of a fact that is not justified. And thirdly, as noted earlier, if the patented invention lowers the cost sufficiently, then the output will expand

beyond the pre-invention level, thus rendering the conclusion that patents restrict production at odds with experiential fact (Sykes, 1992). because these reasons, it would be more useful to limit the concept of monopoly to circumstances where the patents are used as a device to cover what one would otherwise call a monopoly (Baird, 1992) or where patent licenses are used as an means for effecting monopolistic agreements (Becker, 1997). The patent law itself limits any monopoly profits that might be derived from patents (Ramseyer, 1993)

2.6.2.2 The Rent Seeking Challenge

Employing the expression "economic rent" rather than monopoly endorses clearer thinking, but it does not eradicate economic policy matters. On the contrary, because a patent's right to exclude is given by deliberate government policy, the scale of the rent seeking that supervenes deserves to be analyzed as a matter of economic policy in balancing the costs and benefits of the patent system. By rent seeking, we simply imply that firms and individuals will invest resources to obtain patents (not just in the process of obtaining a patent but also in the R&D to make the invention). The social harm from rent seeking has been categorically stated by Landes & Posner (1993) to the search for lost treasure; allowing any and all parties to search for the same treasure may lead to a waste of scarce resources (Sunstein, 1997). Rent seeking is indisputably a general challenge in the economy, and not just in patents, but in relation to patents it can easily be exaggerated. In high technology industries, for instance, investment in R&D is itself a major form of competition and directly leads to consumer benefits in the form of new products and reduced prices. This result may be treated critically as lower costs to the

innovator but from a dynamic viewpoint may have an even more imperative consequence for the economy, in the ability of customers to obtain inputs to their own production that permit them to achieve what they could never accomplish before. The expansion of output and the reduction in price achieved through technological progress resulting from R&D may be quite remarkable, far beyond any possible social loss from rent seeking. In some industries, additionally, the pace of R&D and the market interdependencies between inventions may be such that firms choose to cross-license their competitors. Taking the computer industry as an example, firms cross-license most product patents, including future patents, for an agreed period. They do so because they value freedom of action more highly than either exclusive use or royalty income. For such firms economic advantage comes purely from being the first to enter the market with the application of a discovery rather than from being able to exclude a competitor. Even though side payments between two computer firms based on the relative strength of their patent portfolios are common, it is hard to attach much importance to any rent seeking "waste" resulting from the R&D competition of firms in such industries.

Finally, rent seeking originating from the patent system should, in public policy discussions, be positioned in perspective with the rent seeking that would unquestionably come from other forms of industrial policy. If government chooses to promote the fortunes of one industry, or one firm, at the expense of another through subsidies, licensing or similar interventionist policies, then rent seeking is unavoidable. Furthermore, the resources expended in obtaining those government benefits would be unlikely to have the dynamic benefits that one observes from competition in R&D. Nonetheless, rent seeking is to some as yet unmeasured extent a concomitant of a patent

system. As we shall see, a number of patent law doctrines have the effect of reducing rent seeking behavior (Picker & Bebchuk, 1993)

2.6.2.3 Flow of Future Innovation Challenge

A third predicament faced by the patent system in encouraging innovation is attaining a proper flow of innovation over time. Overly broad patent protection can inhibit future innovation. Therefore, it is essential to think of this third challenge as seeking an economically optimal balance between innovation today and innovation tomorrow. Patent law has a number of rules that help to solve that problem (Ramseyer, 1993).

2.6.3 Patent Right Assignment

The patent system nowadays is indisputably a property rights system as it has the features of personal property." Among these features is the right of alienation, known as assignment. As in the case with many other forms of property, there is a recording system for assignments. Without the recording the assignment is null and void against any subsequent purchaser or mortgagee for a valuable consideration, without notice" (Landes & Posner, 1994).

Patents are different from several forms of property in that they are brought to existence by an administrative proceeding, a patent proceeding done in the Patent Office. One seeking a patent files an application, containing a specification (detailing the invention and how to create and use it) and one or more claims (pointing out and distinctly claiming the subject matter of the invention, somewhat equivalent to the metes and bounds of real property) The application is assigned to a patent examiner who, with the

help of references in the application and information in the patent office files, proceeds to examine whether the invention is entitled to a patent (Dam, 1994). In applying legislative criteria for patentability, the examiner will consider prior patents and other "prior art" (that is, prior sale, description in a publication and the like) that may demonstrate that the alleged invention lacks novelty (i.e., is not a new invention) or would be obvious to a person skilled in the particular technical art or otherwise fails to meet the statutory criteria for patentability. The applicant and the patent examiner will generally communicate with each other in a formal way under Patent Office procedures, but the public or even other applicants in a particular field are not advised of the application by the Patent Office, either by publication or otherwise. In that way, a patent proceeding is an ex parte proceeding and a secret one. But, when two patent applications conflict, an interference is declared, and a special board is invoked to deal with patentability issues and, in particular, to determine which invention has priority; in that situation, the parties to the interference become aware of the other's application (Ramseyer, 1995).

Because a patent proceeding is generally ex parte, an invention cannot normally be challenged as not patentable except in court proceedings after the issuance of the patent. Usually, such a challenge will first arise when the owner of the patent sues for infringement and the alleged infringer raises invalidity as a defense. And because of the ex parte character of patent proceedings, the courts have placed a high premium on not only truthfulness of the applicant's statements, but also the entirety of those statements with regard to prior art. Thus, misrepresentation by the applicant or failure to disclose

material information may lead also lead to an antitrust violation in addition to invalidity of the application (Dam, 1994).

Remedies for infringement of a patent are: Injunctions, both permanent and temporary, are available against infringers upon proof of validity and infringement (Friedman, 1994).To be certain, patents can be invalidated in a judicial proceeding if they should not have been issued by the patent office in the first place, but title to other forms of property can also be nullified in court. Further, patents can be rendered unenforceable for reasons other than that they should not have been issued; the most common example is patent misuse. In any event, statutes increasingly call for forfeiture of tangible property for certain kinds of misconduct (Dam, 1994). Legal differences between patents and other forms of property can therefore easily be inflated. The status of a patent as property is nevertheless fit, from an analytic point of view, by the measure of damages for infringement. At times the decision of the courts may be that the patentee will be entitled to the infringer's profits from the infringement or to remedies due to damages or losses incurred by the patentee (Craswell, 1995).

A patentee may be the one seeking an injunction, including a preliminary injunction pending trial, the patentee will normally be able to bring an infringer to the bargaining table where the parties will have an incentive to agree to license or even assign the patent right to the infringer if he can more efficiently exploit the patent. Of course, an action will not normally be brought until some damages have accrued, since it is through sales of an infringing product that the patentee normally learns of the infringement of a product patent; and even a temporary injunction cannot be obtained until a clear

showing of validity and infringement has been made as a preliminary matter (Dam, 1995).

Normally, the statutes provide that the recovery cannot be less than a reasonable royalty, (Sunstein, 1996) or factoring the infringer's anticipated profits in determining a reasonable royalty. Additionally, the Patent Acts normally permit a court to award escalated damages for willful infringement. If the infringer is more efficient than the patentee, say as a manufacturer of the patented product, then in principle the former will be able to manufacture and sell, pay damages measured by the loss to the patentee, and still be ahead. In other words, if the infringer can put the patent to more profitable use than the patentee, it can be anticipated that the patentee will have an incentive to license the patent to him, making both of the parties' better off (Dam, 1994).

2.7 University Research Patenting in General

One policy field that has brought a surprisingly massive pool of research recently is the role of patenting in the implementation and sharing of scientific research generated by institutions higher learning and public research centres. Even though patents from universities remains low as a proportion of all patents, it has been growing relatively fast at least since the Bayh-Dole Act, particularly in the United States and similar trends elsewhere in the world have been observed. Reasons for this trend are not difficult to find: the increased need of scientific knowledge in the production of many forms of innovation, especially those in the field of biotechnology, changes in the legal treatment of the rights of university patents, and budget constrains on the university that have led to seeking new income sources. An important survey of the wider field of industry-

university relationships that constitutes a discussion of the importance of patents is explained in Foray & Lissoni (2010). Mowery, Nelson, Sampat, & Ziedonis, (2004) conducted and reported a comprehensive study of the impact of the Bayh-Dole Act on university research and patenting.

One of the reasons for the great interest of academic researchers in this topic may be the expectation from their own university administrators for ways to assess the consequences of these trends, as there have been numerous outsiders who critic that universities' use of proprietary protections for knowledge deviates from their main mission as generators of public knowledge. Therefore, the questions posed in these documents are whether patenting offsets researchers from research leading to publications, whether patenting changes the focus of their research towards research commercial ends, and whether university the patenting slows the dissemination of knowledge by making some of it to be private.

Henderson, Jaffe, & Trajtenberg (1998) presented the first study to comprehensively interrogate the trends in university patenting post the Bayh-Dole Act. Using all university held (United States of America) USA patents which were applied for between 1965 and 1988, these researchers showed that such patents were more highly cited and more general, but also showed that the difference in the citation rate was falling over time, and almost fading post 1984. Sampat, Mowery & Ziedonis (2003) reexamine these data but used an additional seven years of citations (11 to 14 years total instead of 4 to 7 years), and reported that although the gap between university-owned patents and a control sample narrows slightly, patents from the university were cited at a significantly

higher rate throughout the study period of the two studies controlled for differences across patent classes in average citation rates.

Thursby & Thursby (2009) show theoretically that licensing of applied research results can have a positive impact on the basic research output of universities, for income effect reasons and because of joint production. A number of papers using both USA and European data have examined whether patenting by academic research affects their research productivity as measured by publications and all have reached the same conclusion: publishing and patenting are complementary activities, not substitutes, when looking across researchers (Azoulay, Ding & Stuart, 2009; Fabrizio & Di Minim, 2008; Breschi, Lissoni, & Montobbio, 2007; Thursby & Thursby, 2009). There is some proof that the quality of research may be affected (Fabrizio & Di Minim, 2008) or that research is directed towards sectors with high commercial interest (Azoulay et al., 2009). However, Thursby & Thursby (2002) highlighted minimal influence of patent licensing to university research. It is probably preferred to conclude by revealing that patenting and publishing are complements across researchers (more productive researchers will normally do more of both) but that they are slight substitutes within researcher (doing more of one inevitably reduces the time available for the other, or at least changes the nature of the research). Mowery & Ziedonis (2002) analyzed data on university patents and licenses for three major research universities prior and post the Bayh-Dole Act and reported that the effect on research content is very modest with no decline in the significance or generality of their patents, while the impact on the marketing efforts of the university technology transfer office is considerable. Analyzing the research universities holistically, they reported substantial entry into technology

transfer and patent licensing and that the patents of the new entrants are less important (as measured by citations) and general than those of universities with extensive patenting experience before Bayh-Dole. There is another proof that the institutional attitude and context seems to have a significant effect on the use of patents. From results of a survey among faculty inventors in two very different research universities, one an elite private institution with a highly active and successful technology transfer office and one that is a large state university, Owen-Smith & Powell (2001) reported that the private institution had ten times as many patents in 1998 and fifteen times the licensing revenue even though the universities were of similar size and rank. This therefore means that the private research institutions with high commercial orientations are more likely to make more use of the patenting and licensing systems. Faculty attitudes toward disclosure to the technology transfer office were significantly different across the two universities and this in turn determined their success at patenting their inventions.

