COMMERCIALISATION OF ACADEMIC RESEARCH IN ZIMBABWE

BY

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ABSTRACT

The Government view is that it has done enough on its part to promote the commercialisation of scientific research. This is but still against a background in which the number of patented commercialised research results has remained low hence the research sought to determine the problems faced by the researcher in commercialising their patented research results. To do this the research looked at knowledge level of the need to patent amongst researchers , effectiveness of Technology transfer offices on the number of patented research results, number of patented research that is industry driven and a comparison of the number of researchers who patented and commercialized their results to those who just commercialized. To do this the researcher targeted universities as they are sources of large numbers of potential innovations, for adequate information of patenting and invention development activities and their inventions can be developed and commercialized like any other inventions. Through the use of questionnaires, observation and interviews the researcher gathered data this was analyzed using SPSS. From the data gathered there is lack of collaborations which leaves all parties without understanding the needs of the other party and therefore the need for enough consultations to be done from either party when coming up with their own individual policies so that they feed into each other. Also most institutions in Zimbabwe do not have experts in terms of IP to advise the researcher's. Zimbabwe has not gained much from the commercialisation of its research results because of inadequacies in the Intellectual property spectrum from creation to management through to utilisation of creations, that is, national administration systems and utilisation.

DECLARATION

I MADYIWA TAFADZWA WALTER DECLARE THAT THIS WORK IS ORIGINAL AND IS NOT SUBMITTED TO ANY UNIVERSITY FOR THE AWARD OF ANY DEGREE

…….

STUDENT SIGNATURE

26 APRIL 2014

DATE

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DEDICATION

This research is dedicated to my wife Sifiso Patience Ncube for indeed you were patient and loving all through the way and my daughter Zoe l love you, my mum Rosemary Madyiwa thank you for everything and my family members who lost valuable time with me during my study at Africa University.

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ACRONYMS

ARIPO: African Regional Intellectual Property Organisation

DST: Department of Science and Technology

GDP: Gross Domestic product

ICF: Innovation and Commercialization Fund

ICT: Information and Communication Technology

IP: Intellectual Property

MJLA: Ministry of Justice and Legal Affairs

S&T: Science and Technology

TTOs: Technology Transfer Offices

UMs: Utility Models

WIPO: World Intellectual Property Organisation

ZAI : Zimbabwe Association of Inventors

CHAPTER 1

INTRODUCTION

1.1 Background to the Study

Technology Transfer occurs when a technology developed or used in one unit of an organization is adopted by another unit of that organization or another organization. Commercialization occurs when the party transferring the technology receives money in exchange for giving up some or all of their rights to the technology. In other words, commercialization involves a sale. The buyer pays the seller for some or all of the seller's rights in the technology. Money changes hands. If no-one wants to pay for a technology, it cannot be commercialized. It still can be great science or great engineering. It still can be incredibly socially important. But by definition, it is not commercialized.

Commercialization of new technologies has contributed to economic development and growth countries like the United States has a history of successfully turning research results and new technologies into commercially viable products and services. Technology transfer activities started to become institutionalized in academia and government after World War II and have grown significantly in the last two decades, triggered largely by political reforms. Also in Korea Over the past 40 years, Korea has shown remarkable economic growth with rapid changes of its Technology Strategy such as Technology Transfer and Technology

Commercialization. One of the most important driving forces of this growth is investment in large-scale facilities, development of infrastructure, and aggressive acquisition of the most advanced technology in global marketplace. While in these countries it has been established that strategic Intellectual Property Rights management and appropriate legal and management frameworks at both national and institutional levels contribute significantly to economic development, the same effect that these have had is yet to be acknowledged and implemented in some African Sub-Sahara countries with weak economies. Among the key reasons contributing to such a situation is lack of awareness of IP issues by policy makers and other key players in the government and in public research and training organisations. Therefore, there is a strong demand for information on appropriate measures that should be taken by the government and the relevant institution to facilitate the transfer of IPs generated by science and technology research organizations from the laboratories to that market so that they contribute to economic development of the country.

Commercialization of science and technology in Zimbabwe are mainly promoted under the Department of Science and Technology (DST) which is under the Ministry of Higher and Tertiary Education Science and Technology. DST operates under the second Science and Technology (S&T) Policy of 2012 with a mandate to promote, facilitate and coordinate the strategic application of S&T in the mainstream of the economy. In order to achieve the above goal the DST works with all S&T related sectors of the economy, chief among them; Agriculture, Research and Development (R&D) Institutes, Zimbabwe Association of Inventors (ZAI), Mining, Information

and Communication Technology (ICT), Intellectual Property (IP) Organizations, Small to Medium Enterprises, Education, Health, Environment, Finance and Energy in promoting the commercialization of scientific research results and technology. ZIPO is the IP regulatory body in Zimbabwe charged with collecting fees for all IP registration and IP information searching. It is a department of the Ministry of Justice and Legal Affairs (MJLA)

The first S&T policy of 2002 was implemented through the establishment of a Department of Science and Technology (DST) under the Office of President and Cabinet in 2004, subsequently followed up by the establishment of the Innovation and Commercialization Fund (ICF) in the same year. The ICF started receiving funding from the budget vote appropriation 26 under the MSTD programmes in 2005 this fund is targeted to be 1% GDP as the policy of Science and Technology and innovation. The ZAI was instrumental in the establishment of the ICF, a commercialization loan facility targeting innovations from the inventors and S&T organizations in Zimbabwe. The ICF is an instrument administered by the Secretary for S&T to fund inventor and S&T organization projects with a great potential in promoting part or all of the following interventions: Technology transfer; import substitution; value addition; employment creation; Empowerment; Industrialization; and Generation of foreign currency through export promotion. The ZAI is a voluntary association of inventors spanning nation-wide with a membership of around 350 registered talented inventors. It was incorporated in October 2001, and is responsible for promoting, advocating and coordinating the use of IP instruments such as patents, trademarks and utility models (UMs) by inventors to protect their

inventions. The ZAI also assists inventors to source funds for commercializing, marketing, assigning, and licensing their inventions. Thus the need to commercialize university research results led to increasing interest in finding the most adequate frameworks to promote Government- university- industry partnerships for the commercialization of science research and technology. But in light of all the efforts by the various the number of patented commercialized science research results and technology has remained very subdued and very little if any to the national GDP

1.2 Statement of the Problem

The number of research results that have been patented and commercialization have become even more subdued , this is against a background in which more research institutions have been established and various government measures that have been put place to promote the commercialization of research results . Thus it therefore implies that researchers are finding it difficult to patent and commercialize their inventions. This study seeks to establish the problem that researchers face in trying to patent and commercialize their inventions. Although many institutions have now put in place IP Policies and the DST has continued to hold workshops on awareness of IP , but the knowledge level of IP and hence patented inventions and eventual commercialization of their inventions continue to be low

1.3 Purpose of the study

The failure by the inventor to reap any gains from the intellectual property that is inventions has had a negative impact on both the quality and quantity of research that come out of research results institutions .This is due primarily to the fact that many of the research results are rarely commercialized and they therefore do not benefit from commercialization process

1.4 Objectives

Main objective

To assess challenges in the commercialization of Scientific and Technological Research Results in from Academic institutions in Zimbabwe from an Intellectual Property Perspective.

Specific Objectives

1. To assess the knowledge level of the need to patent amongst researchers.
2. To assess the effectiveness of Technology Transfer Offices on the need to patent and commercialize on researchers
3. To compare the number of researchers who patented and commercialized their results to those who just commercialized
4. To assess the number of patented research that is industry driven

1.5 Research Questions

1. What is the knowledge level of the need to patent amongst researchers?
2. What is the effectiveness of Technology Transfer Offices (TTOs) on the number of patented research?
3. What is the number of researchers who patented and commercialized their results to those who just commercialized?
4. What is the number of patented research that is industry driven?

1.6 Significance of the study

The research study leads to the formulation of recommendations which in the opinion of this researcher, will assist with the total elimination of the research problem or a drastic reduction in the negative impact of the problem on the operation of DST, ZIPO, ARIPO and WIPO in implementing policies in Zimbabwe. The research aims to find how to best improve relations and coordination between industry and research institutions while at the same time taking into considerations the research that will also benefit the community at large

1.7 Scope of the Study

The research will focus on the level of knowledge on patents and their level of use by the inventors and will be conducted in research institutes around Zimbabwe

1.8 Limitations of the study

This research will be done in five months therefore the researcher will have limited time to conduct the research and no money to extent the research to other Research institutions that have commercialization setting. The behavior of one person may not reflect the behavior of other people thus; it is not known how others might behave at work. The research will have no control on the response given by the respondents in this research. The research therefore is primarily intended to benefit the research institutes and the Government of Zimbabwe, though the researcher will also benefit as partial fulfillment of Master of Intellectual property at the Africa University in Zimbabwe.

1.9 Delimitation

This research will be limited to challenges been faced by researchers in the commercialization of their research results in learning institutions from an intellectual property perspective .These challenges will be interpreted to give the current state of commercialization in Zimbabwe and the recommendation thereof. While every attempt will be made to arrive at valid findings and conclusions, there are factors beyond the control of this study that can contaminate the findings. Some of them are described as follows economic atmosphere of Zimbabwe; this research will be contacted when there liquidity constraint which affects revenue follow in the economy of Zimbabwe which can distort the findings of the research as every play in Government, Industry and University can say it's the major drawback affecting commercialization in the research fraternity.

1.10 Chapter Summary

The first chapter one looks at the statement to the commercialization of research results in Zimbabwe. It looked at the objective of the research and further gives the research questions which will be answered by this research. The chapter gives justification of the research, delimitation and limitation of this research subject to available constrains. The second chapter looks at available literature in the field of technology transfer so as to give a valid research.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

Commercialisation from the researcher's perspective is about maximising the commercial impact and financial benefit of the technology (Martin Croteau , 2005). In addition the researcher benefits from the practical application of their research in developing products they foster the widest possible recognition of their research efforts in which they will be awarded in the form of equity, licenses or royalty payments and collaboration with industrial partners may result in financial sponsorship of additional research and provide an invaluable experience and potentially career paths to students. But for the researcher to benefit from these they must have exclusive rights for a certain period of time to prevent anyone else from making ,using or selling the invention in the form of a patent. Therefore the researcher needs to patent the invention in order to realise the maximum benefits they must patent the invention first.

