

**FACTORS INFLUENCING RESEARCH OUTPUTS IN KENYA: THE CASE OF SELECTED
PUBLIC UNIVERSITIES**

**BY
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**A Research Project Report Submitted in Partial Fulfillment of the Requirements for the Award
of the Degree of Master of Arts in Project Planning and Management of the University of
Nairobi**

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DECLARATION

This research report is my original work and has not been presented for any award in any other University.

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DEDICATION

This research report is dedicated to my mother, Mrs. Elsa Auma Adoyo who taught me that with hard work and patience, I can achieve anything in the world.

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TABLE OF CONTENTS

Page

DECLARATION.....	ii
DEDICATION.....	iii
ACKNOWLEDGEMENTS	iv
TABLE OF CONTENTS	v
LIST OF FIGURES	viii
LIST OF TABLES	viii
ABBREVIATIONS AND ACRONYMS.....	x
ABSTRACT.....	xi
CHAPTER ONE: INTRODUCTION.....	1
1.1 Background of the Study.....	1
1.2 Statement of the Problem	4
1.3 Purpose of the Study	6
1.4 Objectives of the Study	6
1.5 Research Questions	6
1.6 Significance of the Study	6
1.7 Assumptions of the Study	7
1.8 Limitations of the Study.....	7
1.9 Delimitations of the Study.....	7
1.10 Definitions of Significant Terms used in the Study	7
1.11 Organization of the Study	8
CHAPTER TWO: LITERATURE REVIEW.....	10
2.1 Introduction	10
2.2 University Research Outputs.....	10
2.3 Research Funding and Research Outputs.....	11
2.4 University Researcher Characteristics and Research Outputs	13

2.5	Industrial Involvement and Research Outputs	14
2.6	Institutional Administrative Structures and Research Outputs	16
2.7	Theoretical Framework.....	17
2.8	Conceptual Framework.....	19
2.9	Knowledge Gap.....	20
CHAPTER THREE: RESEARCH METHODOLOGY		21
3.1	Introduction	21
3.2	Research Design.....	21
3.3	Target population	21
3.4	Sampling size and Sampling Procedure	21
3.4.1	Sample size	21
3.4.2	Sampling Procedure	22
3.5	Data Collection Instruments.....	23
3.5.1	Pilot testing of the Research Instruments.....	23
3.5.2	Validity of Research Instruments.....	23
3.5.3	Reliability of Research Instrument	24
3.6	Data Collection Procedure	24
3.7	Data Analysis Techniques	25
3.8	Ethical Considerations.....	25
3.9	Operationalization of Variables	26
CHAPTER FOUR: DATA ANALYSIS, PRESENTATION, INTERPRETATION AND DISCUSSION.....		27
4.1	Introduction	27
4.2	Questionnaire return rate	27
4.3	Demographic Characteristics of the Respondents.....	27
4.4	Research Outputs of Selected Universities in Kenya.....	27
4.5	Measure of Commercialization	29

4.6	Research Funding and Research Outputs.....	33
4.7	University Researchers Characteristics	34
4.8	Industrial Involvement and Research Outputs in Universities.....	36
4.9	Institutional Administrative Structures and Research Outputs	38
CHAPTER FIVE: SUMMARY OF THE FINDINGS, CONCLUSIONS AND RECOMMENDATIONS		41
5.1	Introduction	41
5.2	Summary of the Findings	41
5.3	Conclusions	43
5.4	Recommendations	44
5.4.1	Suggestions for Further Studies	44
REFERENCES.....		45
APPENDICES		52
APPENDIX I: Letter of Transmittal of Data Collection Instrument		52
APPENDIX II: Questionnaire.....		53
APPENDIX III: Research Permit		60

LIST OF FIGURES

Figure 1: Triple Helix.....	18
Figure 2: Conceptual Framework.....	19

LIST OF TABLES

Table 3.1: Sampling frame.....	22
Table 3.2: Sample size.....	22
Table 3.3: Reliability Results.....	24
Table 3.4: Operationalization of variables.....	26
Table 4.1: Research Outputs of University in Kenya.....	28
Table 4.2: Level of Commercialization of University Research Results.....	29
Table 4.3: Measure of Commercialization and Highest Degree of Researcher	30
Table 4.4: Measure of Commercialization and Age of Researcher	31
Table 4.5: Measure of Commercialization and University of Researcher	32
Table 4.6: Research Funding and Research Outputs.....	33
Table 4.7: Coordination of Funding.....	34
Table 4.8: Previous Experience and Research Outputs.....	34
Table 4.9: University Researcher Motivation.....	35
Table 4.10: Knowledge and Entrepreneurial skills and Research Outputs	36
Table 4.11: Researchers who partnered with Industry during their Research	36
Table 4.12: University-Industry Linkage and Research Outputs	37
Table 4.13: University Incubation Centres and Research Outputs	37
Table 4.14: MoUs between University and Industry.....	38
Table 4.15: University Policy and Research Outputs.....	38
Table 4.16: University to establish well managed Technology Transfer Offices.....	39
Table 4.17: University training and sensitization on IPR and Research Outputs	39