In another study of university software patents, Rai, Allison, & Sampat (2009) also reported that the "university effect" is very important in describing behavior. The most important determinant of software patenting by a university is not their R&D or employment in the computer science area, but their overall attitude towards patenting. That is, some universities are active in this area than others, but registration of patents is not particularly influenced by output in a particular research field.

The diversity of university experience with licensing patents was also detailed by Geuna & Nesta (2006) who studied European university activity in this software patenting and found wide variation in the extent to which inventions by university researchers were indeed patented by the university rather than industry or a faculty member on his own.

Similar to the findings reported in the US, much of the university patents were recorded in the fields of biotechnology, pharmaceuticals, and genetics. Thursby & Thursby (2009) reported that about 25% of patents in the US produced by faculty researchers are assigned to firms rather than universities and that these patents are less basic and more likely to be in the physical than in the biological sciences. Czarnitzki, Hussinger, & Schneider (2012) reported that although German faculty patents that are owned by corporations have a higher value in terms of forward citations, while those assigned to universities or public research institutions are more complex, more basic, and have stronger links to scientific discoveries. The researchers argued that this signaled weakness in the commercialization of technologies based on basic research, they also highlighted that this could simply be the natural outcome of the different goals and activities of the two types of scenarios. In another distinct study, Murray & Stern (2007) investigated the knowledge dissemination effects of patenting research output which was also described in a published paper, where they exploited the lag between publishing and the patent grant to look at whether future research (measured as citations to the associated paper) is enhanced or discouraged by the proprietary effect of the grant. This investigation reported modest decline in relative citations after the patent is issued. Williams (2013) used a similar quasi-experimental system to the investigation of the impact of Celera Corporation's temporary IP on selected gene sequences, and reported that Celera's IP led to reductions in subsequent scientific research and product development outcomes, relative to a counterfactual where the same genes were always in the public domain.

A related issue that has received some attention is that of proprietary research tools and materials, which escalated the cost of doing research. Even though numerous jurisdictions have an explicit or implicit "research exemption" for those that use patented information solely for research purposes, not all do, and a highly publicized US court decision called this exemption into question (Madey v. Duke University 2002), holding that the so-called exemption was very narrow and did not generally apply to university research. Nagaoka & Aoki (2007) developed a theoretical analysis of the research exemption and concluded that although such an exemption can be justified in multiperiod R&D competition, it is not necessarily enhancing innovation in a two stage pioneer-follower model, since it is limited to reward the first inventor. The recommendation from this study was a broad exemption for research on the subject matter of an invention, together with stronger protection for the pioneer in a product market. Following on the Madey v. Duke University decision, Cohen, Goto, Nagata, Nelson & Walsh (2002) took an early investigation at the effects of increases in research tool patenting in the drug discovery area. They reported that such patenting had little impact thus far due to the work-arounds adopted by university researchers: taking out licenses, inventing around, using an informal research exemption, and developing publicly available research tools.

2.8 International Legislative Framework on Intellectual Property

IP Rights is a field of development that has been instigated and heavily influenced by various things and development processes especially in the developed world. More often than not, the international legislations such as conventions, treaties, protocols and other

agreements have been very pivotal in influencing legislative and policy formulation processes in the different states that are party to those agreements (WIPO, 2004). The creators and supporters of these international legislations have mainly been the governments from the developed world driven by their interests to pursue national interests beyond their borders. As a consequence, some of these interventions are implemented without the considerations to incorporate the cultural norms of the African Societies and thus this normally leads to their failure to be adopted within these communities and then the full benefits envisaged not being a reality at the end of the day under such systems. The development of the targeted human and institutional capacities of the relevant legal and policy frameworks are fragmented. The attainment of the global and especially the national targets and livelihood development of the developing nations under such conventions and agreements remains a huge challenge. The multidisciplinary nature of a university in terms of the academic departments makes all the legislations relevant for the subject of patenting research outputs from all the departments. Some of them are subject specific in terms of relevance. For instance, The International Union for the Protection of new Varieties of Plants (UPOV), is more relevant for the Faculty of Agriculture and a few other department in the natural sciences. These are therefore discussed in the subsections below.

2.8.1 World Intellectual Property Organization (WIPO)

The WIPO is one of the 16 specialized agencies that support different missions of the United Nations. This Organization was established in the year 1967 with the intentions of promoting inventive practices to enhance the protection of IP globally. At the present

moment, WIPO is supported by 184 member states to implement a total of 24 international treaties across the world. A majority of all the UN members as well as the Holy Sea constitute the membership of WIPO. Countries that are not members of WIPO include the states of Kiribati, Marshall Islands, Micronesia, Nauru, Palau, Solomon Islands, Timor-Leste, Tuvalu, Vanuatu, Palestinian Authority, Sahrawi Republic and Taiwan. WIPO then got to be formally implemented in a convention held on April 26, 1970. In article 3 of this 1970 convention, WIPO emphasizes the issue of protecting IP rights across the whole world. It was in the year 1974 that WIPO became a specialized agency of the United Nations. Contrary to the norm with many agencies of the United Nations (UN), WIPO has strong financial power and does not rely on the contributions from the member states. For instance, in the year 2006, more than 90% of it's the income for WIPO was accumulated from the collection of application and registration fees by the International Bureau. Similar to all the other multi-government forums of the UN, WIPO is not an elected body. It normally strives to get to decisions by consensus through comprehensive discussions, but in the process that there is a need to vote, each member state has a right to vote without considering the size of its population or contribution that it makes to the organization in terms of funds. This factor has however resulted in numerous crucial consequences regarding certain issues, especially because of the North-South divisions in the politics of IP. In the 1960s and 1970s, the countries from the developing world were able to block the increased formulations of IP treaties such as the universal pharmaceutical patents which could have occurred through WIPO. It was in the 1980s, that this blocking influenced the United States and other developed countries to redirect the IP standard setting out of the WIPO processes and into a general

Agreement on tariffs and trade, and this later became the World Trade Organization (WTO) where the North has greater control of the agenda than the South. This yielded the desired outcomes to the North with the enactment of the Agreement on Trade-Related Aspects of IPR (TRIPS). A greater proportion of the important work at WIPO is done through committees, including the Standing Committee on Patents (SCP), the Standing Committee on Copyright and Related Rights (SCCR), the Advisory Committee on Enforcement (ACE) and the Intergovernmental Committee (IGC) on Access to Genetic Resources, Traditional Knowledge and Folklore, and the working group on reform of the Patent Cooperation Treaty (PCT).

Since all member states are treated the same by WIPO, and the Geneva Declaration on the future of WIPO, Argentina and Brazil prepared a proposal for the establishment of a Development Agenda for WIPO, it was on this basis that in October 2004, WIPO agreed to adopt the proposal and it was also well supported by developing countries. On the same basis, a number of civil society bodies have been working on a draft on the Access to knowledge treaty which they would like to see introduced.

WIPO has also established WIPOnet, which is a global information network. This project has linked WIPO to over 300 IP offices in all WIPO member states and also provides a means to secure communication among all connected parties. WIPOnet is the foundation for WIPO IP services, and has made patent search easy for various member countries including the developing countries.

2.8.2 The Agreement on Trade-Related Aspects of IPR (TRIPS) and the World Trade Organization (WTO)

The TRIPS agreement was formed through an initiative by developed nations to introduce more stringent IP rights rules in the market to extend the security afforded to the private sector through these rights at the International level. The agreement came into force on 1st January, 1995. Article 27.1 of the TRIPS agreement states that "Patents shall be awarded for any inventions whether products or processes in all fields of technology" and the patents shall be available and patent rights enjoyable without discrimination as to the field of technology. In Article 27.3 of the agreement, it is stipulated that members shall provide for the protection of plant varieties either by patents or by an effective Sui-generis system (such as those of UPOV) or by a combination thereof. Article 27.3(b) explicitly indicates that nations or states could use an alternative system – Sui–generis to protect the plant varieties. Some countries combine the protection of plant varieties with measures to protect farmers' rights over genetic resources (including Traditional Knowledge).

This provision also consolidated the position concerning the granting of IP rights in the field of biotechnology especially as it relates to plant varieties. However, since some countries may exempt plants and animals from patentability, it should be noted that the subject matter of protection is to some extent left to the discretion of national states and thus the scope of protection for products and processes of new technologies is uncertain. Secondly, different countries exclude different subject matter from patentability and thus unification and harmonization of patent laws the world over is not realistic. But the absence of criteria for patentability is favourable because each country with peculiar

national priorities informed by specific national needs is able to develop its national patent laws in line with its development goals. This allows the developing world to use immature industry arguments to protect certain sectors from competition or limit the application of the general patent system in certain fields like medicine or food supply.

It is however remarkable that even with the provision of the Sui-generis system, most African countries have not developed those Sui-generis systems and a few have countries including Kenya, Tanzania and South Africa in Eastern and Southern Africa adopted UPOV provisions yet a huge conceptual debate against IP regimes is that they are based on Western concepts of property rights and are therefore alien and impractical in the cultural, historical and institutional context of most developing world.

2.8.3 African Regional Industrial Property Organization (ARIPO)

ARIPO was created through an agreement known as the Lusaka Agreement in 1976 for the English-speaking African countries. In December 1985, the Lusaka Agreement was amended in order to open up membership of the organization to all African States, members of the Economic Commission of Africa and the Organization of African Union.

ARIPO was created to pull together the resources of member countries in industrial property matters in order to avoid duplication of financial and human resources and to facilitate effective and continuous exchange of information, harmonization and coordination of member countries' laws and activities in industrial property matters. The specific functions relating to industrial property performed on behalf of member countries by ARIPO are mandated under two legal instruments: the Harare protocol and

the Banjul protocol. Harare protocol of 1982 empowers ARIPO to grant patents and register utility models and industrial designs on behalf of member states. The Harare protocol was linked to the Patent Cooperation Treaty (PCT) application which may designate ARIPO.