2.2 Commercialization as a stage of the innovation process

The innovation process consists basically of four overlapping and interrelated main phases: the idea generation and conception phase, the development and design phase, the prototype and pre-production phase, and the production, marketing and commercialization phase. The crucial point in the innovation process is the

production, marketing and commercialization stage, when the invention or the new product or process based on it will meet the test of the market. It is only when it is accepted on the market by the consumers and users that the invention or new product will begin to generate income which will compensate inventors and manufacturers for the investment made and eventually generate also some profit. The innovation process is not a linear process and its different components overlap and interact in a considerable degree. Thus the commercialization of an invention could be initiated at a very early stage of its development, e.g. already during the idea generation and conception phase. However, for the inventor or his company it is not advisable to begin commercialization at such an early stage and at least not before having filed a patent application. (Liang ,1996). The price offered for such an inventive concept would be very low, if any, regardless of its ingenuity and market potential, since a lot more of development work will have to be done, before the invention may be used in practice and could generate any income. A common mistake of many inventors is that they try to sell their invention without taking the necessary steps to at least obtain legal protection and to develop the inventive concept into something more tangible, e.g. to file a patent application and to produce a working prototype before trying to commercialize it. Inventors and all those involved in marketing inventions and innovations should not forget that only a very small percentage (5 to 7 percent) of all inventions for which patents have been granted reach the commercialization phase of the innovation process. The great percentage of failure is usually not due to the quality of the invention, but rather the result of the influence of other factors, such as, for example, the high investment cost for a relatively small effect, need of additional R&D work, the manufacturing and technological environment are not yet

ripe for such invention, no real market need, etc. But the history teaches us that that will not stop creative people from inventing and trying to commercialize their inventions. Inventors are usually very optimistic persons who are always confident that their inventions will sell, and will generate an important income for them. The commercialisation stages are shown below:

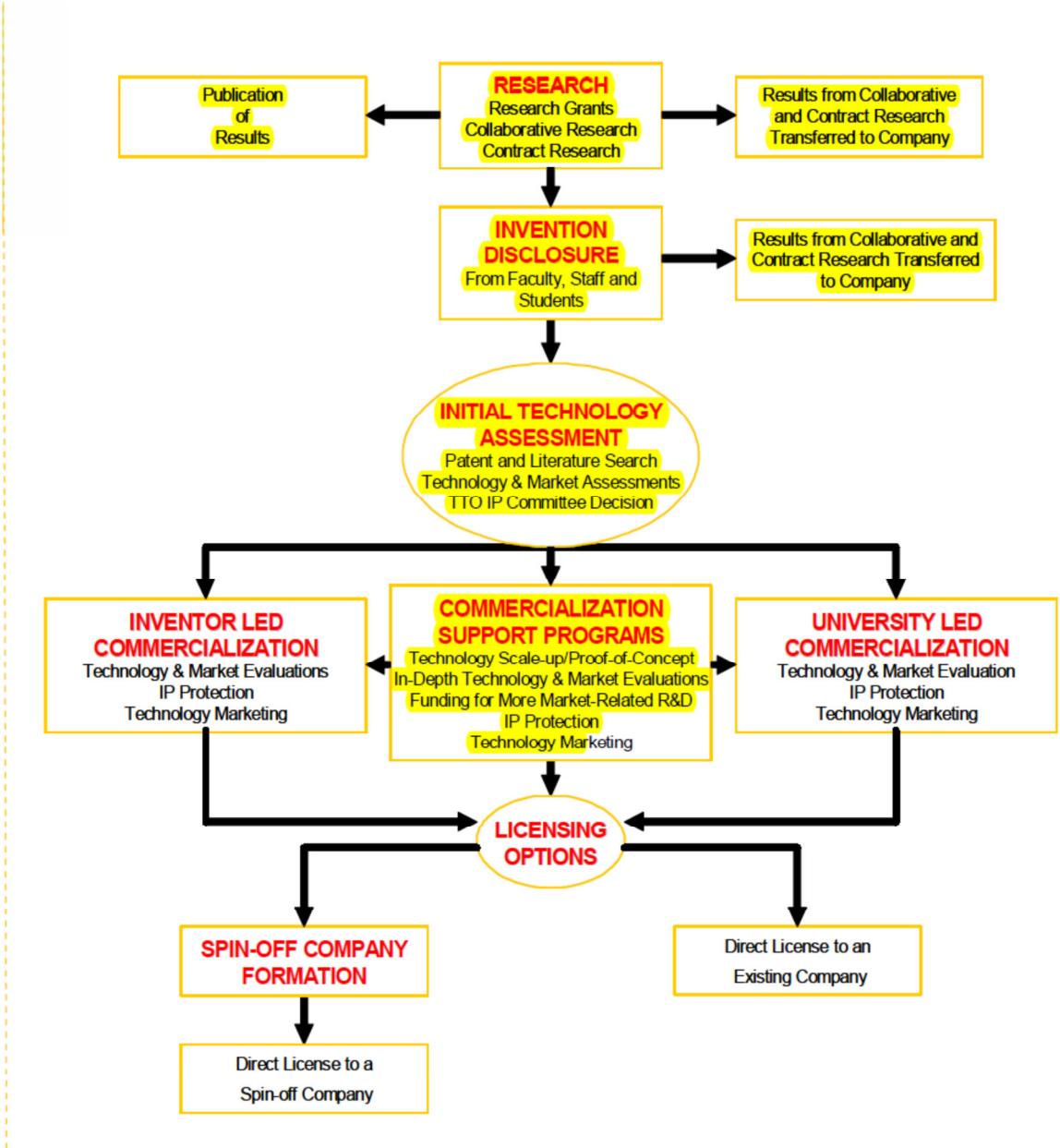

Figure 2-1 the commercialisation stage

2.3 Modes of commercialisation

2.3.1 University research parks

Science parks and incubators are property-based organizations whose aim is business acceleration through knowledge agglomeration and resource sharing (Phan et al., 2005). Unlike incubators, which offer business assistance services to start-ups, research parks are not dedicated to start-up, early-stage companies, or business development services. Instead, research parks are typically large-scale projects that house Research and Technology Commercialization a spectrum of entities, including corporate units, government labs, and medium and small firms. However, these institutions yield positive externalities and network benefits from being co-located with other high-tech firms and important players, such as venture capital providers. Open innovation platforms, virtual networks, and online marketplaces reduce search and collaboration costs, so collectively, they may substitute at least some of the network benefits of science parks and incubators.

2.3.2 Regional clusters

The scope and depth of research across the spectrum of academic disciplines have important implications for universities' ability to commercialize research and technology (Wright et al., 2004a). For example, many mid-range universities typically located away from major metropolitan areas, lack the resources to be world-class players in all research areas, hence the

development of regional clusters is a mechanism some universities use to overcome restricted resource endowments and improve scale economy. Indeed, evidence shows that technology transfer is more efficient in larger metropolitans and regions with high R&D levels (Siegel et al., 2003). While regional clusters are not as vibrant and efficient as metropolitans, they do facilitate collaborations between universities and industry: they create critical mass in TTOs' discipline-specific skills and involve development agencies, public research labs, intermediary organizations, local corporations, and occasionally, venture capital funds.

2.3.3 Academic spin-offs and start-ups

Strictly defined, spin-offs are new ventures that are dependent upon licensing or assignment of a university or corporation's IP for initiation. A corporation or university may own equity in the spin-off in exchange for patent rights it has assigned or in lieu of licence for fees (Wright et al., 2007). The institutional context may determine whether universities and indeed academics can take equity stakes in these firms. However, despite the ground-breaking technology they embody, only a few university spin-offs have created new markets (e.g. Google).Most spin-offs are unlikely to serve national markets, yet taken as a whole, university ventures do have significant implications for local employment creation and revenue generation (Clarysse et al., 2005). Having well-defined strategies and policies are central to the number of spin-offs that universities create, which includes having the necessary business development capabilities among TTOs (O'Shea et al.,

2005). Review of the literature suggests that world-class research and star scientists have considerable leverage in persuading TTOs to create ventures, particularly when licensing is the more obvious alternative (Lockett et al., 2005). Additional determinants of successful academic spin-offs and start-ups include enticing equity incentives for faculty who create businesses (Markman et al., 2005) and strong network ties between TTOs, venture capitalists, business angels, IP specialists (e.g. law firms), and entrepreneurs (Franklin et al., 2001; Wright et al., 2006). The bulk of research on the commercialization of research and technology, especially that emanating from universities, has focused on firm creation with less emphasis on understanding what is required to grow these ventures (Mustar et al., 2006). There is also a paucity of research on more informal commercialization mechanisms, including instances where scientists bypass their TTO when they privately sell, license, or use discoveries made while working in university labs (Markman et al., 2008).

2.3.4 Licensing

Companies license inventions for many reasons. These include harnessing external ideas and talent, keeping up with science and technology, reducing the risks associated with R&D, and enhancing dominance over technology corridors. Thus, firms pursue licensing strategies to increase the speed, scope, odds, and impact of their innovation. An increasing number of universities license their inventions, but because universities are accountable to a broad range of stakeholders, their licensing goals are typically more complex than

those of firms. Public universities typically have even less flexible policies than private universities regarding patenting, licensing, start-up formation, and interactions with industry (Siegel et al., 2003a). Furthermore, historically, public universities were less focused on technology transfer and commercialization as a source of revenue than private universities. In addition, public universities may have objectives relating to the promotion of local and regional development through IP spill overs. The returns to licensing are generally low and highly skewed towards a small number of licenses in small number of universities. The main impediments to effective technology commercialization through licensing are organizational ones – discordant cultures between universities and firms; misaligned incentive systems (e.g. insufficient credit towards tenure and promotion); and inappropriate staffing and compensation practices of the TTO itself (Siegel et al., 2003a, c). Collectively, these impediments explain the fact that as scientists make more valuable discoveries, they are more likely to divert their discoveries to the marketplace by sidestepping their TTOs (Link et al., 2007; Markman et al., 2008).

2.3.5 Contract research and consultancy

Contract research and consultancy also provide ways in which research and technology can be commercialized. Contract research and consultancy may generate significant revenues, although their measurement may be problematical (Wright et al., 2008a). For corporations, it provide access to new knowledge (e.g. basic science and applied technologies), enhancement of

R&D, and access to talent (Poyago-Theotoky et al., 2002). The notion of an overlapping internal labour market between high-tech firms and universities, which via R&D project collaboration, creates a pool of joint human resources with work experiences and career patterns for scientists that straddle the two sectors(Lam ,2007).As with other forms of commercialization, it is unclear how contract research and consultancy counts towards tenure and promotion. Moreover, the fact that university protocols regarding contract research and consulting are frequently stringent (e.g. many universities 'tax' an academic's consulting income), further reduces the incentives to partake in such activity. Contract research and consultancy is an important dimension of the commercialization of research (cf. Link et al., 2007). This route to commercialization is most likely to be effective when universities have developed centres of research excellence. An example is the Institute for Broad Band Technology (IBBT) which brings together over 600 researchers from several universities and knowledge centres in Belgium. The institute is comprised of specialized research groups that focus on the evolving needs of companies and organizations. However, high level contract research and consultancy pose major challenges for so-called mid-range universities that have few if any such centres. This may be especially acute for mid-range universities seeking to develop relationships with major corporations who are more likely to seek out leading research centres in other regions or even other countries (Wright et al., 2008b).

2.3.6 Joint venture spin-offs, alliances and collaborations

Joint venture spin-offs are new ventures in which technology is assigned to a company that is jointly owned by a university and an industrial partner. Academic scientists typically have an equity stake in the new enterprise, in order to accelerate the development and deployment of the technology into a marketable product (Wright et al., 2004a). Such joint ventures with industry partners allow universities to access important resources required to commercialize activities that are not available within universities or through a spin-off created with investment by venture capital firms. Industrial partners facilitate and accelerate the maturation of joint venture spin-offs through their organizational routines, resources, managerial talent as well as access to a vibrant ecosystem of trading partners. As with most partnerships, the uncertainty regarding ownership and control of the joint venture and its IP is a source of concern and hesitation (Wright et al., 2004b).