ABBREVIATIONS AND ACRONYMS

AAU:	Association of African Universities
GCR:	Global Competitiveness Report
IP:	Intellectual Property
IPR:	Intellectual Property Rights
JKUAT:	Jomo Kenyatta University of Agriculture and Technology
KBE:	Knowledge Based Economies
KIPI:	Kenya Intellectual Property Institute
KU:	Kenyatta University
M&E:	Monitoring and Evaluation
MoU:	Memorandum of Understanding
MMUST:	Masinde Muliro University of Science and Technology
NACOSTI:	National Commission for Science, Technology and Innovation
OECD:	Organization for Economic Co-operation and Development
PCT:	Patent Cooperation Treaty
R&D:	Research and Development
R4D:	Research for Development
SPSS:	Statistical Package for Social Sciences
ST&I:	Science, Technology and Innovation
TTO:	Technology Transfer Office
UNECA:	United Nations Economic Commission for Africa
UNESCO:	United Nations Educational, Scientific and Cultural Organization
UoN:	University of Nairobi
USA:	United States of America
USPTO:	United States Patent Transfer Office
WIPO:	World Intellectual Property Organization

ABSTRACT

Universities are now at the centre of the knowledge economy where they are expected to innovate, and use the knowledge they generate to serve the public as well as contribute to economic growth and competitiveness. Many countries globally have pursued Commercialization of University research to increase their national competitiveness, to generate funds for more research and development in order to optimize the returns on taxpayer's investments and the use of research results. This study intended to examine the factors influencing Research outputs of Selected Universities in Kenya. The study objectives were to determine how research funding influences Research outputs in Selected Public Universities in Kenya; to establish how University Researchers Characteristics influences Research Outputs in Selected Public Universities in Kenya; to investigate how Industrial Involvement influences Research Outputs in Selected Public Universities in Kenya and to examine how Institutional Administrative structures influence Research outputs of Selected Public Universities in Kenya. The study reviewed past studies on the topic and identified a knowledge gap. This research problem was studied using a descriptive research design. The target population was 161 University Researchers from University of Nairobi, Kenyatta University and Jomo Kenyatta University of Agriculture and Technology which represent public Universities in Kenya. The study employed Krejcie and Morgan's table for determining sample size to come up with a sample size of 113 respondents. The study relied on questionnaires to collect quantitative was cleaned, coded and analyzed using Statistical Package for Social Scientists (SPSS) Software Version 20. A pilot study to pretest and validate the questionnaire was done, the questionnaire was deemed reliable as it scored reliability coefficient of above 0.8 estimated using the split-half reliability test. The content validity was tested through expert opinion. The results were summarized into frequencies, percentages and correlation tables and the explanation presented in prose. The results indicate that research outputs of Selected Public Universities in Kenya is influenced by Research Funding, Industrial Involvement, University Researchers Characteristics and also by Institutional Administrative Structures. The study concludes that research funding, University Researcher Characteristics, Industrial Involvement and Institutional factors influences Research outputs in Public Universities in Kenya. The study recommends, increasing research funding beyond the final report, development of a National Commercialization Policy in Kenya, linking Universities Researchers with the Industry and sensitization of University Researchers on Commercialization and IPR for University researchers to be able to move beyond the publications and conference presentations stages and commercialize their research results. Future studies on Research outputs from Public Universities in Kenya could focus on all Public Universities and Influence of Academic Research on Economic Development.

CHAPTER ONE

INTRODUCTION

1.1 Background of the Study

Many countries have encouraged University to generate outputs from their research efforts to increase their national competitiveness, to generate funds for more research and development in order to optimize the returns on taxpayer's investments and the use of research.

In Australia, Researchers are often rewarded based on their rate of publication and success in achieving research grants. The Australian Government has designed programmes to improve links with the Universities and some Universities have established Commercialization units which enable their researchers to commercialize their research results and facilitate technology transfer to the industry (Collier & Gray, 2010). The Australian Government also recognizes that support arrangements and educating researchers on Commercialization goes a long way to assist individual researchers to commercialize their own research. University commercialization offices have also played an important role in bridging the gap between innovation and progression, once a major weakness in the Australian innovation system.

The USA highly supports and effectively finances commercialization of University research results; the country has a high technology entrepreneurship financing system, more technology orientated early stage venture capitalists and business angels. The Bayh-Dole Act of 1980 has been regarded as one of the most influential legislation which stimulates commercialization of University research. Academia-Industry cooperation was a major driver of Universities towards entrepreneurship largely facilitated by University-Industry collaboration network approach (Guenther & Wagner, 2008). The Bayh-Dole Act enabled University researchers to gain rights over any invention they developed while undertaking research funded by their Government. The Country awards research students encouraging them to be entrepreneurial and actively pursue commercialization from their research projects (Mowery & Sampat, 2007).