The Banjul protocol on marks was adopted in 1993 and it empowers ARIPO to register marks on behalf of member states. ARIPO developed a legal instrument for Traditional Knowledge and Traditional expressions and folklore. Currently, it's the only instrument available for protection of Traditional Knowledge. The instrument has been formalized into a protocol and it is called Swakopmund protocol on protection of Traditional Knowledge and Expression of Folklore. It will act as a template for member countries and will enable ARIPO to register Traditional Knowledge and expression of Folklore, that are transboundary and multicultural in nature. It will also empower custodians and holders of Traditional Knowledge and expression of Folklore to utilize the knowledge for socio-economic development. It is likely to reduce the misappropriation, bio-piracy and prevent illicit claims of traditional knowledge.

2.8.4 Synthesis of some treaties, conventions and protocols

The introduction of patents in agriculture may have the potential to foster the development of high yielding varieties but this may be achieved at significant environmental and financial costs. For generations, communities have nurtured the available genetic resources and, in the process, selected certain plants and animals for domestication which have formed the basis for modern agriculture and have continued to provide the genetic material needed for the improvement of crops and livestock. All this effort is not recognized by the classic IPRs. Even UPOV 1978 provides for farmers

exemption to use their own seed, but it does not allow for sale or exchange with others. However, the OAU model law affirms that local communities have the right to keep, use, exchange or share their biological resources that sustain their livelihood systems. Both CBD and IT PGRFA recognize farmers' rights and they have indicated that the responsibility of realizing farmers' rights rests with national states. This means that African States need analysis of the treaties so that they could develop appropriate policies and legal frameworks to benefit the communities and the states themselves through benefit sharing.

While IT-PGRFA emphasizes national sovereignty, but introduces some common heritage principles, UPOV and TRIPS have taken a more proprietary stance favouring private investors and reflect the position of northern countries. CBD on the other hand has attempted a compromise in this regard. However, it debunks the concept of common heritage, introducing a notion of common concern, which implies the recognition of the global importance of conserving biological diversity but not the diminishment of a state's permanent sovereignty over the natural resources. It seeks to facilitate and promote global cooperation forcing any one state to participate. The central idea is for access to a resource to be shared equally, but it does not state how it can be used. As with human rights, reference to common concern is an acknowledgement that the state's management of its environment and resources is a matter of common understanding. It however recognizes potentially conflicting rights; for instance, the need to ensure equitable allocation of ownership rights and IPRs over biotechnology. But it does not say which rights should prevail in the event of a conflict, and does not address the rights

of communities apart from a cursory mention of indigenous and local communities in article 15. The issue of farmers' rights is also left outstanding.

Countries have not been able to look at these treaties critically which would enable national governments to seize the opportunities provided to enact policies and legislation that can be for the benefit of local people. The program should initiate documenting of indigenous knowledge and useful mechanisms not only for ensuring sustainable use but also ensure conservation of the existing genetic resources. Developing countries in the region stand to benefit if they are able to seize the opportunity to streamline their local policies and legislation through negotiations, as a block, by sensitizing both Government and the Civil Society in the region through its strong existing network, and interactions with the Common Market for Eastern and Southern Africa (COMESA), the East African Community (EAC) and the Southern African Development Community (SADC).

2.9 National Legislative Framework in the Kingdom of Eswatini

2.9.1 Patent and Designs Laws in The Intellectual Property laws in the Kingdom of Eswatini

The Patent and Designs Laws are administered by the Ministry of Commerce, Industry and Trade in the office of the Registrar General – Intellectual Property office. The plant varieties protection falls under the Ministry of Agriculture. The IP rights laws still rely on pieces of legislation in respect of Patents, Industrial Designs including Copyrights. An Industrial Property law, in respect of patents and designs is governed by the Patents and Designs Act 72/1936 as amended in 1947 and 1955. However, in respect of Trade

Marks, it is governed by Act 6/1981 which came into operation on 1st July, 1994. The 1936 legislation states that all patents granted in the United Kingdom or the Republic of South Africa are automatically protected in Eswatini as long as they have effect in the United Kingdom and Republic of South Africa. The registered proprietor of a patent granted in the Republic of South Africa or United Kingdom on application to the Registrar in Eswatini and on proof of the registration in South Africa or United Kingdom and payment of the prescribed fee, obtains a certificate of registration which subject to the requirement of renewal confers the same rights in Eswatini as the patent in South Africa or United Kingdom. The Act provides for automatic protection, in Eswatini, of designs registered in the United Kingdom and for registration of designs registered in South Africa.

The system is the same as that for the patents. The present patent system in Eswatini therefore depends on the industrial property laws or systems of two different countries – United Kingdom and Republic of South Africa. There is no possibility of obtaining protection without prior protection in one of these two countries. This means that Eswatini enterprises which wish to protect their inventions or designs in Eswatini first have to obtain protection in one of those countries which involves, among other things, additional expenditure. This means that Eswatini enterprises are at a disadvantage compared to enterprises in the United Kingdom or Republic of South Africa.

The dependency on the systems of the two countries means that in order to ascertain the position of owners of patents and designs, it is necessary to refer back to the law in one of these countries. Thus, the legal system is more complicated than it would be, if the protection were exclusively governed by the law within Eswatini. In view of the

disadvantages, the Eswatini Government strongly feels that there should be an independent legislation regarding patents and industrial designs.

2.9.2 Eswatini international obligations and membership to international treaties and conventions

Eswatini is a member of the following conventions and Treaties:

(i) World Intellectual Property Organization (WIPO) and its related conventions such as: Paris convention for the protection of Industrial Property Rights; Patent Cooperation Treaty (PCT), Berne Convention for Protection of Literary and Artistic Works; and Madrid Union.

(ii) World Trade Organization (WTO)

(iii) African Regional Industrial Property Organization (ARIPO).

(iv) Trade-Related Aspects of Intellectual Property Rights (TRIPS).

(v) Convention of Biological Diversity (CBD)

2.9.3 Summary of Intellectual Property Legislative Framework in Eswatini

Intellectual Property Rights System is weak and dependent on the systems of the United Kingdom or the Republic of South Africa. The only difference noted is the draft bill 2009 for the industrial property regimes. The IPR focal point has changed from the Ministry of Justice and Constitutional Affairs to the Ministry of Commerce, Industry and Trade under the Registrar General – Intellectual Property office.

This situation provides for clear opportunities for the IP project through the National Steering Committee in the Chapter to play a key role in influencing the changes required

in IPR and protection of the genetic resources and Traditional Knowledge in Eswatini. Creation of awareness through roundtable workshops/meetings with policy makers, training sessions with other stakeholders especially at the grassroots level will assist in influencing change in Eswatini. This should also provide opportunities to write proposals for assistance from public and donor resources.

For the National Steering Committee to effectively come up with the required influence, working with or incorporating key Government representatives from key Ministries like Agriculture and Cooperatives for Plant Breeders' Rights, Ministry of Tourism, Environment and Communications for protection of genetic resources and Traditional Knowledge and the Ministry of Commerce, Industry and Trade for Industrial Property and Copyright and Neighbouring Rights. This will also enable the NSC to work closely with the Government departments. It could also be useful if other stakeholders like Non-Governmental Organizations (NGOs) or the Private sector could be involved from the beginning, particularly to participate in creation of awareness.

2.10 Intellectual Property and Commercializing University Research

University research commercialization has grown significantly in the recent years. More interestingly is that the intellectual property rights as opposed to delivering value from implementing the new inventions have become the pivotal success factor in many universities (Holgersson & Aaboen, 2019).

Taking from the international community, the University of the Philippines (UP) educational system established the University Intellectual Property Office (UIPO) in 1997 in an effort to coordinate technology transfer and IP management between six

autonomous campuses. While the UIPO does not report to any particular government office, it operates in coordination with the national Intellectual Property Office of the Philippines. The UIPO has reviewed and prepared IP policies. For example, the University of the Philippines Ayala Technology Business Incubator (TBI) or technopark, located in the UP Diliman campus, is encouraging the transfer of research done at the university into the market to generate research returns and new funding sources. The functioning of TBI is based on the implementation of the university's IP guidelines.

In the African continent context, the Moi University in Kenya launched an IP policy in 2003, the Moi University Intellectual Property Policy (MUIPP), aimed at promoting creativity and innovation, ensuring a fair and equitable sharing of the rights and benefits of IP among the researchers or inventors, the institution and other stakeholders. The policy implementation is to be handled by the Technology Management Office (TMO). It is envisaged to provide incentives to the potential inventors and to curb brain drain. Other Universities in Kenya are working on similar IP policies with the collaboration of the Kenya Industrial Property Institute (KIPI). Moi University, like other public universities in Kenya, has been affected by the loss of many teaching staff who quit for similar or better positions in universities in South Africa, Botswana, Namibia, Zimbabwe and elsewhere. This adversely affects the running of some courses. This is one of the problems which Moi University Intellectual Property Policy is designed to address through a more equitable and fairer share of the rights to invention between the inventors, i.e., research staff and the University as the employer

2.11 Summary

Chapter two is consisting of a detailed consolidation of relevant literature around the research title which was used as a guide in formulating the theoretical and conceptual framework for crafting an appropriate methodology for the research. The conceptualized theoretical framework of the study was then localized to be relevant to the current case of UNESWA where the study was conducted. Intellectual property management progression over time has also been reviewed alongside the documented principles and steps for an effective economic development and exploitation of intellectual property management with more emphasis on the intangible assets of intellectual property. The role of patents in economic development was also discussed in detail. The foundation of the patent laws, assignment of patents and university research patenting overview were all discussed in detail. The existing legal frameworks at the international level and national level were also discussed in detail in this chapter. The final section reviewed the potential of universities to extend their trade territories in the field of intellectual property. Examples of success stories from the international and African contexts were cited in this review.

CHAPTER 3 METHODOLOGY

3.1 Introduction

The methodology section basically describes the procedure which was followed to carry out the study and the materials there we used in the process. Specifically, this chapter describes the research design used accompanied by a detailed justification for the choice of the design with special distinguishing characteristics which favoured the current situation. The sampling procedure and representativeness of the sample population is also discussed in this chapter. The data collection instrument (questionnaire) was structured in such a way that it addressed the research objectives and research questions are discussed in this chapter. Lastly the data analysis statistical package used is discussed in detail. The ethical consideration and clearance sought before implementing the research are also briefly highlighted. Lastly, the methodology section is summarized by highlighting the key components of each of the different subsections.