2.3.7 Open science and innovation

The decline in search and collaboration costs is accelerating the pace of open innovation, an innovation mode where diverse constituencies, including customers and end users, co-innovate and co-create. From a societal standpoint, the rise of 'open source' innovation is salient. Linux, Wikipedia, YouTube, Myspace, and Facebook are all examples of mass collaboration on open source platforms. Specifically, thousands of programmers contribute to Linux; over 75,000 people are peer-producing Wikipedia (e.g. these volunteers work on more than 10,000,000 articles in more than 250

languages); thousands of people contribute to YouTube (every minute, ten hours of video is uploaded to YouTube); and MySpace and Facebook are each supported by about 100 million active users worldwide. (Tirole, 2002).Although economists devote considerable attention to the supply side of the open source movement they have not directly examined the managerial implications of this phenomenon. This is due, in part, to the fact that it is difficult to parameterize labour supply under open source innovation, where developers and end users are often volunteers who do not appear to profit directly from these activities (Sauer, 2002).Open innovation firms seek to co-create and co-commercialize research and technology regardless of whether the technology is originated inside or outside their boundaries. Hence, firms and scientists may co-develop research and technology innovations that are commercialized elsewhere. Major issues concern how to access external innovations, how to integrate them, and how to capture and appropriate some of the benefits from such innovations. The development of social capital and external ties plays a central role in attracting scientists, consultants, universities, and industry players who can enhance the promise of external innovations. The development of absorptive capacity is also important in enabling firms to integrate and use research and technology generated externally. Tether and Tajar (2008) find that firms with more open approaches to innovation are more likely to use specialist knowledge providers, such as consultancies, private research organizations, universities and government research laboratories, as sources of information.

2.4 Institutional Measure to help commercialisation

Commercialization of inventions is a most complex process and in a highly competitive market it needs a professional approach and a lot professional expertise in order to have chances of success. Inventors are advised to seek as much as possible professional expert assistance when they are involved in that process. There exist many publications that teach strategies and techniques on how to sell and commercialize products, and all of them always underline that there can be no fixed rule on how to commercialize a product, although certain guidelines are common and basic and are important to remember. The same applies even more to inventions, which by definition are not standard products. Practice has shown that in order to be successful in the commercialization or marketing of inventions, the inventor of his company will need to have access to several or all of the following services:

- Technical and technological evaluation of inventions and innovative projects,
- Economic evaluation and market studies (i.e. feasibility studies),
- Legal advice and assistance,
- Contacts with potential users,
- Experience in business negotiations,
- Contacts to mobilize and attract seed and start-up capital or venture capital,
- Assistance in obtaining industrial property titles, including patenting of inventions or registering trademarks,

- Assistance in publicity matters and preparation of public relation campaigns,

- Advice and assistance in prototype manufacturing, etc.

Institution have put in place various measures to assist researchers in the commercialisation of their inventions among them is the establishment of the Technology Transfer Offices

2.4.1 Use of TTOS

The, U.S senate introduced Bayh Dole Act 1980 (also known as the University and Small Business Patent Procedures Act.) This act helped removed the barriers of intellectual property ownership and thus, universities can now claim rights towards their invention from federal funding. The Bayh Dole Act 1980 has made many changes that stimulate the commercialization process of US universities. This act is often perceived as essential to the growth of university-industry interaction in the US Research. The importance of different knowledge transfer channels between science and industry suggests that personal interaction of academic scientists and private sector firms is a key element of successful transfer. Following the passage of this Act many countries have developed technology transfer (TTOs) at universities.

Technology transfer is the process of transferring scientific findings from one organization to another for the purpose of further development and commercialization…The process typically includes identifying new technologies, protecting technologies through patents and copyrights, forming development and

commercialization strategies such as marketing and licensing to existing private sector companies or creating new start-up companies based on the technology (Reichelt, 2004) . These offices are not only involved in the making research that is relevant for making money but also to demonstrate the relevance of research to local and national development. Researchers can enhance their operations also by cooperating with others or by networking in order to utilize the best expertise of various enterprises or persons in areas such as research, testing, production, marketing or internationalization. However according to the OECD Science, 2012 report few countries and a few institutions have achieved a track record in commercialising the results of public research through TTOs. Moreover, many countries, universities and Public Research Institutes continue to base the productivity of TTOs on traditional measures of technology transfer such as patents and licenses. These TTO offices are still new and less experienced in conducting commercialization process

2.4.2 Institutional Policies

Institutional IP Policy should encourage privately funded research, the institutional IP policy should provide clear provisions on: approval procedures for privately sponsored research proposals, ownership of IP generated from privately sponsored projects, licensing of IP generated from privately sponsored projects and confidentiality issues of privately sponsored projects

2.4.3 Collaborations with Industry

Even though an invention may be good and it may have survived the patenting and product development processes, and even if the enterprise involved is dynamic and

innovative, the invention will not yet bring a competitive advantage or success. Only the most difficult stage in the process, commercialization, can bring income up to that point the venture has only taken up time and money. Thus these costs should be considered as investments rather than expenses. Therefore to ensure that the institution recoup this expense they use the demand-pull model based on contract research or collaborative research whereby universities are solicited by industrial actors to find solutions to production and innovation problems. Thus the research results are easily commercialised as they have a ready consumer. This is unlike the supply-push model whereby universities transfer academic inventions via the sale, transfer or licensing of intellectual property, often on an exclusive basis, to existing firms or to new ventures (e.g. academic spin-offs) through supply and push forces.

2.5 Use of the Patent system to promote Commercialisation

Recently, increasing attention and importance has been given to the role of the patent system as an analytical instrument for such industrial planning and decision-making. Two main uses of the patent system may be of interest in this regard. Firstly, the information aspect of the patent system: Awareness of the state-of-the-art in a particular technical field can avoid duplication in research work by indications that the desired technology already exists. Also it can provide ideas for further improvements; and can give an insight into the technological activities of competitors and, by reference to the countries in which patents have been taken out, the marketing strategies of competitors. A state-of-the-art search can also identify

newly developing areas of technology in which future R&D activity should be monitored. Secondly, as a tool for industrial planning and strategic decision making, the industrial property system may be very useful through analyses of the statistical aggregation of patenting activity as revealed through published patent documents. Since the degree of patenting activity provides an index of the degree of technological activity in a given technical field, the statistical analysis of patent documentation can indicate which countries or companies are active in various fields, in which industries technology is moving at a rapid pace and in which the technology is stable, and which are the enterprises active in particular technical fields. Such analyses provide a means of forecasting future industrial developments, identifying areas in which market demand is increasing, monitoring general technological progress, and testing the soundness of policy and investment decisions.

Technology, and inventions, as a fundamental part of it, is, by nature, both private goods in creation and public goods in productive use or consumption. They are private goods in so far as their creation consumes both mental and physical resources which are thereby diverted from other production or consumption activities. Once technology or inventions become available in the form of information, however, they lose their characteristics as private goods. Unlike a tangible object, they can be used by many without loss to any person, and without further investment in re-creating it for new users. These characteristics of technology and invention create a dilemma. If all are free to use technology and inventions which have been created, who will be willing to bear the cost associated with their creation? One of the basic rationales of

the patent system is to provide such an incentive for the creation of new technology and inventions. It does this by offering to inventors exclusive rights to commercially exploit patented inventions for a limited time in return for the disclosure of the inventions to the public.

The exclusive rights to exploit the invention commercially permit the creator of the invention to work it without fear of interference from imitators who have not incurred the investment in research and development which produced the invention. The inventor will thus have the opportunity to recover research and development costs through the competitive advantage which the exclusive rights to exploit the invention confer. The patent grant in this respect acts as an instrument of economic policy to stimulate further risk-taking in the investment of resources in the development of new products and technology

Patents are granted on technical criteria and not on the basis of commercial or market criteria. The exclusive rights which are conferred by the patent relate to the commercial exploitation of the invention, and do not preclude another person from experimental work using the technological information contained in the patent specification. In other words, while the patent owner can prevent others from using, for commercial purposes, the same technology as is revealed in the disclosure of his invention, he is not protected against those who derive from his disclosed invention a perception of a market need which may be satisfied by the legitimate adaptation or improvement of his technology, or through the discovery of a different technical solution to satisfy the same market need. The patent system contributes to economic

growth and development by creating the conditions for the marketing and commercialization of inventions in several ways:

(a) Gives an incentive to the creation of new technology which will result in among other things new products, inventions and commercial opportunities;

(b) Contributes to the creation of an environment which facilitates the successful industrial application of inventions and new technology, and the legal framework which encourages investment, including from foreign countries;

(c) Acts as a catalyst for the commercialization of inventions and their transfer to productive use;

(d) As an instrument of commercial and industrial planning and strategy.

The framework of the patent system also provides a necessary element of certainty for a technology transfer transaction. If a potential technology recipient were located in a country which did not maintain a patent system, the supplier of the technology would need to rely on purely contractual arrangements seeking to guarantee non-disclosure and use of the invention by third parties. Such arrangements establish an element of commercial risk for technology suppliers which is more pronounced than in circumstances where the transfer transaction can be linked to a patented invention or technology guaranteeing protection against illegal exploitation by third parties

The existence of a patent also introduces another measure of certainty to the commercial transfer transaction by enabling the potential recipient of the technology to sight the essence of the technology which he is wishing to acquire. In the absence

of a patent, such initial sightings of the technology which it is proposed to transfer must take place through disclosures under secrecy and confidentiality agreements, which can again introduce an element of commercial risk of the leakage of the technology to third parties, thus undermining both the value of the technology from the point of view of the supplier, and the value of the technology for which the recipient will be paying. Furthermore, to cover such high risk the supplier would calculate it into a higher price of his technology.

The patent system must be understood as a policy instrument which encourages developing indigenous technological capabilities by providing an incentive to local inventors, research and development organizations and industry, rather than a policy instrument which, if adopted, will immediately effect a transformation in the level of technological sophistication in the relevant country. In fact, it represents a strong shield for the development of innovative domestic industry however small it may be at the moment.

The patent system does not constitute an instant remedy, but rather a long-term infrastructure investment in development of the national market. Without any patent system, local inventors, entrepreneurs and companies would have no effective protection against the imitation of their inventions, and less incentive to invest in the development and strengthening of their technological capacities. It might therefore be expected that the number of inventions produced by local inventors would be even less in the absence of a patent system

2.6 Method s of Funding of the various research for commercialisation

Studies showed that finance is an important contributor to the success of commercialization. Norris & Vaizey (1973) indicated that the research phase accounts for 5-10%; development for 10-20% and commercialization between 70-85% of the total cost. It is found that the level of capital required at the R&D stage is relatively small as compared to the capital investment at the testing and construction phases. Since research breakthroughs pose significant level of capital risk, the availability of early stage venture finance is required. Angel investors and venture capitalists are limited (no angel investors in Zimbabwe), and in addition, due to the high failure rate of new firms, obtaining conventional loans from the banking system is difficult. Realizing that start-ups rarely have a positive cash flow during their first years of operation, continuous funding assistance is required. However, researchers turning to venture capitalists yield no significant help since most venture capitalists (VCs) are low risk takers and are not prepared to wait for a long time.

Researchers can also fund their research using the following different ways:

-Privately funded research is where the resources are supplied by private enterprises or organizations.

-Contract research: Research which is conceived and funded by industries to provide a solution to a specific problem. However the perception of the industries towards universities and research institutions needs to be changed. Industries do not view universities or research institutions as an important source of innovation (Rasiah and Chandran, 2009). They fail to understand the nature of science and always want to focus on quick returns out of their R&D investment. In addition, large organizations

tend to conduct R&D solely by themselves due to wide range of issues, e.g., confidentiality, IP issues and bureaucratic processes and procedures in most institutions.