The UK Government has established the National Intellectual Property Management Office to support capacity building in technology transfer and commercialization of Intellectual Property. Through an IP fund the UK provides financial support to institutions for the statutory protection and maintenance of intellectual property rights. In Russia, the bulk of University Research and Development funding is provided by the Government. Through an innovation policy, the Russian Government introduced incentives to commercialize research results, including reform of legal framework for Intellectual Property Rights, providing public funds for venture capital, as well as increasing overall public participation in Research and Development expenditures. The Russian innovation policy is largely focused on Commercialization of research from higher education Institutions (Gutierrez & Correa, 2012).

Many Universities in Japan are able to link with the Industry through Government policies that promote University-Industry collaboration. Through these linkages Japanese Universities are able to generate outputs from their research results as well as commercialization (Tantiyaswasdikul, 2013). The country has made huge strides since the late 80s, in exploiting Intellectual properties through technology licensing and contractual Research and Development projects with the industry. Many spin-off companies created through seed funding and increased availability of commercial venture capitalists has enabled many Universities to commercialize their research results.

University legislation and policies influence University Commercialization practices in New Zealand. Technology transfer offices have played an important role in educating and promoting awareness of Intellectual Property processes and requirements among researchers with IP protection (Collier & Gray, 2010). Identifying potential industry partners and collaborators, negotiating license agreement, forming start-up companies, funding investors and industry partners have also been identified as some of the factors that greatly encourage Commercialization of University research.

The South African Government recognizes that exploitation of Intellectual Property through Commercialization must be carried out by publicly funded research institutions in order to achieve a knowledge based economy. A case study by the Association of African Universities (AAU) on University-Industry linkage in Africa shows that South Africa has the most developed University-Industry linkages, yet only a few patents are held by the Universities in South Africa.

This is because most patents accruing from research commissioned by industry are owned by industry and also because there are many barriers and risks involved in patents acquisition (AAU, 2012).

In Nigeria, the management of IPR and the technology transfer are handled by the National Office for Technology Acquisition and Promotion which has established Intellectual Property and TTOs in tertiary institutions across the country to assist innovators prepare and file for IPR (Ogunwusi & Ibrahim, 2014). A legislative and administrative framework as well as incentives for researchers in Universities to disclose their ideas and inventions through both monetary and non-monetary mechanisms have been found to be effective towards promoting commercialization of research results. A case study on University lecturers in Ilorin University in Nigeria indicate that less than 60% of the academic staff disseminate their research results and that commercialization takes a back seat with only about 28% of University lecturers developing research products that can be put into use for societal development, less than 10% of the University lecturers commercialized the outcomes of their research (Oduwaiye, Onasanya, & Shehu, 2010). The study concludes that Research thrives in many Universities yet the rate of commercialization of research results is still low (OECD, 2014).

The National Commission for Science, Technology and Innovation (NACOSTI) formerly known as the National Council for Science and Technology is mandated to advice, coordinate, promote and regulate on matters of Science and Technology in Kenya (ST&I Act, 2013). NACOSTI administers the Research Endowment Fund created by the Ministry of Higher Education, Science and Technology now known as the Ministry of Education, Science and Technology on behalf of the Government of Kenya since 2008. The aim of the Fund is to support research and innovation projects by Kenyans in the country. Through the promotion of research, science and technology in higher education institutions, it is expected that the learning institutions translate their research findings into products and services, generate new ideas and adopt innovation to achieve an innovation-driven economy for Kenya's prosperity (NACOSTI, 2014). NACOSTI coordinates the ST&I desks programme in Universities and Research Institutions in the country to enhance dissemination of research findings and partnerships with institutions. NACOSTI also organizes fora for dissemination of Research products including an annual Science Week in the month of May. The Science, Technology and Innovation (ST&I) Act, 2013 advocates for the commercialization of research outputs through the Kenya National Innovation Agency which is

established through the Act, but is yet to be operational. The University Act, 2012 also mandates Kenyan Universities to advance knowledge through teaching, scholarly research and scientific investigation and also dissemination of the outcomes of their research work to the public.

Governments and Institutions involved in funding research all over the world are becoming increasingly keen on the effectiveness of research towards benefiting the society as research money mainly comes from the taxpayers. Therefore they have focused their efforts on conducting evaluations and assessing returns on any research efforts they fund (Sutherland, Goulson, Potts, & Dicks, 2011; Mutz, Bornmann, & Daniel, 2013). The findings from this research study attempts to establish Research outputs of Selected Public Universities in Kenya.

1.2 Statement of the Problem

Universities are now at the centre of the knowledge economy where they are expected to innovate, and use the knowledge they generate to serve the public, contribute to economic growth and competitiveness (Allen, 2012). Research actually shows that University research plays a great role in contributing to a country's economic growth; studies done by Salter and Martin (2001) show that there is a positive correlation between academic research and economic growth.