3.2 The Research Design

The study used a mixed method approach whereby both qualitative and quantitative methods were used to collect and analyse data. Qualitative approach was used to collect detailed data through open-ended questions with a view to giving participants the opportunity to respond more elaborately and in greater detail (Denzin & Lincoln, 2000). The closed-ended (rigid) questions were used to collect quantitative data.

The quantitative research design as guided by the research questionnaire was used for this study. A semi-structured questionnaire was distributed among the university staff members who are involved in research to extract their perceptions and opinions on the

investigated topic. Because of the approach that the research took in terms of capturing the data by counting the numbers of respondents with certain views, even though no other physical or measurements were done, the quantitative design remained the best option. The views of the researchers were then used to deduce the status of patenting research output in the university and also craft a way forward to improve the situation and reap benefits thereof.

3.3 Population and Sampling

The study was conducted at the University of Eswatini. The study population consisted of lecturers and researchers in all the 38 departments which fall under all the 8 faculties of the University. The study sample was purposively selected to consist of respondents who had been actively involved in research for the past three to five years. The sample consisted of 38 respondents, with one representative from each of the department. Hence, a total of 38 questionnaires were distributed for responses by the same number of active researchers from all the faculties of the university.

Out of the thirty-eight respondents targeted from the thirty-eight departments, a total of thirty respondents participated in the study. The other respondents could not be found, either because their departments were closed or were said to be only conducting their classes virtually. The restrictions on movements and banning of meetings to follow the protocols of mitigating the spread of COVID-19 were the major barriers in reaching all the targeted respondents of the study as it was implemented during COVID-19 lockdown.

3.4 Data Collection Instruments

Data collection was done through use of a semi-structured questionnaire (see Appendix 1) designed to capture information to address the objectives of the study. The semi-structured questionnaire consisted of closed-ended questions which were analysed quantitatively and open-ended questions which were qualitatively analysed. Open-ended questions were used to collect in-depth information by allowing participants to freely express their views and ideas.

3.5 Data Collection Procedure

Due to COVID-19 restrictions, it was not possible for the researcher to administer the questionnaire face-to-face. The questionnaire was distributed to each of the 38 departments of all the Faculties within the UNESWA. The questionnaire was completed by individual lecturers who represented their departments. The departmental representatives were those who had been actively involved in research for past three years or more. Then arrangements were done for the researcher to collect the completed questionnaires from the departments.

3.7 Analysis and Organization of Data

The first phase of the data included the demographics of the participants/respondents. This data were analysed using descriptive statistics and also presented in graphs and tables. The analysis of data included means, proportions of the whole population, standard deviations to identify the trends and deducing the overall direction of the responses. After all the data were subjected to some statistical analysis, the results were presented, followed by discussions and then conclusions and recommendations.

Analyses of qualitative data from open-ended questions focused on how individual participants responded to each question. Therefore, all the data for each question were put together. After organising the data by question, themes were identified and then organised into coherent categories. The study objectives also provided themes and direction on what to look for in the data.

3.8 Ethical Consideration

In order to ensure adherence to ethical considerations, the research ethical clearance was sought from the Africa University Research and Ethics Committee (AUREC), Mutare, Zimbabwe (see Appendix 2). Subsequent to the approval, the researcher sought permission to conduct research from departments of UNESWA through the office of The Registrar based in the main Campus of the university in Kwaluseni, Eswatini (see Appendix 3). On the request letter to the office of The Registrar, the AUREC approval letter was attached to substantiate the request to conduct the research. Lastly, the participants were sent a letter of invitation to participate in the study. In this letter, it was clearly stated that participation was on a voluntary basis and the participants may withdraw anytime during the duration of the study. Furthermore, participants' identifications were kept anonymous in the thesis compilation and were given total confidentiality. All copyrighted works that were used anywhere in the dissertation were acknowledged and cited and a reference list in the American Psychological Association format was adopted to limit plagiarism as much as possible (Africa University, 2016). The approval by the AUREC and the permission by the office of Registrar at UNESWA were in essence the license to continue conducting the study observing all ethical issues.

3.9 Summary

This chapter has explained the step-by-step procedure of implementing the study. The data collection instrument was divided into sections that were addressing the specific objectives. The study design, population and sampling methodology, data collection tools and data collection procedures are all explained in detail in this chapter. Finally, the data analysis and statistical tools used are discussed.

CHAPTER 4 DATA PRESENTATION, ANALYSIS AND INTERPRETATION

4.1 Introduction

The study was conducted to assess the status of patenting of research output at UNESWA. This was achieved through addressing the research objectives and research questions outlined in Chapter 1 and following the methodological steps detailed in Chapter 3. The results of this study are presented in the same order of the objectives in the form of tables and figures. The presentation of the results for each objective is immediately followed by the relevant discussions and interpretations in terms of how the research objectives were achieved and the implications with regards to other findings, and then the future prospects of improving the status of patenting research outputs at UNESWA and in the country. Based on the results and discussions, conclusions were drawn and the necessary recommendations were made.

4.2 Data Presentation and Analysis

4.2.1 Biographic and Demographic Information about the Respondents

Out of the thirty-eight sampled participants, thirty participants responded to the study questionnaire representing 79% of the targeted number of respondents from the university. The information about each of the respondents that participated in the study included the scientific (study) discipline, the age group and the gender. The study disciplines were then basically grouped into two categories which were i) sciences, generally comprising the Agricultural Sciences, Natural Sciences, Health Sciences, and ii) non-sciences, comprising mainly the faculties such as Education, Languages,

Psychology and related fields. Figure 4.1 is a graphical representation of the two categories of sciences and no-sciences in terms of proportions of the actual respondents.

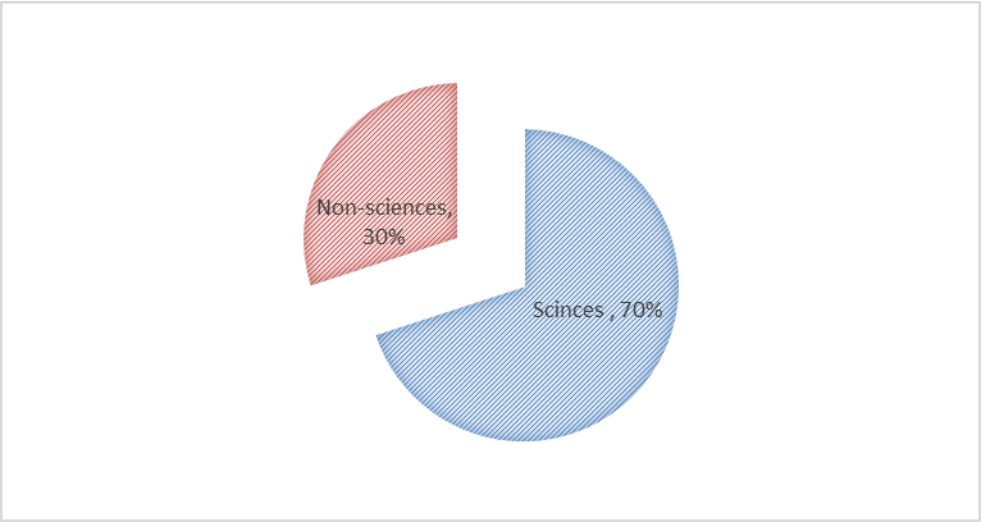

Figure 4.1: Proportion of study participants by discipline categories

Out of the thirty respondents that participated in the study, a proportion of 70% was from the fields of science and the remaining 30% were from the non-science fields. The analysis of the patenting experiences and perceptions were analysed in line with these two categories delineated and interrogated first individually and the across comparison done between the two groups.

The age groups of the respondents who participated in the study across both the sciences group and non-sciences are presented in Figures 4.2.

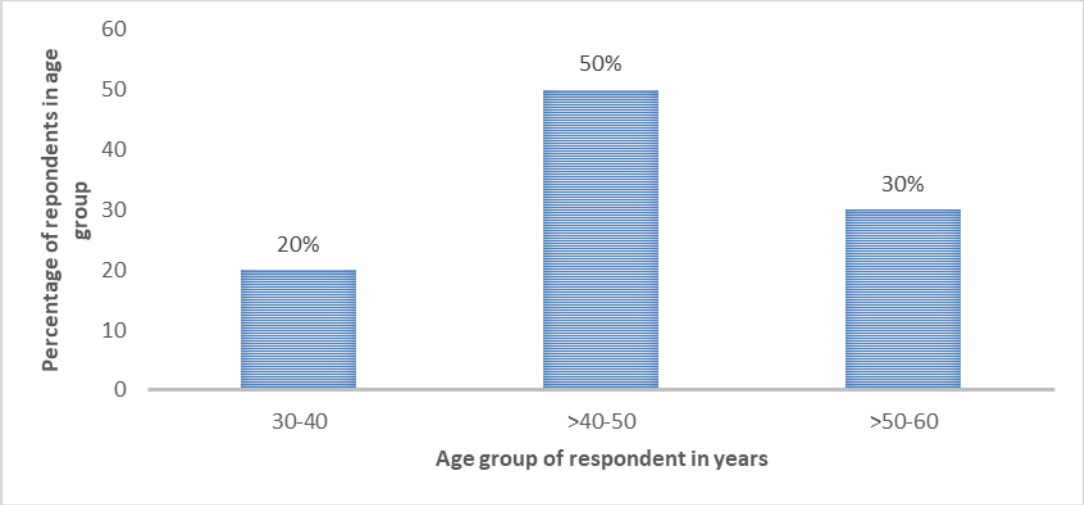

Figure 4.2: Distribution of study participants by age group

The majority of the respondents (lecturers/researchers) from the university, which was 50%, were within the age group of 40 to 50 years. In the age group of 50 to 60 years there were 30% of the respondents. The remaining proportion of 20%, which was the smallest proportion of the respondents within the respondents, was within the age group of 30 to 40 years.

The next in line for analysis within all the discipline categories was the gender of the respondents. The genders of the respondents in both the sciences and non-sciences groups were collectively presented in Figure 4.3.