- Sponsored research: Where a university conceives a research project and prepare a proposal for funding and where the funding agency is not directly a beneficiary of the research results

-Collaborative research: Similarly, for universities and research institutions, close collaboration with industry is essential to place the inventions in the market place. Chandran)In Malaysia it has been empirically showed the importance of collaboration for university technology commercialization in Malaysia Research collaboration between a public university and private research unit of an enterprise or private organization(Chandran et al, 2009) Research collaborations are managed by legal agreements such as Contract research agreement , Collaborative research agreement , Consulting/know how Agreement , Material transfer agreement (MTA)) Contracts that govern the transfer of physical assets, Typical materials are biological materials (reagents, cell lines, plasmids, and vectors) that are transferred for the purpose of research or commercialization and Chemical compounds . MTA ensure transfer of possession but not legal title, Non-Disclosure Agreements(NDA) provisions include identification of parties , identification of confidential information , definition of purposes for which information can be used e.g., solely for purposes of evaluating a licensing opportunity , requirements for return/destruction of confidential information NDAs does not apply to: information

in the public domain information already possessed by the recipient , information disclosed to the recipient through legitimate means

2.7 Challenges the Commercialisation of Research Results

Moving these research results as technologies or inventions into the market place may not be such an easy feat. There is always that question of whether the technology would make enough impact so as to be commercially rewarding. Extraordinary returns would probably be more achievable if researchers integrate their innovations into an existing value chain, often involving cooperation with established industry players. More challenging of course is to spin off a company to produce manufacture and market the products being commercialised. There are also issues in patent and intellectual property that must be properly addressed in the commercialization process. Patent protection and capital investment are necessary components for the effective commercialization of innovations. Furthermore, there is the lack of internal support and structure .Currently, the commercialization management structures and systems have low efficiency to ensure commercialization opportunities associated with IP discoveries which progress by appropriately resourced and skilled staff. This, in turn, impacts the commercialization time lines and outcomes. For instance, technology transfer office (TTO) in universities is normally managed by academics that lack the expertise needed to manage scientific discoveries of their researchers. The lack of qualified staff significantly affects the proper management of organization's inventions and dissemination of information to industry. Indeed the absence of adequate technology management practices and lack of experience serves as the major obstacle to poorly established linkages. While

many research and development systems in the West evolved to the fourth generation – attention is given to the market needs, technical feasibility and marketability at a very early stage (Miller and Moris, 1999), it is evident that most research organizations in developing countries, are at first generation stage where focus is devoted to the science based research and development labs consequently limiting attention to research and development management. The source of university learning on research management is limited given the lack of network cohesive with other actors within the innovation systems. Owing to the lack of experience in marketing new innovations, negotiation and commercialization exposure, failures are rampant in research and development commercialization. Similarly, the private sector also lacks such research and development management systems. Success in commercialization also depends on the roles the leaders play within an organization. Ulric and Holger (2009) highlighted the importance of champions in driving the commercialization efforts. Past research indicates that champions are capable of recognizing the commercial opportunities, provide the leadership, direct resources appropriately and treat Research and Development project as their own. Other internal dynamics include organizational culture towards Research and development effective communication systems.

2.8 Solutions to some of the commercialisation challenges

2.8.1 Timeliness:

A commercialization activity is a long process over time. It requires initial investment before making profit. Initial investments are normally for intellectual property filing, company registration, hiring qualified entrepreneur and marketing of

products as (William R, 2011). Brody president of Johns Hopkins University ‘‘from the university’s perspective, it’s mostly a money-losing operation. The fees that universities get do not cover the expenses involved in licensing and marketing the inventions. That’s because only a very small fraction of licenses actually generate much revenue. It is therefore important for universities to have a proper commercialization strategy and Intellectual Property Policy that minimizes risk. The following costs and investment can be implemented by the university:

They can outsource some of the services to reduce the costs, find some sponsor, find co -sourcing, lease courses from or to outside, use open source technology to reduce the costs and they can also ask government funds for some of the projects. The marketing of the programs also should be thought of in advance.

2.8.2 Incentives and Rewards:

Another problem in the commercialization activity is the lack of proper incentives and rewards system. Although there is an on-going debate about reward and incentive, it is imperative that universities have a proper rewards system. This is consistent with a long research stream on pay and performance. On the other hand, royalties’ incentive effect might seem surprising, given the norms of open science and free dissemination of knowledge under which universities are expected to operate. In fact previous studies on this topic have shown contrasting results suggesting that monetary incentives given to university scientists are negatively related to the number of equity licenses in young ventures and to the number of start-ups; similarly, sharing revenues with scientists departments is negatively related to

the number of incubators. This therefore proposes that royalties grant to faculty inventors have positive effect on the number of licenses, while royalties granted to the inventors departments have a negative effect. There were those who warned about undue influence by corporations that provide research funding and potential abuse by faculty and university staff due to conflicts of interest, triggered by the lure of readily available money and conflicts of commitment. But this has not been the case as the university is more looking forwards to the publications and teaching and even though, the academic know about the commercialization activity but they don't have time and knowledge to interact with the industry. But research has shown that the interactions between university and industry will create and give an important contribution to all the agents involved in it, with all the research university in United States are leading the way.

2.8.3 University -industry Interactions

Nevertheless, a solution to some of the problems in commercialisation is creating an effective university-industry linkage it has always been a great challenge and is by no means easy as generally speaking, universities today are still holding the line on open publications of all research results and, insisting on retaining entitlement to all inventions. Universities worldwide today are wrestling with ways to accommodate the needs of the industry without sacrificing the university's long tradition, principles and long term objectives. However, for more interaction of industry with universities, several changes may have to be instituted and revised which include increased professionals in the University Technology Transfer Office and substantial

interflow of personnel between industry and university and between university and industry. There must be increase in sophistication of licensing agreements, increase in understanding of the importance of protecting the Intellectual Property, a better understanding of patent law and technology transfer and more importantly, increasing awareness of the roles and risks of industry/entrepreneurs in commercialising academic inventions.

2.8.4 Recognition of the researcher:

More recognition perhaps, should be given to the scientist/researcher for commercialisation of their research findings, in terms of promotion.

2.8.5 Government support:

The Government should continue to support and sponsor commercialisation plans and also programmes involving industry/university collaboration. There must thus be increasing recognition of the importance of university's research to support the National Economic Development. Successful commercialisation requires a new way of thinking amongst academics, industry and the government. A paradigm shift is vital in carrying concerted efforts in commercialisation of research findings from the universities and research institutions in order to secure long term benefits for the nation. Emerging markets in Asia, Republic of Korea, Taiwan province of China, China, and India, are striving to bring new products and services to the market using more innovative approaches. Samsung and Hyundai of Republic of Korea, Haier and Lenovo of China, Asus and Acer of Taiwan province of China, as well as Tata Nano of India are emerging as new rivals in the dominant world of the Japanese and the American electronics and automotive industry. For these firms, sustaining

competitiveness means significant investment in research and development (R&D) and the ability to bring R&D outcomes to marketplace. Indeed, policy-makers in these countries place innovation, technology development and commercialization agendas as their strategy focus to enhance economic performance. Malaysia and other developing countries tend to follow the same strategic path especially in using innovation as their next source of growth performance. Even though Malaysian economy has successfully evolved and progressed, the current competitive advantages based on low cost labour, resource availability, and capital incentives can no longer be the key drivers. As such, focus on the operations and task of bringing research results to the market and to the hands of the users is important. The burden of bringing the idea to the market now lies on the shoulder of the government, universities, research institutes and the industries, mainly the Small Medium Enterprises (SMEs). However, the business of commercialization is not straightforward nor is it easy. Even in the case of developed countries, especially in Europe, success is still limited. While many developing countries have recorded few success cases, however, as a whole its intellectual property creation and commercialization efforts are fairly low. Although the government undertakes various initiatives to accelerate the rate of commercialization, namely, by setting up institutions and programs (including grants), at large, there still exist gaps that need urgent attention. National progress in intellectual property (IP) and technology commercialization is low (Chandran & Wong, 2010 ;). Academic patents typically are early stage technological developments characterized by high degrees of technical and market uncertainty. Indeed, patent applications in developing countries like Malaysia patent systems, are relatively low, let alone its majority owned by

foreign multinational companies - Motorola, Intel, Avago, and Agilent Technologies - operating in Malaysia (Chandran and Wong, 2010).

2.9 Implications for Zimbabwe as a Developing Country

It is in such a wider policy context that an increasing number of institutions of higher Learning are being established in Zimbabwe with new missions and innovative configurations of training, serving populations that previously had little access to higher education. Apart from accommodating a larger number of students, higher education institutions are under pressures not only to perform outstandingly in terms of research and teaching but also in entrepreneurial activities through promoting the third mission of the university, namely, economic and social development(K*a Ho Mok* ,2010). The new mission opens up lots of opportunities for universities to establish linkages with the industry sector, particularly through the setting up of university spin-off companies, conducting licensing activities and contract research, providing consulting services, and exploring graduate and researcher mobility between the two sectors (Wright et al, 2008). This has widely been the case in most institutions in Zimbabwe which have moved a step in this direction by establishing institutional IP Policies in this direction. Though such efforts have been put into place the overall contribution to the overall to the nation GDP is still relatively subdued (Go Spin, 2014)

2.10 Conclusion

In this chapter the researcher analysed literature pertaining to commercialisation of research results. The review pointed out to both the theoretical and practical circumstances surrounding commercialisation of research results. A critical analysis

of the various works on mainstream and commercialisation of research results was used to evaluate and give a guided position on the subject matter.

CHAPTER 3

METHODOLOGY

3.1 Introduction

This chapter presents an overview of the research methodology used in this research. The research sought to find out the commercialization of research results in Zimbabwe and to do this the researcher looked at the challenges faced by the researcher in commercialization of their research results. This section highlights research instruments used in data collection and the merits and demerits of each method. The researcher also presents measures to counter the setbacks inherent in the instruments being used. The researcher sought to answer research questions as guided by the outlined objectives listed in Chapter 1.

3.2 Research Design

The researcher employed a mixed method approach or a methodological triangulation, which will largely depend on quantitative techniques and to a lesser extent qualitative methods of research. The mixed method was necessitated by the fact that some descriptive aspects of the research would not be complete without verifying certain quantitative elements of data.

3.3 Research Population

The researcher targeted researchers in the different institutes on which the research would be based, these were, University of Zimbabwe (UZ), Harare Institute of Technology (HIT), Bindura University of Science Education, National University of Science and Technology (NUST) and Chinhoyi University of Technology (CUT)

3.4 Research Sample

Sampling was done using a mixed strategy that combines deliberate sampling, convenience sampling and judgement sampling. The population groups from each institute which the researcher intended to interact with were diverse, fragmented, and of unknown quantity, thus the research undertook to use small samples of 10 units from each population group

3.5 Pilot Testing and Content Validity

After the instrument was developed it was pre-tested by domain experts in academia and practice before the data was formally collected. The domain experts were chosen based on their knowledge of commercialization of research results and/or research methods, availability and willingness to help. Those experts were being asked to carefully examine the instrument and give feedback on the content, wording, and clarity of the questions in particular and to provide any comments on the instrument in general. The domain experts included people with different areas of expertise: academic experts in methodology, information systems and statistics, as well as practitioners from the Government and University. In the first phase of the pre-test, academicians reviewed the questions, scales, instructions and the appropriateness of

the questions and language for the target population. They provided valuable feedback on the instrument both in written and oral form. Several revisions were made to the survey instrument based on the feedback from the academicians.