Globally, it has been realized that many University research ideas are not taken to the next stage and are left to gather dust in shelves whilst they would have been used to transform many economies despite involving huge Government funding. A report compiled by OECD Directorate for Science, Technology and Industry in 2013 on commercializing public research shows that very few Universities are engaged in Commercialization of inventions from their research efforts. In Europe for instance, a region which represents the majority of Universities in the World, only about *10% of universities account for 85% of the total income generated by inventions* (OECD, 2013). Again, despite Government spending on Research and Development being the highest (about 90%) in developing countries, R&D Institutions including Universities have not being able to show outputs that meet the expectations of industry and society needs (Ukiwoma, Amade, & Moghalu, 2013).

Some of the reasons proposed for low rates of Commercialization of University research results include lack of funding to commercialize, lack of business expertise; low understanding on commercialization, lack of human-capital to build startup companies when appropriate and lack of mentoring and educational support for new entrepreneurs (Holy, 2010). Research can only be beneficial to society if the results can be converted into products and services; in other words, commercialized (Bornmann, 2013). Concerns have been echoed since 1997 about the importance of translating publicly funded research to benefit the society in Kenya. A study carried out to investigate into factors that influence the diffusion and adoption of Inventions from Research Institutes and Universities in Kenya in 1999 revealed that lack of adequate funding mechanisms, lack of appropriate institutional arrangements and lack of capabilities to transfer knowledge and technologies are some of the reasons that inhibit the Commercialization of research results (Bwisa & Gachui, 1999).

Several studies have been carried out on Research Outputs in Universities in Kenya, they include; factors affecting research productivity in Public Universities of Kenya, a case of Moi University (Kendagor, Kosgei, Tuitoek, & Chelangat, 2012); approaches that can increase Commercialization of University Research in Kenya (Ondimu, 2012); reasons for low publications of research (Migosi, 2012) and Evaluation of strategies and mobilizing resources for research and enhancing outputs in Public and Private Universities in Kenya (Mathooko, 2010). These studies focused on gathering perceptions and views from University top managers (Migosi, 2012; Kendagor, Kosgei, Tuitoek, & Chelangat, 2012; Mathooko, 2010) on Research outputs in Universities in Kenya. This research study however gathered perceptions from University researchers funded by a public Institution in order to determine research outputs from the research results demonstrate their experience in Commercialization of their Research results and also gathered their views on how Commercialization of University Research can be enhanced to benefit the society. Again, University knowledge transfer channels including patenting and licensing, recruiting graduates', collaborations in research and publication have been widely researched on yet commercialization has received little focus, Mowery and Sampat (2007). Therefore, Rothaermel, Agung, and Jiang, (2007) in their recommendations proposed further studies in this area as University entrepreneurship is an under-researched yet very important topic.

1.3 Purpose of the Study

The purpose of this study was to examine the factors influencing research outputs in Selected Public Universities in Kenya.

1.4 Objectives of the Study

The study was guided by the following objectives:

- i. To determine how research funding influence Research Outputs in Selected Public Universities in Kenya
- ii. To establish how University Researchers Characteristics influence Research Outputs in Selected Public Universities in Kenya
- iii. To investigate how Industrial involvement influence Research Outputs in Selected Public Universities in Kenya
- iv. To examine how Institutional Administrative Structures influence Research Outputs in Selected Public Universities in Kenya

1.5 Research Questions

The study answered the following questions:

- i. How does Research funding influence Research Outputs in Selected Public Universities in Kenya?
- ii. How do University Researcher Characteristics influence Research Outputs in Selected Public Universities in Kenya?
- iii. How does Industrial Involvement influence Research Outputs in Selected Public Universities in Kenya?
- iv. How do Institutional Administrative Structures influence Research Outputs in Selected Public Universities in Kenya?

1.6 Significance of the Study

It is hoped that the results from this study will be important to demonstrate the economic value of University research and why the country needs to continue supporting investments in research and development as earmarked by the Vision 2030 (GoK, 2013). It is hoped that the results from this study will form baseline information on the extent of social impact from the Government support through NACOSTI's Research Endowment Fund.

It is also hoped that the results from this study will prompt Public Universities in Kenya to encourage their Researchers to generate outputs from their research efforts and exploit them to

benefit the society. It is hoped that the results from this study would also increase the wealth of knowledge available regarding Commercialization of Universities research in Kenya as they will be published in Academic Journals.

1.7 Assumptions of the Study

The research study was designed on the premise that NACOSTI would provide information on the University researchers they funded to enable the research study to be undertaken. It was also assumed that a research permit would be obtained in good time to facilitate field visit and data collection. It was also assumed that the respondents would be truthful and give accurate information to inform the conclusions of the study.

1.8 Limitations of the Study

Many University researchers had moved from the Universities from which they were when they received the research funding from NACOSTI. The challenge was overcome by crosschecking to confirm that the data collected from each researcher was from the appropriate University. Some of the University researchers who agreed to participate in the study travelled in the course of the field study and this posed a challenge on collection of the research questionnaires. This was overcome by developing an online survey which enabled them to fill up the questionnaire online then submit it back.