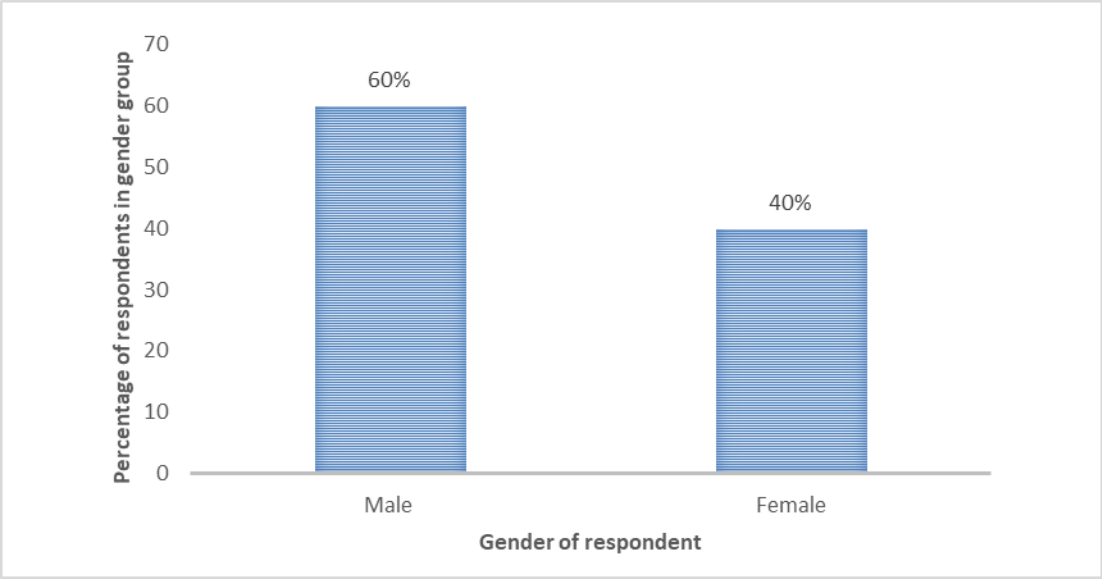

Figure 4.3: Distribution of study participants by gender

The respondents who participated in the study were male dominated as there were 60% males and 40% females. This means that the researchers/teaching staff of the university is also male dominated.

4.2.2 Level of Intellectual Property (IP) knowledge in the University of Eswatini

The first objective of the study was to establish the level of intellectual property (IP) knowledge within the UNESWA. To address this objective, the respondents were asked to rank their level of knowledge on IP matters from two fronts. First, it was on the IP itself and then, the laws and institutional framework that govern IP matters at the national level. In both fronts the respondents were requested to rank their level of knowledge on a scale ranging from 1 to 4, where 1 meant a poor level of knowledge, 2 meant a fair level of knowledge, 3 meant a good level of knowledge, and 4 meant a very good level of knowledge. Table 4.1 presents the ranks given by all the respondents in the sciences on their level of knowledge on the two aspects that were asked of them.

Worth noting also was the fact that all respondents in all the groups (sciences and non-sciences) responded and affirmed that they realized that IP is important for the protection of research outputs.

Table 4.1: Level of knowledge of Intellectual Property (IP) and IP laws among the science group

Rank scale	Awareness on IP protection (A)	Percentage of total resp. for (A).	Awareness on IP laws (B)	Percentage of total resp. for (B).
1	1	5%	3	14%
2	4	19%	12	57%
3	11	52%	4	19%
4	5	24%	2	10%
Ave. score	2.95		2.24	
Std Dev.	0.80		0.83	
N	21		21	

The level of awareness on IP was predominantly good among the respondents in the sciences group as indicated by their ranking scores. More than half (52%) of the group of the 21 respondents selected rank scale number 3 which meant good level of awareness. A proportion of 24% of the respondents had a very good level of awareness on IP in general. The 19% and 5% of the respondents had a fair level of awareness and poor level of awareness on IP protection respectively. On average the IP awareness among the science group of respondents was good as the average score of all the respondents in the group was 2.95. The standard deviation of 0.8, which is less than a

unit ranking scale also showed minimal variability of the understanding of the subject of IP among the respondents.

On the IP laws and institutional framework on IP matters at the national level, the awareness was somewhat lower among the respondents when compared to the level of awareness on the IP subject itself. For instance, a whopping 57% of the respondents still in the science category indicated a fair understanding of the national IP laws in the country. About 19% indicated a good understanding of the national IP laws. Only 10% (2) of the respondents responded to indicate a very good understanding of the national IP laws as they selected a scale of 4. The remainder of the respondents which were a proportional 14% indicated a poor understanding of the IP laws and institutional framework in the country. The average ranking score given the group of respondents in the science group was 2.24.

The same analysis of IP level of awareness on the subject of IP and national IP laws in the country was also done on the non-science group. The results of this analysis are presented in Table 4.2.

Among the respondents within the non-science group, a total of 44% out of the 9, which was the majority of the different sections of respondents, indicated that they had a fair understanding of the IP subject. This somehow indicated a lower understanding of the IP subject by the non-science group when compared to the science group. Those who indicted a good and a very good level awareness of the IP subject made 22% for each of the two levels of awareness. The fair level of awareness on the IP subject by the non-science group had a proportion of 11%. The average of the ranking scale scores given

by the non-science group to indicate their level of awareness of the subject of IP was 2.56.

Table 4.2: Level of awareness of Intellectual Property (IP) and IP laws among the non-science group

Rank scale	Awareness on IP protection (A)	Percentage of total resp. for (A).	Awareness on IP laws (B)	Percentage of total resp. for (B).
1	1	11%	3	33%
2	4	44%	3	33%
3	2	22%	2	18%
4	2	22%	1	9%
Ave. score	2.56		2	
Std Dev.	1.01		0.87	
N	9		9	

On the level of awareness on the national IP laws and institutional framework, the non-science group of respondents had equal proportions of 33% for each of the fair level of awareness and poor level of awareness. The good level of awareness and very good level of awareness were respectively indicated by 18% and 9% of the non-science respondents respectively. The average of the ranking scale scores given by the non-science group to indicated their level of awareness on the laws and institutional framework for IP in the Kingdom of Eswatini was 2.00.

Even though the awareness level of the respondents in the sciences category was higher than that of those in the non-sciences, the level of awareness among the lecturing staff of the university was generally good. The awareness on the institutional and legal framework governing the matters of IP at the national level, the awareness was lower than that of the IP subject in general. The lack of awareness on the national legal routes may also limit the researchers in terms of registering patents for their research findings or any other means of IP protection. The issue of awareness on IP is very critical for the overall performance and high achievements in the area of IP. For instance, the University of California, which is the leading university with patents in the world, has put more emphasis on the issue of IP awareness especially for their staff, students and those whom they collaborate with.

4.2.3 Opportunities for Patenting Research Outputs at the UNESWA

The second objective of the study was to identify patenting opportunities of the research outputs in UNESWA. The respondents in both the sciences and non-sciences groups were asked three questions in this regard. These were meant to find out if they considered their research outputs patentable and if they registered any patents in their study discipline or department. The participants were further asked to indicate if they had patentable research outputs which they had not patented. The results for the two groups of respondents (sciences and non-sciences) are presented in Figures 4.4 and 4.5.

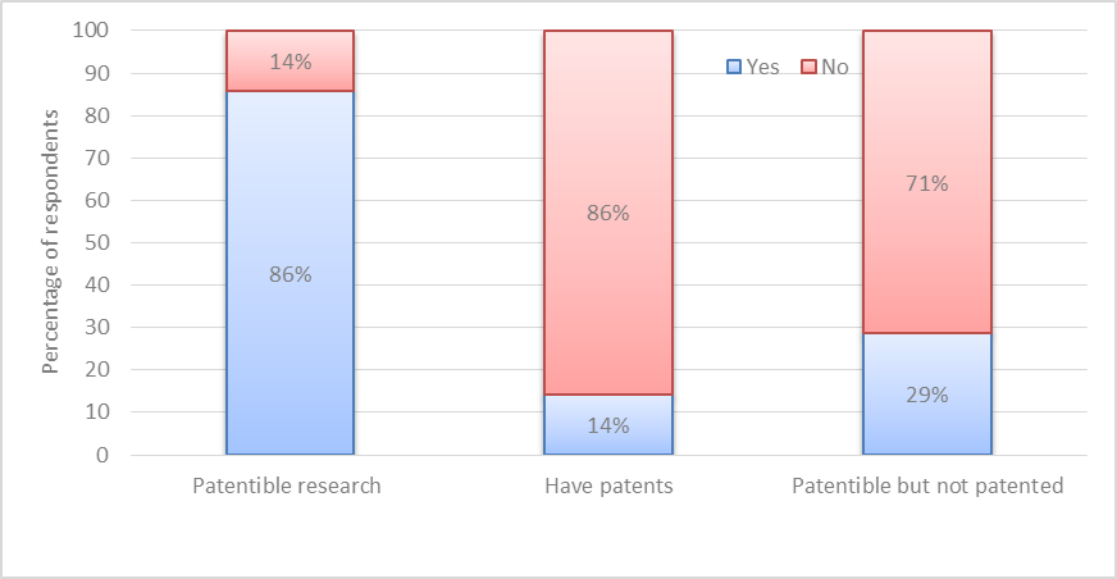

Figure 4.4: Percentage of respondents with patentable research outputs, with patents and those with patentable research outputs but not patented in the sciences group

Out of all the respondents within the sciences group, 86% regarded their research outputs as patentable and the remaining 14% regarded their research outputs not patentable. When asked if they had any registered patents, 86% of the respondents indicated that they did not have registered patents within their departments. There were only 14% of the respondents who indicated that they had registered patents. On the research outputs which the respondents considered patentable but not eventually patented, there was a proportion of 71% compared to 29% who indicated that they did not have any research outputs with a potential for patent protection. The same interrogation was also done on the respondents falling within the non-sciences as shown in Figure 7.

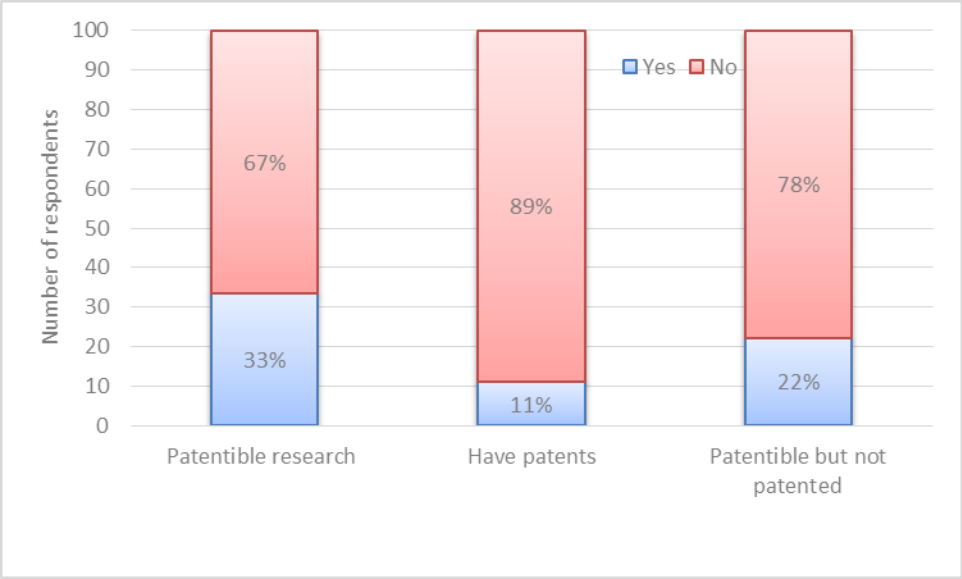

Figure 4.5: Percentage of respondents with patentable research outputs, with patents and those with patentable research outputs but not patented in the non-sciences group

Out of all the respondents within the non-sciences, there were 33% who indicated that their research outputs had the potential for patent protection. The majority (67%) of the respondents indicated that their research outputs did not have the potential to be registered for patents. Only 11% indicated that they had registered patents. The other 89% of the respondents within the non-sciences category did not have any registered patents. When looking at the possibility of registering the research outputs for patents, 22% of the respondents indicated that they had some research outputs with a potential for patenting. The remaining 78% of the respondents did not have any research outputs with a potential for patenting.