In the second phase of the pre-test, practitioners from research centers reviewed the survey instrument to confirm the appropriateness and sensitivity of the questions, the language, and the presentation of the instrument. In addition, several other elements of the instrument package including the cover letter, etc. were reviewed by the experts. The experts provided valuable feedback on the instrument both in written and oral form. Based on the feedback from the academicians and practitioners the survey instrument was revised. The changes that will be made included clarifying some of the items and wordings, changing the format of the questionnaire, and re-sequencing the questions. Based on the above discussions, in this study content validity could be reasonably confirmed on both theoretical and practical grounds.

3.6 Data Collection

In this study the researcher collected two types of data which were primary data and secondary data. Data was collected using questionnaires, interviews and observations. To come up with a complete and solid gathering of data, the researcher employed mixed methods of data collection as a strategy. This implies that the researcher considered and implemented triangulation for data collection co-joining observation, interviews, questionnaires, and literature review. Of importance to the research design was the overall ability of the researcher to gain access to

information. The core methods of data gathering took into cognisance the issue of accessibility to usable, quality or verifiable information

3.7 Research Instruments

The researcher used research instruments that were compatible with the mixed methodology strategy used. Taking note of the nature of data being sought as defined under the objectives, the instruments used were designed to attest to a higher degree of reliability, validity and veracity. The researcher took note of the nature of the subject which was being investigated especially the fact there was a high possibility that the subjects would not have wider and deeper understating of commercialisation research results.

3.8 Primary Data

Primary data for this particular research was collected through interviews, direct observation, and questionnaires. The practical facts on commercialisation of research results by researchers were generally determined through primary data. The researcher provided guides for each of the collection methods used to keep in line with the objectives of the research

3.9 Questionnaires

The questionnaire was designed to capture important aspects of commercialisation of research results by the scientist. The researcher did a pre-test on the usability of the questionnaire. The onus was to appreciate the level of acceptance and friendliness of the questionnaire to the average participant. The questionnaire had a mixture of open ended and closed questions. Open ended questions where used to solicit personal opinions or views of the respondent. Closed questions where used in cases were the response was deemed to be limited or where respondents where likely to give unrealistic responses, further the closed questions allowed the participant to make quick choices when completing the questionnaire.

3.9.1 Type of Data Sourced In Questionnaires

The questionnaire sought to gather data on the challenges of commercialisation of research results by the researcher. The questionnaire was set to look at areas defined by the objectives which pertained to the knowledge level of the need to patent among inventors ,compare the number of researchers who patented and commercialised their results to those who just commercialised and also asses the number of patented research results that is industry driven .

3.9.2 Advantages of Questionnaires

Questionnaires gave respondents a longer period of time in which they could respond to questions which enticed them to present in-depth and thoroughly thought information. The questionnaires were designed in a way that made them simpler for the respondents to use. The questionnaire was systematically designed to capture the themes of the research on the challenges faced by the researcher in commercialization of research results

3.9.3 Problems Encountered Using Questionnaires

Using questionnaires had its own setbacks. The most prevalent was the lack of will to attempt all questions. Some respondents attempted only closed type questions and left the open ended questions unanswered. Though the researcher inserted contact details on the questionnaire, those who failed to understand some of the questions went on to complete the questionnaire without getting clarification, in the end providing incorrect information for some of the questions.

3.9.4 Remedies to the Problems

The researcher simplified the questions so that they were easier to understand. The use of technical jargon was minimised. Further, the questionnaires included specific

sections for the respondent to give their own unsolicited opinion on the subject of commercialisation of research results. The researcher also personally delivered questionnaires to respondents and went on to collect them to give convenience to the respondent.

3.10 Field/Direct Observation

The research used observations to gather evidence notably the researcher used written descriptions, audio-visual imaging, photography and recent documentation like memos, notices and newsprint articles in the observation. The researcher managed to collect information unobstructed, using his own conscience. The researcher managed to gather the current phenomenon of the commercialisation of research results in Zimbabwe.

3.11 Setbacks Encountered In Using Observation Method

Observation was done from one area to another thus there was a high probability the researcher did not capture or missed some of the events whilst doing other things or observing other occurrences. To counter the setbacks the researcher set observation rules and planned a worksheet capturing the themes to be observed.

3.12 Case Study

A case study tries to verify the activities of a single individual, a group of persons or an entity by analysing the data of its activities and trying to link it to the subject of research. The researcher sought to use a case study of commercialisation of research results in Zimbabwe. The method was very versatile, as it used the triangulation method to gather information. The researcher used various methods of gathering data which may make it reliable and credible.

3.12.1 Disadvantages

The case study was not a complete representative of a wider social setting which probably gave a bias to the results of the research. The results of the case study were not used to generalise a theme over the entire population.

3.13 Secondary Review

Secondary data was used to provide a guide on the genesis of commercialisation and how it developed. Secondary data was used to help understand the views of other researchers and critically analyse the gaps that exists that the research would like to fill. The secondary data was used in preparing the literature review and coming out with relevant area of discussion which suit Zimbabwean situation. Secondary data

was filtered from journals, published papers, policy documents, textbooks, internet reviews and audio visual works.

3.14 Advantages Of Secondary Data

Secondary data sourcing proved to be cost effective method as data was easily sourced. Apart from being cost effective secondary data was rich in historical data and offering a general background view of the subject. Secondary data played an important role in guiding the structuring of objectives as it steered the researcher away from already researched subjects.

3.15 Disadvantages of Secondary Data

Whilst secondary data was readily available, selecting the relevant data and putting it together to match the objectives of the research proved difficult. Some of the data was out dated or irrelevant. Some secondary data sources are not found on the same geographical, economic and political footing thus may not be entirely relevant in explaining local events.

The researcher resolved not to rely on secondary data extensively, because some of the facts presented by it did not have absolute relevance to the matter being researched. The researcher sifted the sources of secondary data and removed

irrelevant material. The idea was to minimise the chance of being too theoretical and deviate from real issues on the ground. The researcher used a few secondary data sources written before 1990.

3.16 Data Analysis and Interpretation

The researcher analysed data from each population sample on its own and then created a complete and relevant picture of the outcomes. The data was collected and grouped according to themes, patterns, ideas and phenomena identified. Analysis was used to interpret the trends and meanings from the data. The researcher in his analysis used narration, tables, graphs and descriptive comparisons. Primary data analysis was done basing on the instrument that was used for collection. This was done because each instrument portrayed attributes quite different from the other and thus each category had to be verified in its raw state. The researcher collected evaluated, organised and coded data under each instrument to detect identifiable themes. The results were collated for final analysis and interpretation.

3.17 Ethical Consideration

As a researcher, it is my responsibility that the following prescribed codes where they are applicable only involved people with their consent or knowledge. Participants were always had enough information about the research to make an

informed decision as to whether to take part in it or not. During the research, participants were allowed to draw back and remove consent if they so wish. The respect of their' rights to privacy and anonymity and confidentiality were guaranteed. This was always maintained all respondents were treated the same with consideration and respect. The research was presented with honesty and integrity and the researcher was never knowingly allowed any one to misuse and misinterpret this work and the people who participate have a right to know about the result of the research unless they give reasons to the contrary.

3.18 Chapter Summary

This chapter highlights the methodological strategy employed by the researcher. The research was identified as being quantitative in nature. The researcher used questionnaires, interviews, a case study and observations for sourcing primary data. The researcher also made use of secondary data through the use of library literature resources and e-publications. The researcher examined the sourced information to check for general themes in the data. The data collated was systematically organised, coded and merged into the research. The facts of the data analysis became the basis for Chapter four.

CHAPTER 4

DATA PRESENTATION, ANALYSIS AND INTERPRETATION

4.1 Introduction

This chapter presents the researchers findings from the data gathered in relation to commercialisation of research in Zimbabwe. The researcher presented the outcomes of the data gathering, go through analysis and interpret the results. The objective of the research was to determine the challenges been faced by the researchers in commercialising their research output. In order to answer the research questions, the researcher used both qualitative and quantitative methods, the results of which were presented in tables. Were neither graphs or tables were used, descriptive analysis was presented. The table below shows the number of people that participated in this research and the research institute where they come from.

Table 4-1 Institutions that participated in the survey

	Frequency	Percent	Valid Percent	Cumulative Percent
Bindura University of Technology	9	19.6	19.6	19.6
University Of Zimbabwe	14	30.4	30.4	50.0
National University Of Science and Technology	14	30.4	30.4	80.4
Harare Institute of Technology	6	13.0	13.0	93.5
Chinhoyi University Of Technology	3	6.5	6.5	100.0
Total	46	100.0	100.0	

The researcher targeted the above five research institutes which mainly as universities are sources of large numbers of potential innovations, it is important to arrange for adequate information of patenting and invention development activities. Universities are an important area for Innovation Centers. University inventions can be developed and commercialized like any other inventions, although often the university researchers` skills and know-how are needed during the whole development and commercialization process.

Table 4-2 Highest level of education attained

Highest Level of education					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	'O' Level	1	2.2	2.2	2.2
	University/College	42	93.3	93.3	95.6
	Other	2	4.4	4.4	100.0
	Total	45	100.0	100.0	

95.6 % of those interviewed are at University / College stage and are holders of at least a bachelor's degree with a majority been masters students working towards theirs PhDs , those who wrote mostly on others are mostly professors therefore the population is mostly made up of active researchers

4.2 Knowledge level of the need to patent amongst researchers

The following table's present findings about the knowledge level of the need to patent amongst inventors and this is addressing objective number one. Some of the question will touch on whether there is active research going on in the research institutes. The table below shows that 84.4% of the respondents indicated have at

least one publication and only 15.6 % have not yet published. This therefore indicates that there is very much active research taking place at most research institutes.

Table 4-3 Researchers who have published their results

Those who published					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	No	7	15.6	15.6	15.6
	Yes	38	84.4	84.4	100.0
	Total	45	100.0	100.0	

Table 4-4 Corresponding or lead authors to publication

Corresponding authors to publications					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	No	17	37.8	37.8	37.8
	Yes	28	62.2	62.2	100.0
	Total	45	100.0	100.0	

The table above show that 62.2% of the respondents are the principle investigators and are the ones who will be leading in the research in what direction they want the direction to take this are whether patentable results or not This suggests that there is need for more education on how the intellectual property system works and operates in Zimbabwe.

Table 4-5 Knowledge of WIPO

Knowledge of WIPO					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	No	30	66.7	66.7	66.7
	Yes	13	28.9	28.9	95.6
	2	2	4.4	4.4	100.0
	Total	45	100.0	100.0	

Table 4-6 Knowledge of ARIPO

Knowledge of ARIPO					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	No	27	60.0	60.0	60.0
	Yes	18	40.0	40.0	100.0
	Total	45	100.0	100.0	

Table 4-7 Knowledge of ZIPO

Knowledge of ZIPO					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	No	30	66.7	66.7	66.7
	Yes	15	33.3	33.3	100.0
	Total	45	100.0	100.0	

The above three tables sought to gather familiarisation of the respondents to organisation that deal with Intellectual Property and over 60% of the respondents are not familiar with any of the organisations that deal with intellectual property at local, regional and international scale. This means therefore that a majority of the respondents have not heard or dealt with any of these organisations in any way. There is therefore need to make people aware on the works of the organisations, how they can access these and what benefits they stand to derive from the

Table 4-8 Holders of patents of research outputs

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	None	35	77.8	77.8	77.8
	Some	9	20.0	20.0	97.8
	All	1	2.2	2.2	100.0

Zimbabwe's commercialization effort to date has been quite modest with low number of patents indicated by 22.2% holders of patents of all or some of the population which translate to almost 4.320 patent applications per population million as compared to Australia (546), USA (623) and South Korea (1,561).This might be due to the low knowledge level of the patents laws and even patent organisation in Zimbabwe. This also shows the lack of knowledge of the need to patent among inventors. Thus 84% of the respondents are actively involved in the research and have published, but as much as 78% have not patented these research.