1.9 Delimitations of the Study

The study only focused on research projects in Public Universities targeting the University of Nairobi, Kenyatta University and Jomo Kenyatta University of Agriculture and Technology. JKUAT is a Public university in Kenya situated in Juja, 36 kilometres northeast of Nairobi, along the Nairobi-Thika Super Highway. The University of Nairobi is situated in Nairobi's city centre along the Uhuru Highway while Kenyatta University's is located in Kahawa, about 20 kilometres from Nairobi's city centre.

1.10 Definitions of Significant Terms used in the Study

Research outputs: products from research and includes publications in refereed journals, conference presentations, policy briefs, text book, patents, utility model, copy right, industrial design, trademark and business startup

Research Funding: money disbursed to University researchers to carry out research

- Researchers Characteristics:** University researchers personal drive towards commercialization
- Industrial Involvement:** refers to University researcher networks with the Industry
- Institutional Administrative Structures:** established institutional cultures and the kind of environment that encourages researchers to commercialize their work, includes University policy, training and sensitization and technology transfer organizations
- Disbursement Process:** release of research funds to University researchers
- Collaborative Research:** joint Research effort between University and Industry
- Commercialization:** process by which researchers in the University convert their research results into products that can be promoted for economic gain both for the researcher and the University too. The products include, patents, trademarks, utility models, business startups among others
- Publicly funded research:** research activity in University funded by central Government or Government agency or donors
- Entrepreneurial University:** University that has embraced Commercialization of its research for economic gain
- Research and Development:** economic activities concerned with applying results of scientific research to develop new products or improve existing ones.
- Technology Transfer:** uptake of technologies developed by University Researchers by the Industry for economic development

1.11 Organization of the Study

The study is organized from the first Chapter to the last as follows; Chapter one covers Introduction, background of the study, statement of the problem, purpose of the study, objectives of the study, basic assumptions of the study, limitations of the study and delimitation of the study. Chapter two covers literature review; it includes a brief introduction on how the literature review is laid out, the second section is concerned with Research Funding as one of the factors influencing Research Outputs in Public Universities in Kenya; the third section focuses on University Researcher Characteristics; the fourth section looks at Industrial Involvement and how it influences Research Outputs in Selected Public Universities; the fifth part examines how Institutional Administrative Structures influence Research Outputs in Selected Public Universities. Chapter three describes the research methodology used in the research study. It includes a brief introduction, the research design, target population, sampling procedure,

methods of data collection, validity of the data collection instrument, reliability of the data collection instrument, methods of data analysis, operationalization of variables, ethical issues considered during the research study and a brief summary at the end.

Chapter four describes data analysis methods employed to summarize the data collected from the respondents through questionnaire, interpretation and discussion of their meaning as it relates to the research topic. Chapter five provides a summary of the findings, conclusions and recommendations of the research study.

CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction

The reviewed literature follows the empirical works of five authors per variable. The themes were developed from the theoretical and empirical works that are relevant to the variables being studied. The chapter is structured into empirical reviews on dependent and independent variable and relates the variables with theoretical framework that facilitated the development of a conceptual framework and knowledge gap.

2.2 University Research Outputs

University education plays an important role in growth and development. This is largely because of the research carried out in these institutions that is capable of driving economic development through innovations and new technologies (Bloom, Canning & Chan ,2006).

Dissemination is part of the research process and an important one because it is what makes research work important and valid (Crosswaite & Curtise, 1994). Research findings can only be utilized if they are effectively disseminated (a process which must be timely with the researcher knowing which media to use depending on their end-users). It is also the duty of a researcher to share knowledge generated from their research to the wider society (Crosswaite & Curtise, 1994). Lack of dissemination creates a gap between research and practice (Wilson, Petticrew, Calnan, & Nazareth, 2010). Universities have an obligation to disseminate any information which can benefit society and this includes findings from research they conduct (AAU, 2009; Kenyan Constitution, 2010; Awuor, 2013). Effective dissemination of research findings also enables researchers to make their input into policy decisions that can influence behavior of the target population under study by encouraging them to generate outputs from their research.

University Research is expected to increase the existing stock of knowledge through publications. Publications may be in form of papers published in refereed journals or Academic text books. Formal publications include books or book chapter, peer-reviewed journals monographs preprint. Digital publications include academic repositories, blogs and websites. The World share of scientific publications in 2008 indicate that Africa had 2% with South Africa alone accounting for 0.5% of the world's publications in referred journals.

Other regions performed as follows; Asia 30.7%, America 35.3%, and Europe 42.5% (UNESCO, 2010). Publishing positively correlates with commercialization (Trencher, Yarime, McCormick, Doll, & Kraines, 2013) and permits the fastest and open diffusion of research results.

Copyrights gives authors exclusive rights to reproduce copyright material which can either be published or unpublished work. Trademarks on the other hand may either be logo, word, slogan symbol or design that distinguishes a product or service. Patents provide inventors with exclusive rights for a limited time to prevent anyone from making , using or selling the invention and can reinforce a competitive advantage. Spin-offs or business start-ups are new companies founded to exploit intellectual property from Universities (Adams, Graham, Gray, Purcell, & De Fazekas, 2005).