The study results showed that there is plenty of potential to have research outputs registered for patents. The majority of the researchers, especially in the sciences category considered their research outputs patentable. But when this was considered against the already registered patents, the results revealed that very few researchers had

registered patents. This meant that the opportunity for registering more patents is very high, especially among the researchers in the sciences category.

If the existing patenting opportunity can be explored, it can contribute massively to the economy of the university and of the country at large. In a study on inventions and patents at Chalmers University of Technology, in Sweden Wallmark (1997) highlighted that the economic value of patents goes beyond the physical patented products and licenses or agreements that the university signs with the potential investors in the industry. In his argument he stated that even the spinoff employments from the companies that emanate from the invention are still included in the value of the patented research.

4.2.4 Challenges in Patenting of Research Outputs

The study also set out to investigate the reasons why researchers at the UNESWA were not registering patents for their research outputs. The challenges from all the respondents were counted and presented as a percentage of all the respondents that participated in the study. The summary of the results of these challenges is presented in Table 4.3.

Table 4.3: Challenges of patenting research outputs at the University of Eswatini

Challenge	Number of respondents	Percentage of respondents
Lack of budget	24	80%
Institutional / Policy	21	70%
Lack of IP awareness	18	60%
Research quality	10	33%
Industrial linkages	3	10%
Toal number of respondents	30	

An overwhelming 80% of the respondents cited lack of budgets as a challenge that hinders the registration of patents at UNESWA. This was across both the sciences and non-sciences categories. The lack of budget specifically for strengthening IP in the university was raised with regards to patent registrations and subscriptions as well as substantial allocations for conducting research. Lack of institutional and policy framework was raised by 70% of the respondents. The views of the respondents indicated that there was no office or department leading the issue of patenting research outputs and that the routes for registering patents even at national level were not clear. Lack of awareness on IP matters among the researchers was raised by 60% of the respondents. The awareness on IP especially the potential it has for economic development is still lacking yet this can contribute to the economy of the university and the country. This can first be through the patents and the related royalties and also through spinoff businesses from the patented inventions which can create jobs for the citizens of the country. About 33% of the respondents indicated that the quality of

research also compromise the patentability of the research outputs. The research quality was highlighted as an area of concern for the patenting of research outputs. The issue of weak or no linkages between the university and industries was also identified as a bottleneck to patenting, and this was raised by 10% of the respondents. The formulation of the research agenda was said to be lacking the input of the industry and thus less adoption by the industry and the public.

4.2.5 Ways of promoting the use of patents to protect research outputs at UNESWA

The last objective of the study was to explore ways of promoting the use of patents to protect research outputs at UNESWA. Participants were asked to suggest ways of promoting protection of their inventions using patents. The suggestions as provided by participants are presented in table 4.3.

Table 4.4: Ways of promoting the use of patents to protect research outputs at UNESWA

Area of improvement	Number of respondents	Percentage of respondents
IP awareness	18	60%
Institutional / Policy	14	47%
Funding	10	33%
Research quality	7	23%
Industrial linkages	3	10%
No. respondents	30	

The issue of IP awareness to improve the status of patenting research output at the university was raised by 60% of the respondents across both the sciences and non-sciences. Another issue of concern which was highlighted by 47% of the respondents was that of institutional and policy framework in the university as well as at the national level. The issue of funding which was highly linked to the issue of investing more to research and improving its quality was raised by 33% of the respondents, while the improvement on the research quality was raised by 23% of the respondents. About 10% of the respondents recommended that the linkages between the university and industry have to be strengthened to stimulate patenting of research outputs.

The section on challenges was actually addressed in this section where the options for improvement were also highlighted by the respondents. Awareness came as the major recommendation for improvement in order to increase the rate of patenting research outputs. On the awareness, the indication was that awareness workshops among the working staff and students. The next major issue was that of strengthening the institutional and policy framework from within the university structures all the way to the national level. On the policies, the researchers indicated that the university has already started working on an IP policy to provide guidance on the IP issues at the university. It was also highlighted that an office dealing with IP or even a department focusing on IP as a major of study would go a long way in exploring the field of IP and enables the realization of the potential economic contribution for the university and the country.

Other matters that need attention included funding specially to support research so that there are many inventions that are developed and then be pushed further for patent registration. It was highlighted that once the process of patenting begins it will be possible to revolve funds and fund itself going forward. The funding issue was also highlighted to be a factor for improving the quality of research conducted at the university. The quality of research is the basis because that is the determinant in the patentability of the research outputs. The issue of linkages with the industry was also raised as an area that can contribute to improvement in the registration of patents. The industry can influence the research agenda because the needs of the industry are known by those who are already in the industry. So, they can influence the researchers to work on existing gabs in the industry. On the other hand, with the strong linkages the industry will always be waiting for the new inventions, which will also improve the patenting of the research outputs.

4.3 Chapter Summary

This chapter analysed data using the adopted research methodology in chapter 3, in order to achieve the four research objectives and the relevant research questions. The start was however to scrutinize the demographics of the respondents themselves in terms of study discipline (sciences or non-sciences), age groups and gender. The data analysis and presentation of the results was also covered in this chapter. The section on discussions and interpretation of the results was done to basically detail the implications of the presented results highlighting the present status, existing opportunities, challenges and possible solutions to increase the rate of patenting research outputs in the university.

The discussions of the results were presented immediately after presenting the results for each objective.

CHAPTER 5 SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

5.1 Introduction

This chapter presents the summary of the research findings, the conclusions, the recommendations and suggestions for future research.

5.2 Summary

The overall objective of the study was to assess the status of patenting research outputs in the UNESWA. This main aim was met through the conduction of a study to address four specific objectives. Before detailing a summary of the findings, it is worth highlighting how the demography of the respondents looked like. The majority of them (70%) were in the sciences stream. Also, about half of them were in the ages ranging between 40 and 50 years. There were more males (60%) among the respondents when compared to the females. The first objective was about establishing the level of knowledge at the UNESWA. The level of awareness on IP matters was generally good across the respondents. However, the level of awareness on IP legislations and institutions at the national level was somewhat lower. The second objective was about identifying the patenting opportunities at the UNESWA. The potential for patenting of research outputs from the university was found to be high especially in the sciences where 86% of the researchers consider their research outputs patentable. Despite the high number of patentable research output, very few patents were registered at the time the study was conducted. The third objective was to identify the challenges hindering the patenting of research outputs at the university. The major challenges constricting the patenting of research outputs were found to be i) lack of budget within the university to

specifically cater for IP matters, ii) lacking or unclear institutional and policy framework to guide the process of patenting at the university and national levels, iii) low quality of research and weak or no linkages between the university and the industry. The correction of these issues was then recommended as solution to increase the rate of patenting with the university, a solution which the fourth and final objective was seeking to achieve as ways of improving patenting of research outputs going forward.

5.3 Conclusions

The conclusions of the study were drawn based on the response of the findings to the main research aim of this study, which was to assess the status of patenting research outputs in the UNESWA. This was specifically with regards to the level of knowledge on IP among the researchers, the existing patenting opportunities, the challenges and strategic focus areas that need attention to improve the patenting of research outputs at the UNESWA. The level of IP awareness among the lecturing staff of the UNESWA was generally good, even though it was somewhat higher among those in the sciences than those in the non-sciences. Awareness on IP laws and policy framework at the national level was fair according to most of the respondents. Most of the research outputs, especially in the sciences category had a potential for patent registration. At the time of the study, the rate of registering patents by the researchers at the UNESWA was very low as there were a very few registered patents. It could also be concluded from the findings that the availability of funds to support IP matters at the university was a bottleneck to the patenting of research outputs. The issues that need immediate attention to improve the rate of patenting research outputs at the UNESWA included; i)

Awareness among the researchers on IP itself and governing legislations and institutions, ii) strengthening the institutional framework on IP from the university to the national level, ii) funding for improving research quality and maintaining patents, and iv) establishing strong linkages between the university and the industry.

5.4 Implications

The high level of awareness on IP by the researcher implies that it cannot be very difficult to support them into patenting their research because already they had ideas about patents and their benefit. The challenge however arises from the fact that these issues of patent registrations and maintenance are normally governed and controlled at the national offices, so the lack of awareness by the researchers on the IP matters at that level is of concern because it means most of them would not know how to go about registering their patents. The fact that there is a lot of patentable research that is not patented yet implies that there is room for registering patents and generate some income for the university. The challenges posed by the issues of IP awareness, weak policy framework from the university to the national level, lack of funds for improving the quality of research and the weak linkages between the university and the industry, all imply that the potential ability of patent registrations that the university can attain will be difficult to achieve if these challenges are not addressed.

5.5 Recommendations

In view of the results of the study, the following recommendations should be considered by the University of Eswatini:

1 Training workshops for the researchers on IP and the existing legal structures in the country can go a long way in improving the patenting of research outputs for the university.

2 Establishing an office or a department to focus on intellectual property can enhance the success of all the other departments in all the faculties in patenting of their research outputs.

3 Directing more focus towards research even in terms of allocating increased budgets can improve the quality of research and hence improve on the patentability of the research outputs.

4 Strengthening the linkages between the university and the industry will make the industry to influence the research agenda and utilize the findings from the research. This could increase the applicability of the results to the industry and thus increase the patented research outputs

5.6 Suggestions for Future Research

The present study focused on the UNESWA only. Therefore, there is need to expand it to the other institutions of higher learning and research institutions of the country. The study also looked at the general status of patenting research output without establishing the patentability of the research outputs. Therefore, future research may also focus on determining the potential economic value of patents that can be derived from the research outputs as well as identifying the capacity gaps in the research system of the university.