Table 4-9 Comparison of those who published to holders of patents

Those who published * Holders of patents of research outputs Cross tabulation						
			Holders of patents of research outputs			Total
			None	Some	All	
Those who published	No	Count	6	0	0	6
		% of Total	13.3%	2.2%	.0%	15.6%
	Yes	Count	29	8	2	39
		% of Total	64.4%	17.8%	2.2%	84.4%
Total		Count	35	9	1	45
		% of Total	77.8%	20.0%	2.2%	100.0%

Of those who published 77.8% do not hold any patents to these publications. However 20% hold patents to some of the publications and only 2.2% hold patents to all the publications.

4.3 Comparisons of those who patented and commercialised their research results to those who just commercialised.

Table 4-10 Commercialised research outputs

Those who commercialized their research outputs					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	No	39	86.7	86.7	86.7
	Yes	6	13.3	13.3	100.0
	Total	45	100.0	100.0	

Ccommercialization of R&D has not been traditionally a high priority of universities, but personal career advancement of the individual researchers so as to enable them to be tenured and securing enough security for their jobs and teaching of students are of high priority as 86.7 % of the respondents have not commercialized their research outputs, whilst 13.3 % have commercialized.

Table 4-11 Commercialised patented research outputs

Those who commercialized patented research outputs					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	None	42	93.3	93.3	93.3
	Few	2	4.4	4.4	97.8
	All	1	2.2	2.2	100.0
	Total	45	100.0	100.0	

There is tendency to disclose findings by the researchers prior to intellectual property protection with as much as 93.3% of the respondents not having patented their commercialized research results, 4.4 % having patented a few of their research outputs and 2.2 % having patented all their research output.

Table 4-12 Effect of funding on commercialisation

Funding increases commercialization.					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	No	11	24.4	24.4	24.4
	Yes	34	75.6	75.6	100.0
	Total	45	100.0	100.0	

Table 4-13 Effect of awareness on commercialisation

Awareness increases commercialization.					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	No	26	57.8	57.8	57.8
	Yes	19	42.2	42.2	100.0
	Total	45	100.0	100.0	

From the above two tables the most 75.6 % gave that there is need to increase funding for in order to increase the number of commercialized research results were further funds would be used through the stages of commercialization process but only 42.2% responded that awareness increases commercialization . Therefore there is need to increase relations between research institutes and industry so that the industry might be able to fund both the research process and the commercialization itself.

Table 4-14 Commercialised to commercialised patented research output

Those who commercialized their research outputs * Those who commercialized patented research outputs Cross tabulation						
			Those who commercialized patented research outputs			Total
			None	Few	All	
Those who commercialized their research outputs	No	Count	39	0	0	39
		% of Total	86.7%	.0%	.0%	86.7%
	Yes	Count	3	2	1	6
		% of Total	6.7%	4.4%	2.2%	13.3%
Total		Count	42	2	1	45
		% of Total	93.3%	4.4%	2.2%	100.0%

86.7% of the respondents have not commercialized or patented their research results, whilst 6,7% have commercialized and not patented their research results and in this case some researchers had jumped the gun by negotiating with the industry without referring to the commercialization office. They would only refer once they encountered problems. In most cases, they failed to legally protect themselves and

the university resulting in long-term repercussions. 6.6 % of the respondents have commercialized and patented at least some of their research results.

Table 4-15 Chi-squared tests commercialised to commercialised patented research outputs

Chi-Square Tests			
	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	20.893[a]	2	.000
Likelihood Ratio	13.726	2	.001
Linear-by-Linear Association	18.016	1	.000
N of Valid Cases	45		

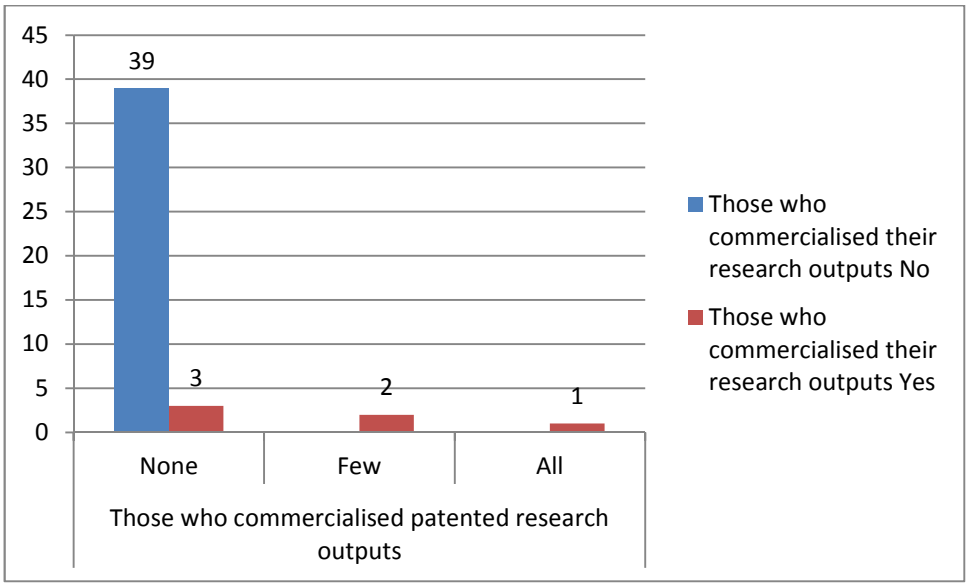

Figure 4-1 commercialised to commercialised patented research output

4.4 Assessment of Research That Is Industry Driven

Table 4-16 Determination of the kind of research conducted at research institutes

Who determines the kind of research that you conduct at your research institution					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Government	1	2.2	2.2	2.2
	Industry	5	11.1	11.1	13.3
	Self	31	68.9	68.9	82.2
	Other	8	17.8	17.8	100.0
	Total	45	100.0	100.0	

The issue of incentive mechanism to encourage patentable and commercializable research on the researchers will change the overall type of research conducted to that

which is commercializable as 68.9% of the respondent's research results are determined by the researchers themselves. Other included donor funded organizations ,research grants , the institute itself but the major contribution under others was the requirements of research that is sought after in prestigious publications that will earn the researcher more points so that they are promoted to been a doctor or professorship had a total of 17.8% .Government and industry combined have the lowest and total contribution of 13.3% and this shows that less commitment to research by both the state and industry itself and also less contribution of the research to the industry and country .

Table 4-17 Major source of research funding

Major source of research funding or sponsorship					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Government	11	24.4	24.4	24.4
	Industry	5	11.1	11.1	35.6
	Self	17	37.8	37.8	73.3
	Other	12	26.7	26.7	100.0
	Total	45	100.0	100.0	

Most academia research and development (R&D) activities are funded by the individual researchers and other governmental agencies with only 11.1 % university R&D funding coming from the industry as compared to the more advanced countries such as Canada, Germany , UK and USA which have industry funding a greater part of the research. This also shows a weak university- industry linkage in Zimbabwe and also weak policies on the part of the Government to support research and development at most institutions can also be seen with the low contribution of Government of only 24.4%.

Table 4-18 Ownership of research after it is completed

Ownership of research after it is completed					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Government	2	4.4	4.4	4.4
	Industry	8	17.8	17.8	22.2
	Self	16	35.6	35.6	57.8
	Research Institution	16	35.6	35.6	93.3
	Others	3	6.7	6.7	100.0
	Total	45	100.0	100.0	

35.6% of the respondents retain ownership of their research results this is because they provide funding that to do to their own research, research institutes through the employment contracts and providing most of the infrastructure for the researcher to conduct their research also have a 36.5% in which the research institute retain ownership of the research. Others with 6.7% include mostly publishing houses in which the researcher surrenders their rights to the research in exchange for publishing of their research and donor organization which might require a specific research to be carried out for specific purposes. Industry and Government have a rather low ownership of the research results conducted with Industry at 17.8% and Government at 4.4 % this thus suggest that research that is been done is not of interest and particular to the industry and government

Table 4-19 Assessment of the ownership arrangement that motivates the researchers

Ownership arrangement that encourages research between researcher/funder.					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	50/50	30	66.7	66.7	66.7
	80/20	13	28.9	28.9	95.6
	20/80	2	4.4	4.4	100.0
	Total	45	100.0	100.0	

Researchers are not very much concerned with total ownership of the research results with 66.7% saying that they are comfortable with an equal sharing of the research results. 28.9% saying the researcher is entitled to a larger share in the ownership of the results and only 4.4% will give the funder a larger percentage of the ownership of their research results. This means that most researchers will cede a larger percentage

of their research to the funder who has more resources in commercialization of these research results if the researchers are available.

Table 4-20 Comparison of major source of research funding to the number of patents holders

Major source of research funding or sponsorship * Holders of patents of research outputs Cross tabulation					
Count					
		Holders of patents of research outputs			Total
		None	Some	All	
Major source of research funding or sponsorship	Government	7	3	1	11
	Industry	4	1	0	5
	Self	15	2	0	17
	Other	9	3	0	12
Total		35	9	1	45

Government and industry sponsored research are the ones which lead to been patented with a ratio of one in every three, this is unlike those that are funded by

individual researchers with a ratio of one in every seven. This is mostly attributed to that government and industry mostly sponsors research that is specific to the needs of the people and is easily commercialized and hence patented to ensure that the researcher also benefits from the research that they conducted. Also individual researchers don't have enough money to protect their research results and let alone commercialize their research results therefore they choose to just hide their research or leave it lung idle. Fig 2 below tries to explain the same data in the form of a bar graph.

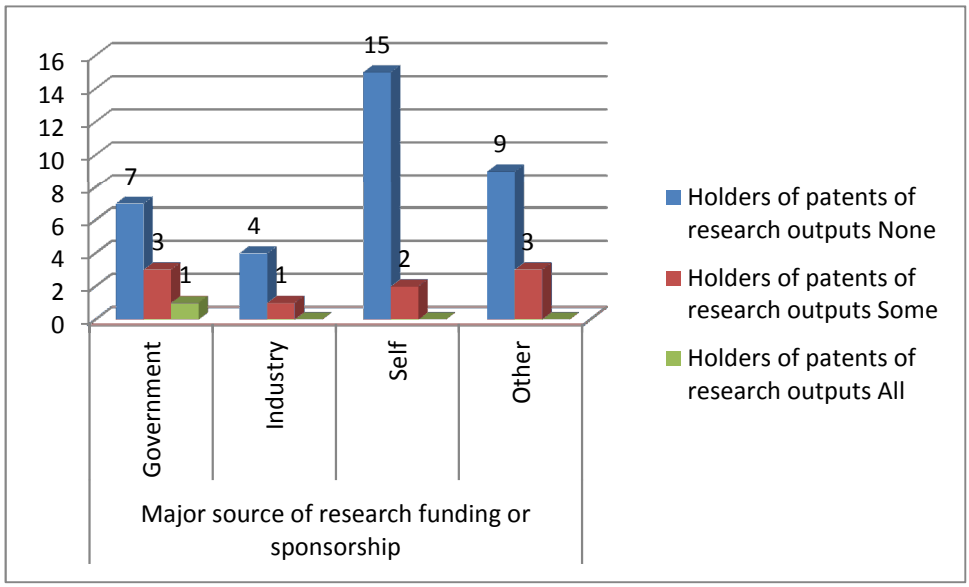

Figure 4 2 Major source of research funding to the number of patents holders

4.5 To assess the effectiveness of Technology Transfer Offices on the need to patent and commercialize on researchers

Data under this section was gathered through interviews and observation and is summarized and presented in the form of a table below. From the data gathered National University of Science and Technology (NUST) which has a well-established technology transfer office has a well-established commercialization process which a researcher can follow. Other Universities though they have an IP Policy but it is difficult to really establish the stages commercialization process which one can follow .Also unlike in NUST these institutes don't have an office which helps in the implementation and overall responsibility of their IP Policy document.