2.3 Research Funding and Research Outputs

Research and Development (R&D) funding is one of the indicators of a country's economic position (OECD, 2014). Investments in R&D form the foundation of new knowledge generation through research which ultimately leads to generation of products and services through applied research. Research is an expensive venture which constantly requires funding mechanisms and commercialization leads to alternative income to fund more research activities. An estimated 60% of R&D expenditure in most African countries comes from Governments, donors and public Institutions as reported by African Union.

There are several reasons attributed to rise in entrepreneurial Universities in the developed world which include the fact that these countries have increased their venture capital and also adopted favorable legislation (like the Bayh-Dole Act in the USA) which makes it possible for Universities to patent their work using public funds, develop incubation centres, build science parks and University spinoff companies (Rothaermel, Agung, & Jiang, 2007).

Exploitation of publicly funded research by Universities is important to demonstrate and justify public investment and therefore commitments to commercialize research needs to be prioritized right from the funding stage (Narayan & Hooper, 2010). This is so much so since about 70% of Research activities are funded by Governments in developing countries. While it is true that many Governments are the greatest funders for University research, little or no funds are set

aside for Commercialization of the research results. A study carried out in New Zealand Universities to determine the role of Governments towards encouraging development of academic research indicate that lack of funding coupled with lack of foresight into commercialization leads to few academic research moving past the research results (Narayan & Hooper, 2010).

Some of the reasons in literature given for the need to evaluate basic research include the need for accountability, effectiveness and efficiency of public money by many Governments all over the world and importantly, the need for society to understand the role of research towards economic development (Grant, 2006).

There is an increasing role for Universities in the twenty-first (21st) Century towards wealth creation and increasing employment opportunities by molding job creators rather than seekers (WIPO, 2007). The University's mission is no longer only focused on teaching and research but is expanded to also include its contribution to the society by promoting economic development through the knowledge it generates (Yaakub, et al., 2011; AAU report 2012; Bonaccorsi, Daraio, & Geuna, 2010). Again, the push towards knowledge based economies has reinforced the link between academics and economic needs putting Universities in a place where they need to respond more to their environment (Martin, 2012).

Knowledge societies or economies are characterized by their agility in knowledge creation, dissemination and application to improve the well-being of their societies. Universities have become the foundation on which knowledge economy is built due to their role in education and training and innovation systems pillars (Gorasson & Brundenius, 2011). An Innovation system comprises of Universities, research institutions, industrial sector, think tanks and other organizations that can tap into the available knowledge, adapt it into local needs and create solutions to its people (World Bank, 2012). Korea, Malaysia and China top the list of Knowledge based economies as highlighted by World Bank Knowledge Economy Index (KEI) Rankings in 2012 which focused on 146 countries all over the world. Many African countries however trail the list (Kefela, 2010).

University entrepreneurship is recognized as the third mission of a University, a mission greater than research and teaching (Allen, 2012). The conversion of research results into products, services and processes that can be the object of commercial transactions (Downie & Herder, 2007), helps avail benefits of publicly funded research to the public WIPO(2007); Bloom, Canning and Chan (2006). Gutierrez and Correa (2012) reiterate the vital role of research in development, knowledge dissemination and contribution to knowledge and the need for Universities to bring out more from their research to meet socioeconomic challenges. Universities constantly churn out new knowledge from the research they undertake and through human resource as students who graduate from these institutions every year. This is critical to spur on production processes and innovations leading to increased economic performance (Power & Malmberg, 2003).

Strong knowledge bases can be exploited to achieve sustained economic growth (Dosi & Nelson, 2013). Universities are uniquely placed to address knowledge gaps in the society, address challenges facing society and to provide mitigation to ever pressing socioeconomic challenges. Research benefits come in different forms, economic if they can create products that can be commercialized to improve the quality of life and also add on existing knowledge. Commercialization was foreign to many Universities in 1980s yet today many countries have introduced policies that have given Universities the impetus to come up and market their research (Students, 2007).

Financial support to University researchers is important to provide them with funds not only to carry out their research successfully but also to generate outputs and commercialize them. However, many University Research Results cannot be exploited further due to lack of funds. The research funding given is not enough to support further development of the research ideas (Khademi, Ismail, Lee, & Shafaghat, 2015). External funding such as business angels or venture capital funds are not readily available in many developing countries making them lag behind.

2.4 University Researcher Characteristics and Research Outputs

Researcher motives, expectations and perceptions towards research outputs and economic benefits through commercialization are very important. Internal factors that may trigger researchers to commercialize their research results include individual skills, age and career, industrial experience, social and personal rewards, networks, interests (Ambos, Makela, Julian,

& D'Este, 2008). These factors are different from one researcher to another. Intrinsic factors refers to an internal drive by the researcher, maybe for more money, academic entrepreneurship, an interest or awareness and is different from one researcher to another (Keerati-angkoon, Pichyangkura, & Chandrachai, 2012). Researcher personal factors like lack of time, knowledge of entrepreneurship, and understanding of University IP policies influence their commercialization tendencies (Amanor-Boadu & Metla, 2008).