List of References

Africa University. (2016). *Board approved graduate studies regulations.* Mutare: Africa University.

Agarwal, R., Ganco, M., & Ziedonis, R. H. (2009). Reputations for toughness in patent enforcement: Implications for knowledge spillovers via inventor mobility. *Strategic Management Journal*, *30*(13), 1349-1374.

Arrow, K. J. (1962). Economic welfare and the allocation of resource for inventions, in the rate and direction of inventive activity: economic and social factors. *RR Nelson (red.), Princeton University, Princeton*.

Azoulay, P., Ding, W., & Stuart, T. (2009). The impact of academic patenting on the rate, quality and direction of (public) research output. *The Journal of Industrial Economics*, *57*(4), 637-676.

Baird, D. G. (1992). Reconstructing Contracts.

Baird, D. G. (1993). Revisiting auctions in Chapter 11. *The Journal of Law and Economics*, *36*(1, Part 2), 633-653.

Barzel, Y. (1997). *Economic analysis of property rights*. Cambridge university press.

Becker, G. S. (1997). The Economic Way of Looking at Life/Nobel Lectures, Economics 1981-1990, World Scientific Publishing Co., Singapore.

Becker, T., Dammer, I., Howaldt, J., Killich, S., & Loose, A. (2011). Netzwerke–praktikabel und zukunftsfähig. In *Netzwerkmanagement* (pp. 3-11). Springer, Berlin, Heidelberg.

Bentham, G. (1839). *Plantae Hartwegianae: imprimis Mexicanas adiectis Grahamianis enumerat novasque describit*. Apud Gul. Pamplin.

Bessen, J. (2004). *Patent thickets: Strategic patenting of complex technologies* (No. 0401).

Breschi, S., Lissoni, F., & Montobbio, F. (2007). The scientific productivity of academic inventors: new evidence from Italian data. *Econ. Innov. New Techn.*, *16*(2), 101-118.

Bromfield, T., & Barnard, H. (2009). The evolution of the intellectual property management strategy of an emerging multinational: Learning the purpose of patenting and scientific publications. *IEEE Transactions on Engineering Management*, *57*(1), 118-131.

Cantrell, R. L. (2009). *Outpacing the competition: patent-based business strategy*. John Wiley & Sons.

Carayol, N., & Matt, M. (2004). Does research organization influence academic production?: Laboratory level evidence from a large European university. *Research Policy*, *33*(8), 1081-1102.

Cohen, W. M., Goto, A., Nagata, A., Nelson, R. R., & Walsh, J. P. (2002). R&D spillovers, patents and the incentives to innovate in Japan and the United States. *Research policy*, *31*(8-9), 1349-1367.

Craswell, R. (1995). Freedom of contract.

Czarnitzki, D., Hussinger, K., & Schneider, C. (2012). The nexus between science and industry: evidence from faculty inventions. *The Journal of Technology Transfer*, *37*(5), 755-776.

Dam, K. W. (1994). Some economic considerations in the intellectual property protection of software. *The Journal of Legal Studies*, *24*(2), 321-377.

Denzin N.K. & Lincoln Y.S (eds.) (2000). *Handbook of Qualitative Research.* London: Sage Publications

Eppinger, E., & Vladova, G. (2013). Intellectual property management practices at small and medium-sized enterprises. *International Journal of Technology Management 11*, *61*(1), 64-81.

Ernst, H. (2017). Intellectual property as a management discipline. *Technology & Innovation*, *19*(2), 481-492.

Fabrizio, K. R., & Di Minin, A. (2008). Commercializing the laboratory: Faculty patenting and the open science environment. *Research policy*, *37*(5), 914-931.

Fisher III, W. W., & Oberholzer-Gee, F. (2013). Strategic management of intellectual property: an integrated approach. *California management review*, *55*(4), 157-183.

Foray, D., & Lissoni, F. (2010). University research and public–private interaction. In *Handbook of the Economics of Innovation* (Vol. 1, pp. 275-314). North-Holland.

Friedman, D. D., Landes, W. M., & Posner, R. A. (1991). Some economics of trade secret law. *Journal of Economic Perspectives*, *5*(1), 61-72.

Geuna, A., & Nesta, L. J. (2006). University patenting and its effects on academic research: The emerging European evidence. *Research policy*, *35*(6), 790-807.

Henderson, R., Jaffe, A. B., & Trajtenberg, M. (1998). Universities as a source of commercial technology: a detailed analysis of university patenting, 1965–1988. *Review of Economics and statistics*, *80*(1), 119-127.

Holgersson, M., & Aaboen, L. (2019). A literature review of intellectual property management in technology transfer offices: From appropriation to utilization. *Technology in Society*, *59*, 101132.

Jain, K., & Sharma, V. (2006). Intellectual property management system: An organizational perspective.

Kitch, E. W. (2002). The Nature and Function of the Patent System', Journal of Law and Economics, XX (1), April, 265-90. *INTERNATIONAL LIBRARY OF CRITICAL WRITINGS IN ECONOMICS*, *145*, 59-84.

Landes, W. M., & Posner, R. A. (1993). The influence of economics on law: A quantitative study. *The Journal of Law and Economics*, *36*(1, Part 2), 385-424.

Landes, W. M., & Posner, R. A. (1994). The Economics of Anticipatory Adjudication. *The Journal of Legal Studies*, *23*(2), 683-719.

Langinier, C., & Moschini, G. (2002). The economics of patents. *Intellectual Property Rights in Animal Breeding and Genetics, ed. Max F. Rothschild and Scott Newman*, 31-50.

Lichtenthaler, U. (2008). Open innovation in practice: an analysis of strategic approaches to technology transactions. *IEEE transactions on engineering management*, *55*(1), 148-157.

Locke, J. (1985). A Letter to Edward Ld Bishop of Worcester Concerning Some Passages Relating to Mr. Locke's Essay of Humane Understanding: In a Late Discourse of His Lordships, in Vindication of the Trinity.

Mazzoleni, R., & Nelson, R. R. (1998). The benefits and costs of strong patent protection: a contribution to the current debate. *Research policy*, *27*(3), 273-284.

McGinley, C. (2008). Taking the heat out of the global patent system. *Intellectual Asset Management*, *31*, 24-29.

Menell, P. S. (1999). Intellectual property: General theories. *Encyclopedia of law and economics*, *2*, 129-188.

Merges, R. P. (1995). The economic impact of intellectual property rights: An overview and guide. *Journal of Cultural Economics*, *19*(2), 103-117.

Merges, R. P. (1997). *Intellectual property in the new technological age*. Aspen Publishers.

Mowery, D. C., & Ziedonis, A. A. (2002). Academic patent quality and quantity before and after the Bayh–Dole act in the United States. *Research policy*, *31*(3), 399-418.

Mowery, D. C., Nelson, R. R., Sampat, B. N., & Ziedonis, A. A. (2001). The growth of patenting and licensing by US universities: an assessment of the effects of the Bayh–Dole act of 1980. *Research policy*, *30*(1), 99-119.

Mowery, D. C., Nelson, R. R., Sampat, B. N., & Ziedonis, A. A. (2004). The Bayh-Dole Act of 1980 and university–industry technology transfer: A model for other OECD governments?. *The Journal of Technology Transfer*, *30*(1), 115-127.

Murray, F., & Stern, S. (2007). Do formal intellectual property rights hinder the free flow of scientific knowledge?: An empirical test of the anti-commons hypothesis. *Journal of Economic Behavior & Organization*, *63*(4), 648-687.

Nagaoka, S., & Aoki, R. (2007). Economic analysis of patent law exemption for research on a patented innovation. *Tokyo, Japan: IIR Working Paper, Hitotsubashi University*.

Nunes Gimenez, A. M., Machado Bonacelli, M. B., & Carneiro, A. M. (2012). The challenges of teaching and training in Intellectual Property. *Journal of technology management & innovation*, *7*(4), 176-188.

Oddi, A. S. (1987). The international patent system and third world development: Reality or myth. *Duke LJ*, 831.

Owen-Smith, J., & Powell, W. W. (2001). To patent or not: Faculty decisions and institutional success at technology transfer. *The Journal of Technology Transfer*, *26*(1), 99-114.

Parchomovsky, G., & Wagner, R. P. (2005). Patent portfolios. *University of Pennsylvania Law Review*, *154*(1), 1-77.

Picker, R. C. (1992). Security interests, misbehavior, and common pools. *The University of Chicago Law Review*, *59*(2), 645-679.

Picker, R. C., & Bebchuk, L. A. (1993). Bankruptcy Rules, Managerial Entrenchment, and Firm-Specific Human Capital.

Posner, R. A., & Philipson, T. J. (1992). Optimal Regulation of AIDS.

Raffoul, N., & Brion, A. (2011). Reasons for patent protection and cost-effective patent filing options for SMEs. *Technology Innovation Management Review*, *1*(3).

Rai, A. K., Allison, J. R., & Sampat, B. N. (2009). University Software Ownership and Litigation: A First Examination. *North Carolina law review*, *87*(5), 1519.

Ramseyer, J. M. (1995). Credibly Committing to Efficiency Wages: Cotton Spinning Cartels in Imperial Japan. *U. Chi. L. Sch. Roundtable*, 153.

Sampat, B. N., Mowery, D. C., & Ziedonis, A. A. (2003). Changes in university patent quality after the Bayh–Dole act: a re-examination. *International Journal of Industrial Organization*, *21*(9), 1371-1390.

Scheffer, G. and Rehn, U. (2007) 'IP exploitation – from idea to license', *Presentation at the Perugia University*, 26 June 2007, Perugia, Italy.

Sell, S. K. (1995). Intellectual property protection and antitrust in the developing world: Crisis, coercion, and choice. *International Organization*, 315-349.

Strom, D. (2002). Intellectual Property Issues for Higher Education Unions: A Primer. Item Number 36-0699. *American Federation of Teachers*.

Sunstein, C. R. (1996). Behavioral analysis of law. *The University of Chicago law review*, *64*(4), 1175-1195.

Sykes, A. O. (1992). The welfare economics of immigration law: a theoretical survey with an analysis of US policy.

Thursby, J. G., & Thursby, M. C. (2002). Who is selling the ivory tower? Sources of growth in university licensing. *Management science*, *48*(1), 90-104.UK Intellectual Property Office, & Smith, S. A. (2011). *Intellectual asset management for universities*. UK Intellectual Property Office.