Table 4-21Summary on effectiveness of TTOs

Institute	Institutional IP Policy	TTO Office	Qualified Personnel in TTO	Presence of specified procedures on commercialization process	Efforts done by institute in IP awareness
National University of Science and Technolog	Present	Present	More than three IP experts	yes	Masters with a course om IP , regular workshops

y					and seminar series
Harare Institute Of technology	Present	No separate office but a committee	There are IP experts in the committe e	yes	A series of courses are taught with collaboratio n with WIPO
Bindura University technology	pending	absent	Absent	no	no
Chinhoyi University technology	absent	Absent	absent	no	No
University of Zimbabwe	present	Absent but there is a departmen t under the Pro VC Office	absent	no	An optional course for their law students on IP

4.6 Chapter Summary

The researcher presented findings which will be a basis of the next chapter. In this chapter the researcher sought to find trends and themes as in line with the objectives of the research. From the themes gathered the researcher concluded that a lot still need to be done in the field of appropriate technology as it clearly is a misunderstood concept.

CHAPTER FIVE

CONCLUSIONS AND RECOMMENDATIONS

5.1 Introduction

The previous chapter gave details of the presentation and interpretation of the data collected. This chapter therefore gives conclusions and recommendations based on the findings of this research and the decisions made after testing the hypothesis.

5.2 The need to patent amongst researchers

The **Negative parts shown about national policy** gathered in this research shows a weak appreciations and understanding of both the patent system and the need tom patent among researchers almost 66% of the respondents have no knowledge of any patent body at the national ,regional and international level that is ZIPO,ARIPO and WIPO respectively.. This suggests that there is need for more education on how the intellectual property system works and operates. The research indicated that 64.4% of the respondents have published their research results and only 19.9% have at least patented some of the research and this shows the need for an effective intellectual property education and also government to incentivise and assist the researchers to register their research as a majority complained of the high cost of the high cost needed in the registration process

The positive part established on the need to patent among researchers is that we have a large pool of active researchers in Zimbabwe who are also lead authors and thus expert researchers almost 84.4% thus therefore we have a large number of people conducting research and therefore the issue of getting people to conduct research will not be a problem. But, with enough education on both the need to patent and policies to encourage the conducting of patentable research there is likely to be an increase in the patented research, and also subsidising the registration of patents.

5.3 Comparisons of those who patented and commercialised their research results to those who just commercialised

The research shows that 86.7% of the respondents have not commercialised and or patented their research results. This show that the kind of research that is been conducted is of no commercial value and not highly demanded by the public. However 6.7% have commercialised their research results but the research was not patented and in this case cases of researchers who gone to negotiate with industry without referring to the technology transfer office were prominent and they would only refer when they encountered problems.in most cases they failed to legally protect themselves resulting in long term repercussions. Only 6.6% of the

respondents had commercialised and patented their research results and this shows the need again to enlighten people on the benefits of commercialisation and of protecting their research before commercialising the research.

5.4 Assessment of research that is industry driven

There is no linkage between industry and research shows and industry is making little contribution in both influencing the research that is conducted and the funding of the research itself. 37.8% of the research is funded by the researcher and only 1.1% industry contribution. There is need to establish linkage between industry and research so that the industry plays a pivotal role in determining both the kind of research been done at the research institutes as this research will be easily commercialised and also in funding of the research

5.5 To assess the effectiveness of Technology Transfer Offices on the need to patent and commercialize on researchers

Technology Transfer Offices are very effective as noted in the case of National University of Technology, it has processes and procedures in place to follow in the commercialisation process. It is not only enough to have an IP Policy , but in addition a technology transfer office helps in the implementation of the policy document .Which is the case in most university with an IP Policy but not clear procedures on the commercialisation procedures that the researcher can follow.

5.6 Recommendations

The researcher recommends and encourages:

Setting a solid policy framework that enhances commercialisation of research within the dictates of general government and institutional policy. Such a framework would also encompass modalities for massing appropriate technology, with includes specifying and setting commercialisation systems and patent information dissemination mechanism(s)

Setting up a Governmental-University-Industry committee on technology transfer and commercialisation of research results. The Governmental-University-Industry committee will enable a broad based discussion of the subject across government. This will enabled interlinking of various government departments to discuss more commercialisation strategies and policy.

Creation of a commercialisation fund for inventors, researchers, students, scientists and any deserving individuals meeting a set criterion.

There is also need for Universities to set up Technology Transfer offices or Joint technology transfer offices and Government should provide resources for their establishment

Knowledge sharing on the benefits and process of patenting.

Creation of awareness among planners, researchers, scientists, inventors, business sector; to equip them with tools and techniques of patenting, commercialisation, assessment, diffusion and forecasting.

Universities should start courses on IP at undergraduate and postgraduate level.

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Appendix A: Questionnaire

My name is Madyiwa Tafadzwa Walter, Africa University student. I kindly ask you to respond to the following questions for a research that is part of the requirements of my degree programme, Masters in Intellectual Property. The research is entitled; Commercialisation of Research Results. The research seeks to find the challenges been faced by the researcher in commercialisation of their research results

Please feel free to say out your honest opinion and I assure you that all the information you provide will be treated in strict confidence. Please place a tick in the spaces provided and write below the question for an elaborate response**.**

Section 1 – Demographic Information

1.	Sex	Male		Female	

2.	Age	<18 yrs		18-30yrs		30-50yrs		50yrs >	

2. Highest Level of education so far: TICK ONE √

level completed			**UNIVERSITY/COLLEGE**	
level completed			**CERTIFICATE/DIPLOMA**	
Others				

3. Have you ever published?

Yes [ ]

No [ ]

4. Are you a corresponding author in any publication?

Yes [ ]

No [ ]

5. Do you hold any patents to any of your research out-put ?

all [ ]

some [ ]

None [ ]

6. Have you ever commercialised your research out-put?

Yes [ ]

No [ ]

If response is Yes in 6 attempt 7,8

7. Was any of the research that you commercialised patented:

All [ ]

Some [ ]

8. Did you acquire any of the patents while working outside Zimbabwe?

Mostly [ ]

A few [ ]

None [ ]

9. Do you understand the Intellectual Property Rights laws of Zimbabwe?

Yes [ ]

No [ ]

10. What, in your opinion, should be done to increase the number of research that can be patented and commercialised ?----------

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11 . What are your Major sources of income?

Teaching		other	
Research			

12. What are your Major sources of research funding / Sponsorship for your research or innovation?

Government		Industry		Self	
Other(s) specify					

13. Who determines the kind of research that you conduct at your research institution?

Government		Industry		Self	
Other(s) specify					

14. Are there any cases of conflict of interest that arise between the researcher, funder or industry and Institution:

Yes [ ]

Partially [ ]

No [ ]

15. Who holds ownership of the research after it is completed

Government		Industry/ Donors		Self	
Research Institution		Other(s) specify			

16. Does the ownership arrangement encourage you to conduct further research?

Yes	[ ]
Partially	[ ]
No	[ ]

17. Do you receive any form of assistance from your institution in the commercialisation of your research?

Yes	[ ]
Partially	[ ]
No	[ ]

18. Does the institution have an office with qualified personnel who assist in the commercialisation process?

Yes	[ ]
No	[ ]

19. Does your Institution have an Intellectual Property Policy?

Yes [ ]

No [ ]

20. What, in your opinion, should be the ownership arrangement of research that encourages you to conduct further research ?----------

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21. What in your opinion is a fair benefit sharing arrangement with regards to benefits from commercialization of research out-put?

Researcher/Funder

20/80 [ ]

50/50 [ ]

80/20 [ ]

22. Are you familiar with any of these organisations?

Organisation	yes	no
A. WIPO		
B. ARIPO		
C. ZIPO		

23. Do you know what the following abbreviations stand for.?

WIPO……

……..

ZIPO……

ARIPO……

……

Thank You

INTERVIWEE……

INTERVIEWER……

DATE……

PLACE……

Appendix B: Frequency Tables and graphs

Sex					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Female	10	22.2	22.2	22.2
	Male	35	77.8	77.8	100.0
	Total	45	100.0	100.0	

Age Group					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	<18 yrs	1	2.2	2.2	2.2
	18-30	7	15.6	15.6	17.8

	yrs				
	30-50 yrs	26	57.8	57.8	75.6
	> 50 yrs	11	24.4	24.4	100.0
	Total	45	100.0	100.0	

Highest Level of education					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	'O' Level	1	2.2	2.2	2.2
	University/College	42	93.3	93.3	95.6
	Other	2	4.4	4.4	100.0
	Total	45	100.0	100.0	

Those who published					
		Frequency	Percent	Valid Percent	Cumulative Percent
Vali	No	7	15.6	15.6	15.6

d	Yes	38	84.4	84.4	100.0
	Total	45	100.0	100.0	

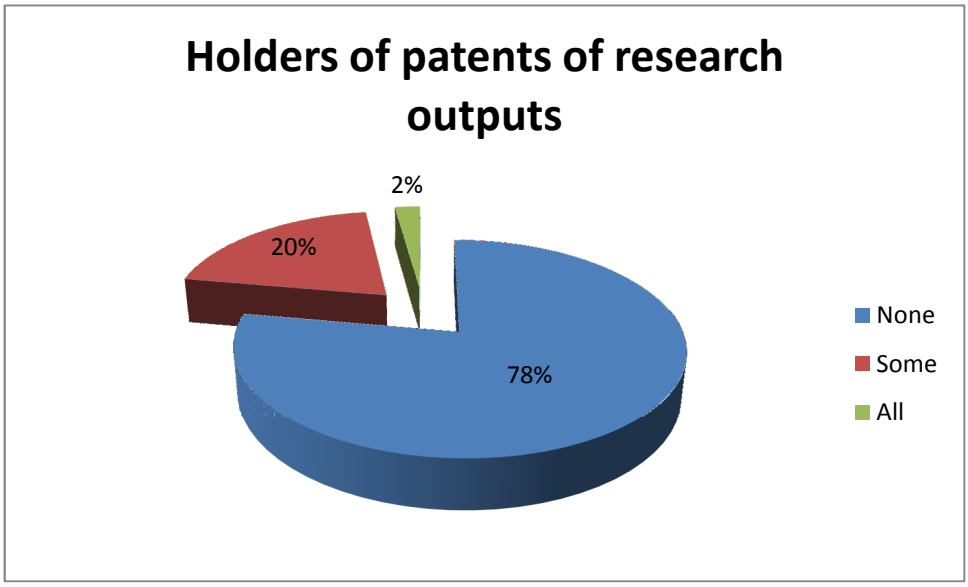
Corresponding authors to publications					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	No	17	37.8	37.8	37.8
	Yes	28	62.2	62.2	100.0
	Total	45	100.0	100.0	