Researchers can be motivated in three key ways; recognition among their peers including promotion, monetary reward, availing resources or funding or through encouragement to increase their productivity through publications and patents (Goktepe-Hultein, 2008). Researcher's motivation towards generating research outputs is key for them to develop exploitative behavior. To boost their motivation; training by university on importance of transferring knowledge is a crucial element as well as setting up a reward program for researchers involved in commercialization. Reputation and recognition has been found to supersede any financial or economic profits researchers may accrue from the commercialization process (Goktepe-Hultein, 2008). Lam, (2010) categorizes factors which motivate researchers in commercializing research outputs into three concepts which she names "ribbon" (reputational/career rewards); "puzzle" (intrinsic satisfaction) and "gold" (financial rewards). She concludes that researchers who are entrepreneurial by nature are driven by "puzzle" and "gold" factors while traditional researchers who cannot link research and business more often are motivated by "ribbon" factors. Acs, Audretsch, Braunerhjelm, & Carlsson, (2008) proposes that new knowledge is commercialized; first when the researcher sees the personal benefits of engaging in commercialization, secondly, if they can identify the commercial value of their research and thirdly when someone else demonstrates value in their research and invests in the knowledge.

2.5 Industrial Involvement and Research Outputs

Collaboration between Universities and the Industry is able to harness knowledge generated through research and use it to drive economic development. Measurable benefits of this collaboration include funding for Research and Development; source of employment for graduates leaving Universities; collaborative research; experience and equipment for teaching and learning but most importantly the ability to offer solutions of many societal challenges through exploitation of research results. University- Industry linkage is a strategic partnership that when well coordinated is able to connect the discovery culture of the University to meet with innovation culture of industry resulting into economic development. It works better when there is

a shared vision between the two players and moreover University's strong leadership is identified as very important to make this collaboration work (Link & Siegel, 2007).

University-industry partnership is a major concern as pertains to innovation and economic development yet appropriate incentive mechanisms; organizations form and implications for a research policy still remain a challenge (D'Este & Patel, 2007). University-industry partnership enables the University to fulfill its entrepreneurship role, also known as the third mission (Leisyte, 2011). The term Entrepreneurial University describes Universities that are responsive to socioeconomic challenges and are important to regional economic development, (Etzkowitz & Leydesdorff, 2000). Entrepreneurial Universities have been known to pursue and initiate partnerships with industry. Indicator of University-Industry collaboration is co-publication. This indicator has been used to study University- Industry partnerships in many countries.

Commercialization is itself an expensive venture requiring huge financial investments not in the immediate disposal of researchers hence there is need for a strategy for collaboration with Industry to help take research results into the products level (Yaakub, et al., 2011). University-industry partnerships are considered as one of the frameworks that can promote commercialization of research results from higher education institutions (Ondimu, 2012; WIPO, 2007). In the recent past, it is strongly asserted that University linking with Industry, Government and Civil Society provides them with a more sustainable mission required and necessary to survive in the new era (Trencher, Yarime, McCormick, Doll, & Kraines, 2013).

For publicly funded research, motivation by creating conducive research environments and incentives to industry are ways of generating outputs from research and pushing them into the markets through commercialization (Grimshaw, Eccles, Lavis, Hill, & Squires, 2012). Promoting collaboration between three co-actors in research that is Government, University and industry is important towards creating a knowledge based economy and enhancing a country's development in the international arena. This partnership is commonly known as triple-helix (Narayan & Hooper, 2010). This has been extended to include the private sector and venture capitalists in recent years. Some of the ways through which researchers in industrialized countries have promoted University-Industry is through incentives that allow them to earn from their ingenuity including retaining up to 50% from income earned as their research outputs are commercialized (WIPO, 2007; Nordfors, Sandred, & Wessner, 2003).

Universities form strategic partnerships with the industrial sector based on an understanding of their strengths and areas of expertise for the collaboration to be mutually beneficial (shared vision). Economic development is linked to the process of translating knowledge into business ventures which can generate jobs and create wealth. Through their Industrial linkages, many Universities in industrialized nations also have established enterprises which employ thousands of people/ wealth creation. The industrial sector in these countries is also very vibrant and most of them are ready to take up research results from University and commercialize them as is depicted by some Chinese companies who give up to 40% to fund University Research and development (WIPO, 2007).

2.6 Institutional factors and Research Outputs

University policies that govern research activity must inspire and encourage researchers to generate outputs from their research results. University policies must also enable the researchers to transfer knowledge from their research into goods and services to benefit society (Farsi, Modarresi, & Zarea, 2011). Universities keen to promote generation of research outputs among its faculty must pay attention to its research policies and training as this affects researchers. Friendly legislation like Bahy- Dole Act in the United States of America encouraged Universities to patent their research findings and later transfer and commercialize them in business played a great role in commercialization of University research results, (Guenther & Wagner, 2008). Many of the commercialization efforts in USA have been accredited to the enactment of the Bahy-Dole Act of 1980 which enabled academic research to be interlinked with industrial needs.