Thursby, J., Fuller, A. W., & Thursby, M. (2009). US faculty patenting: Inside and outside the university. *Research policy*, *38*(1), 14-25.

Wallmark, J. T. (1997). Inventions and patents at universities: the case of Chalmers University of Technology. Technovation, 17(3), 127-139.

Williams, H. L. (2013). Intellectual property rights and innovation: Evidence from the human genome. *Journal of Political Economy, 121*(1), 1-27.

World Intellectual Property Organization. (2004). *WIPO intellectual property handbook: Policy, law and use* (Vol. 489). WIPO.

Ziedonis, R. H. (2004). Don't fence me in: Fragmented markets for technology and the patent acquisition strategies of firms. *Management science, 50*(6), 804-820.

Appendix 1: Questionnaire

Research title: Patenting of research outputs in the University of Eswatini

Dear Sir/Madam,

My name is Cinisani M. Tfwala. I am conducting this study in partial fulfilment of the requirements for the award of a Master degree in Intellectual Property (MIP) at the Africa University, Mutare, Zimbabwe. The topic of study is "Patenting **of research outputs in the University of Eswatini**".

The purpose of the study is to assess the status of patenting research outputs in the UNESWA. Please, be informed that all information provided will be treated with the utmost confidentiality and for academic purpose only. I would be grateful if you could complete this questionnaire by 31 March 2021.

Thank you in advance for your assistance.

Section A: Demographic information

1. Name of respondent (optional)

…….

2. Department……

3. Scientific field (natural, agricultural, engineering, social, health etc)…….

4. Respondents' age groups (years)

<30	>30-<40	>40-<50	>50-60	>60

5. Gender: Male…….Female……

Section B: Level of IP knowledge

6. Are you aware of the importance of registering Intellectual Property (IP) for protection?

7. Using a scale of 1 to 4 where 1=poor, 2= fair, 3= good and 4 =very good, how would you rate your knowledge of IP protection? Please explain your answer.

……

8. Using a scale of 1 to 4 where 1= poor, 2= fair, 3= good and 4 =very good,

how would you rate your familiarity with IP laws and IP management in Eswatini?.....

Section C: Patenting opportunities

9. Do you consider some of your research outputs from your department patentable?.....

10. Does your department or institution have any patents? If yes, for what inventions?

……..

……..

11. Do you produce inventions that have potential for protection but you are not protecting them? .....

Section D: Challenges of patenting research outputs

12. If the answer to 11 is yes please explain why? .....

.....

.....

.....

.....

.....

13. Do you have a budget or a special fund for IP protection of your inventions? Please explain .....

.....

.....

.....

14. In what ways can protecting your inventions through patents help your department to generate income? .....

.....

.....

.....

.....

SECTION E: Ways of promoting patenting of research outputs

15. What else can be done to promote protection of your inventions using patents?

.....

.....

.....

16. What support does the University need to promote patenting of inventions?

.....

.....

.....

.....

Appendix 2: Ethical clearance request at AUREC

AFRICA UNIVERSITY
(A United Methodist-Related Institution)

For office use only

Protocol no. ……

Type of review: Full Committee

Expedited

Exempted

Office

st

a

AFRICA UNIVERSITYRESEARCH ETHICS COMMITTEE (AUREC)

APPLICATION FOR INITIAL REVIEW

NB: This form must be completed by all persons/teams applying for ethical review by AUREC. Upon completion by the investigator(s) /researcher(s) it should be submitted electronically to AUREC, Africa University, Fairfield Road, Old Mutare, P.O. Box 1320, Mutare. Application fees (to cover the costs of reviewing prposal) should be paid to the Africa University Business Office, and proof of payment should accompany each application. Please complete all sections of this application form. If there is insufficient space on the form you may use additional pages.

Check list

This checklist is meant to aid researchers in preparing a complete application package and to help expedite review by the AUREC. Please tick all boxes as appropriate (Indicate **N/A** where inapplicable).

CONTACT PERSON'S NAME : Cinisani M. Tfwala

CONTACT ADDRESS: Malkerns Research Station, P.O. Box 4, Malkerns, M204, Kingdom of Eswatini

EMAIL ADDRESS : cinisaniyfwala@yahoo.co.uk

CONTACT NO: +26876137025

UNDERGRADUATES

		Applicant	AUREC
1	Application form duly completed		
2	Electronic version of research proposal to aurec@africau.edu		
3	Consent forms in English and local language of study population		
4	Advertisement or letter or card used for recruiting participants and any		

	supplementary information *(if applicable).*		
5	Data collection tools being administered during the study in English and local language of study population *(if applicable)* included in the proposal		
6	Budget and timeframe included in the proposal.		
7	Approval letter from your academic supervisor/college or institution		
8	Approval letter from authorities where study will be conducted		
9	Application fee paid at AU Business Office and receipt (or copy) attached to application form.		

POST GRADUATES AND OTHER RESEARCHERS

		Applicant	**AUREC**
1	Application form duly completed	yes	
2	Electronic version of full research proposal (chapter 1 – 3 completed) to aurec@africau.edu	yes	
3	Proposal summary (see guidelines below)		
4	Consent form in English and local language of study population	yes	
5	Advertisement or letter or card used for recruiting participants and any supplementary information *(if applicable).*	N/A	
6	Data collection tools being administered during the study in English and local language of study population (if applicable)	yes	
7	Budget and timeframe	N/A	
8	Approval letter from academic supervisor/college or institution *(if you are a student)*	no	
9	Approval letter from authorities where study will be conducted	N/A	
10	Application fee paid at AU Business Office and receipt attached to application form.	N/A	
12	CV's for D Phil and Phd candidates.	N/A	

Cinisani M. Tfwala 15-12-2020

Signature: Investigator/Researcher **Name** **Date**

1. General information

Study title: PATENTING OF RESEARCH OUTPUTS IN THE UNIVERSITY OF ESWATINI

1.1. PATENTING OF RESEARCH OUTPUTS IN THE UNIVERSITY OF ESWATINI

1.2. Name of Principal Investigator(PI)/ Researcher: Cinisani M. Tfwala

1.3. Nationality of Investigator/Researcher: Kingdom of Eswatini

1.4. Proposed date of start of study: _(02/01/2021)

1.5. Expected duration of study: 2 weeks (until 15-01-2021

1.6. Study site(s) in Zimbabwe: N/A

1.7. Sites outside Zimbabwe: University of Eswatini, Kingdom of Eswatini

1.8. Study budget:_____ Source of Funding: WIPO

1.9. Is the researcher a student? Yes

1.10. If Yes, indicate the following:

1.10.1. Name and address of institution: Africa University

1.10.2. College: Peace, Leadership and Governance

1.10.3. Level of study Undergraduate/Master's/PhD: Master's

1.10.4. Name of Supervisor: Dr Byson Sabola

1.11. If No to question 1.10, then indicate the following:

1.11.1. Name and address of institution:

_____

1.11.2. Academic Title of PI:

_____

1.11.3. Existing Qualifications:

_____

1.11.4. Co Investigators:

Names:	Qualifications	Institution

2. Statement by the investigator

I _____certify that the information in this application document and the accompanying documents is true and complete in all respects. I confirm that the application has NOT been rejected by any other ethics review committee.

Signature
Date: 15-12-2020

3. Guidelines for the proposal summary: (Times New Roman, double line spacing, font size 12)
   - 3.1. Introduction
   - 3.2. Background ,purpose, statement of the problem, justification, significance of the study
   - 3.3. Aim(s) and objectives: Outline the main aim(s) and objectives of the study and research questions.
   - 3.4. Literature review
   - 4.0 Methodology

   4.1 Research Design *(describe how the research will be carried out including plans for data analysis and dissemination)*
   - *4.2* Study population and sampling procedure*(give details of the study population and how you will carry out the sampling procedure and NOT general meanings of population and sampling methods)*
   - 4.3 Inclusion/exclusion criteria*(state who qualifies for selection and who does not)*
   - 4.4 Devices, Tests, Questionnaires, and Interview Guides:
   - 4.5 Research participants/subjects
     - 4.5.1 State the total number of human participants to be enrolled
     - 4.5.2 State the source(s) of recruitment *(e.g. hospitals, schools, etc.)*
     - 4.5.3 Age range and sex of participants to be recruited.
     - 4.5.4 Special or vulnerable populations *(state if vulnerable populations e.g. pregnant women, adolescents, children, prisoners, refugees etc are involved)*
     - 4.5.5 Payment *(if any)* to be paid to each participant
     - 4.5.6 Informed Consent Procedure*(describe how this will be carried out)*
   - *4.6* Potential Benefits of the research *(Describe the benefits of the study both to the participants and to the community)*
   - 4.7 Potential Risks
     - 4.7.1 Describe any potential risks, discomforts or harms that may be experienced by the participants. These may be physical, psychological, social, legal, economic or other and state procedures to minimise these.
     - 4.7.2 Management of Risks*(describe how these risks will be managed/mitigated)*
   - *4.8* Confidentiality/privacy *(give details of how these will be maintained)*
   - 4.9 Investigator Experience/qualifications *(describe any experience or training/courses that the investigator has/has taken that put him/her in good stead to carry out the study)*

4.10 Explain how research results are going to be disseminated to participants

5. Reference List

6. Attachments

6.1 Approval letter from College Supervisor (if you are a student)

6.2 Data collection instruments *(Include anything you will be using to gather data from human subjects e.g. Tests/Questionnaires/Observation Checklists/interview guides/ FGDs guides etc.)*

6.3 Informed Consent Forms or assent (*informed consent form guide is available from AUREC)*

6.4 Budget and timeframe

6.5 Proof of payment of the review fees.

Appendix 3: Request to conduct research at UNESWA

Ubombo Sugar Ltd
P.O. Box 128
Big Bend

25 March 2021

The Registrar
University of Eswatini
Private Bag 4
Kwaluseni

Dear Sir / Madam

RE: PERMISSION TO CONDUCT RESEARCH IN THE UNIVERSITY OF ESWATINI

My name is Cinisani M. Tfwala. I am requesting permission to conduct this study in partial fulfilment of the requirements for the award of a Master degree in Intellectual Property (MIP) at the Africa University, Mutare, Zimbabwe. The topic of study is "**Patenting of research outputs in the University of Eswatini**".

The purpose of the study is to assess the status of patenting research outputs in the UNESWA. The scope of the study will cover all the departments in all the Faculties of the university where at least one respondent will be required per department. Attached herewith are the data collection questionnaire and approval from Africa University for conducting the study.

Thank you in advance for your assistance.

Yours Sincerely

Cinisani M. Tfwala
Cell: 76137025