Holders of patents of research outputs

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	None	35	77.8	77.8	77.8
	Some	9	20.0	20.0	97.8
	All	1	2.2	2.2	100.0

Holders of patents of research outputs

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	None	35	77.8	77.8	77.8
	Some	9	20.0	20.0	97.8
	All	1	2.2	2.2	100.0
	Total	45	100.0	100.0	



Those who commercialised their research outputs					
		Frequenc	Percent	Valid	Cumulative

		y		Percent	Percent
Valid	No	39	86.7	86.7	86.7
	Yes	6	13.3	13.3	100.0
	Total	45	100.0	100.0	

Those who commercialised patented research outputs					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	None	42	93.3	93.3	93.3
	Few	2	4.4	4.4	97.8
	All	1	2.2	2.2	100.0
	Total	45	100.0	100.0	

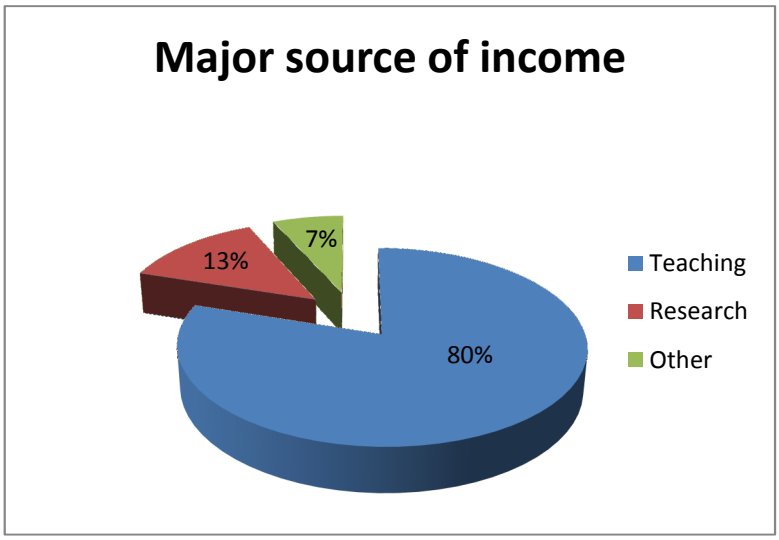
Those who acquired patents working outside Zimbabwe					
		Frequency	Percent	Valid Percent	Cumulative Percent

Valid	None	42	93.3	93.3	93.3
	Few	1	2.2	2.2	95.6
	Mostly	2	4.4	4.4	100.0
	Total	45	100.0	100.0	

Those who understand the Intellectual Property Rights of Zimbabwe					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	No	23	51.1	51.1	51.1
	Yes	22	48.9	48.9	100.0
	Total	45	100.0	100.0	

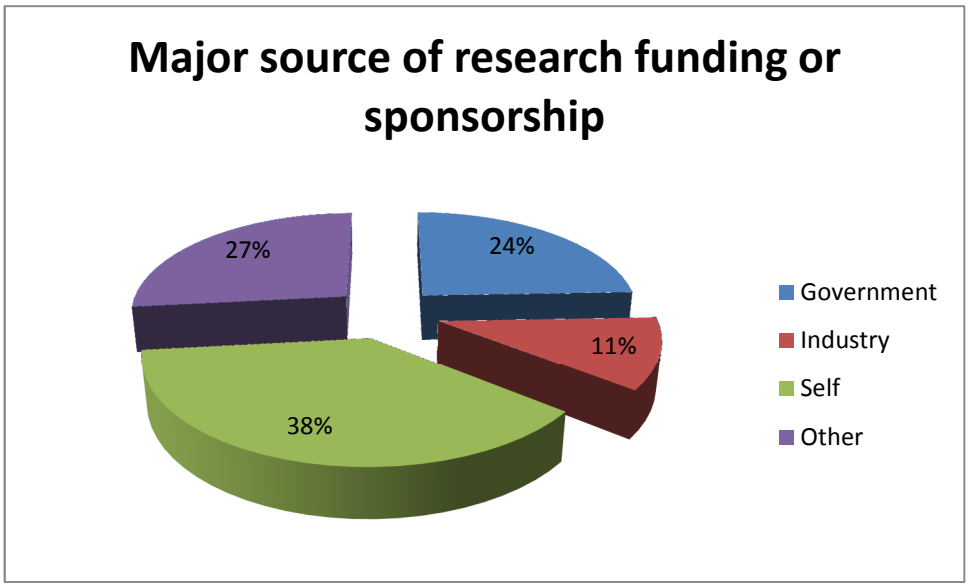
Major source of income					
		Frequency	Percent	Valid Percent	Cumulative Percent

Valid	Teaching	36	80.0	80.0	80.0
	Research	6	13.3	13.3	93.3
	Other	3	6.7	6.7	100.0
	Total	45	100.0	100.0	



Major source of research funding or sponsorship					
		Frequency	Percent	Valid Percent	Cumulative Percent
Vali	Governme	11	24.4	24.4	24.4

d	nt				
	Industry	5	11.1	11.1	35.6
	Self	17	37.8	37.8	73.3
	Other	12	26.7	26.7	100.0
	Total	45	100.0	100.0	



Who determines the kind of research that you conduct at your research institution					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Government	1	2.2	2.2	2.2
	Industry	5	11.1	11.1	13.3
	Self	31	68.9	68.9	82.2
	Other	8	17.8	17.8	100.0
	Total	45	100.0	100.0	

Conflict of interest between reseacher, funder or industry and institution					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	No	15	33.3	33.3	33.3
	Partially	14	31.1	31.1	64.4
	Yes	15	33.3	33.3	97.8

	3	1	2.2	2.2	100.0
	Total	45	100.0	100.0	

Onwership of research after it is completed					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Government	2	4.4	4.4	4.4
	Industry	8	17.8	17.8	22.2
	Self	16	35.6	35.6	57.8
	Research Institution	16	35.6	35.6	93.3
	Others	3	6.7	6.7	100.0
	Total	45	100.0	100.0	

Ownership arrangement that encourages further research					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	No	6	13.3	13.3	13.3
	Partially	21	46.7	46.7	60.0
	Yes	17	37.8	37.8	97.8
	4	1	2.2	2.2	100.0
	Total	45	100.0	100.0	

Assistance from research institution in the commercialisation of the research					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	No	24	53.3	53.3	53.3
	Partially	11	24.4	24.4	77.8
	Yes	10	22.2	22.2	100.0
	Total	45	100.0	100.0	

Institute with qualified personnel who assist in commercialising research					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	No	22	48.9	48.9	48.9
	Yes	21	46.7	46.7	95.6
	2	2	4.4	4.4	100.0
	Total	45	100.0	100.0	

Institutions with IP policy					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	No	19	42.2	42.2	42.2
	Yes	26	57.8	57.8	100.0
	Total	45	100.0	100.0	

Ownership arrangement that encourages research between researcher/funder.					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	50/50	30	66.7	66.7	66.7
	80/20	13	28.9	28.9	95.6
	20/80	2	4.4	4.4	100.0
	Total	45	100.0	100.0	

Knowledge of WIPO					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	No	30	66.7	66.7	66.7
	Yes	13	28.9	28.9	95.6
	2	2	4.4	4.4	100.0

	Total	45	100.0	100.0	

Knowledge of ARIPO					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	No	27	60.0	60.0	60.0
	Yes	18	40.0	40.0	100.0
	Total	45	100.0	100.0	

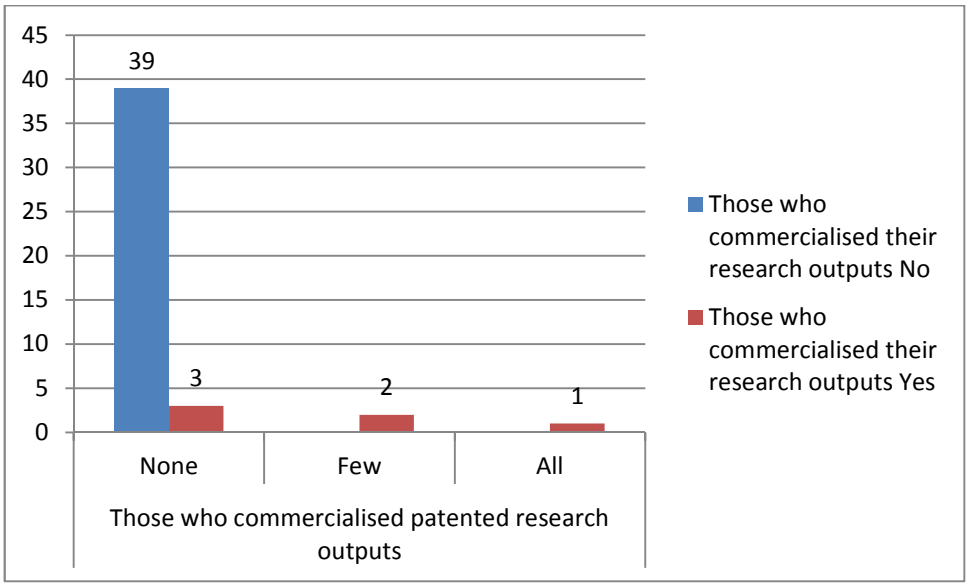
Knowledge of ZIPO					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	No	30	66.7	66.7	66.7
	Yes	15	33.3	33.3	100.0
	Total	45	100.0	100.0	

Funding increases commercialisation.					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	No	11	24.4	24.4	24.4
	Yes	34	75.6	75.6	100.0
	Total	45	100.0	100.0	

Awareness increases commercialisation.					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	No	26	57.8	57.8	57.8
	Yes	19	42.2	42.2	100.0
	Total	45	100.0	100.0	

Objective 4

Those who commercialised their research outputs * Those who commercialised patented research outputs Crosstabulation						
			Those who commercialised patented research outputs			Total
			None	Few	All	
Those who commercialised their research outputs	No	Count	39	0	0	39
		% of Total	86.7%	.0%	.0%	86.7%
	Yes	Count	3	2	1	6
		% of Total	6.7%	4.4%	2.2%	13.3%
Total		Count	42	2	1	45
		% of Total	93.3%	4.4%	2.2%	100.0 %



Chi-Square Tests			
	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	20.893[a]	2	.000
Likelihood Ratio	13.726	2	.001
Linear-by-Linear Association	18.016	1	.000
N of Valid Cases	45		

Those who published * Holders of patents of research outputs Crosstabulation						
			Holders of patents of research outputs			Total
			None	Some	All	
Those who published	No	Count	6	0	0	6
		% of Total	13.3%	2.2%	.0%	15.6%
	Yes	Count	29	8	2	39
		% of Total	64.4%	17.8%	2.2%	84.4%
Total		Count	35	9	1	45
		% of Total	77.8%	20.0%	2.2%	100.0%

Major source of research funding or sponsorship * Holders of patents of research outputs Crosstabulation					
Count					
		Holders of patents of research outputs			Total
		None	Some	All	

Major source of research funding or sponsorship	Governme nt	7	3	1	11
	Industry	4	1	0	5
	Self	15	2	0	17
	Other	9	3	0	12
Total		35	9	1	45