Universities conduct basic research which is important to provide understanding and discovery necessary for innovation (Science Coalition, 2010). Innovation increasingly plays an important role in economic growth which has driven Governments in the recent past to demand more from research and development investments they make (WIPO, 2007). Researchers are encouraged that as they come up with inventions and innovations, they need to protect them by filing for patents (WIPO, 2007). Intellectual property as a product of research can promote technology transfer from University to Industry. IP Policies in Universities must provide rules and guidelines on IP exploitation. Through patenting, knowledge produced by research in University can increase economic productivity (Svensson, 2008). Training and sensitization can help University researchers understand how they can exploit their linkages with the Industry to help them commercialize their research outputs (Fletcher & Bourne, 2012).

Commercialization is posited as a function of University Technology Transfer Offices which have the responsibility to turn research inputs into products that can be commercialized (Weckowska, 2010). Technology Transfer Offices link Universities with Industry mainly by matching what Universities supply with the demand of the business world (Gutierrez & Correa, 2012). While academic researchers may identify entrepreneurial opportunities, in their research work, exploitation of these opportunities is driven by their collaboration with industry to a large extent. Technology transfer Offices are important as knowledge brokers between academia and industry as they provide expertise and management of commercialization process including technology transfer, patenting, licensing and business start-ups creation (Ambos, Makela, Julian, & D'Este, 2008). Commercialization is possible through academia industry linkages into technology transfer mechanism that benefits the two, in one hand the industry accesses research from academia while on the other hand; academia who develops innovations and technologies can obtain resources in form of skills and expertise to commercialize their work (Henderson & Smith, 2002).

2.7 Theoretical Framework

This research study is based on the Triple Helix Theory. The Triple Helix Theory was first put forward in 1983 by Etzkowitz(1998); Etzkowitz and Leydesdoff (2000). The Theory highlights the relationship between University, Industry and Governments towards development of Knowledge societies. The Triple Helix theory (Breznitz & Ram, 2011), has also been referred to as a model (Etzkowitz, 2003; Etzkowitz & Leydesdorff, 2000; Rieu, 2011) and also as a concept (Ranga & Etzkowitz, 2013).

The Triple Helix theory advocates for increased interaction between three actors; University, Industry and Government (Rieu, 2011) which in the case of University- Industry linkage, leads to changes in culture and values within Universities that drive them towards more entrepreneurial tendencies (Mowery & Sampat, 2007). In the Triple Helix Theory, the Government's role is critical not only as a funder of the Research and Development in Universities but also as main financier for the technology transfer and commercialization of products from the funded University Research activities (Rao, Piccaluga, & Meng, 2011) and in

formulating relevant policies and institutions to actualize commercialization of the research knowledge (Gorasson & Brundenius, 2011). The University's role in innovation as highlighted by the Triple Helix theory is enhanced especially in light of the emergence of knowledge based societies; it includes research as well as teaching for socioeconomic development.

Three interlocking dynamics govern the relationship between the three spheres; institutional transformations, evolutionary mechanisms and the new position of the University (Etzkowitz & Leydesdorff, 2000). The theory advocates for increased role played by the University in innovation and economic development as well as the joint efforts it has to make together with Industry and Government towards facilitating the production, transfer and application of knowledge for socioeconomic development.

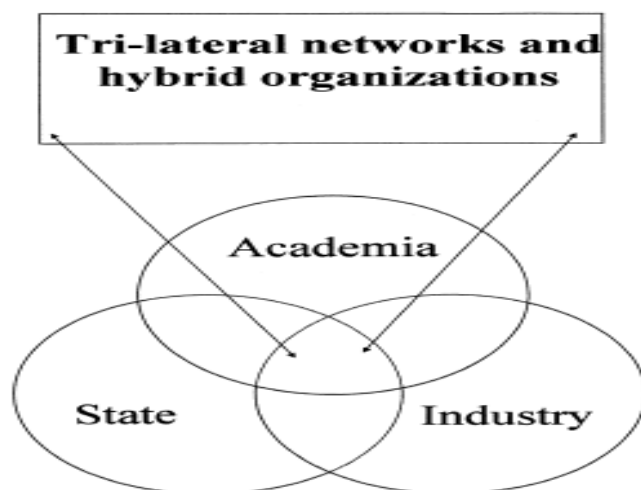


Figure 1:Triple Helix model, adopted from (Etzkowitz & Leydesdorff, 2000)

The Triple Helix model centres on the Entrepreneurial University which is described as a University that is actively involved in creating knowledge, exploiting it and generating new knowledge (Etzkowitz, 2003).

2.8 Conceptual Framework

Conceptual framework explains the relationship between the interlinked concepts and variables, matches the set objectives and assists researchers make meaning of their research findings (Kombo & Tromp, 2009; Smyth, 2004).

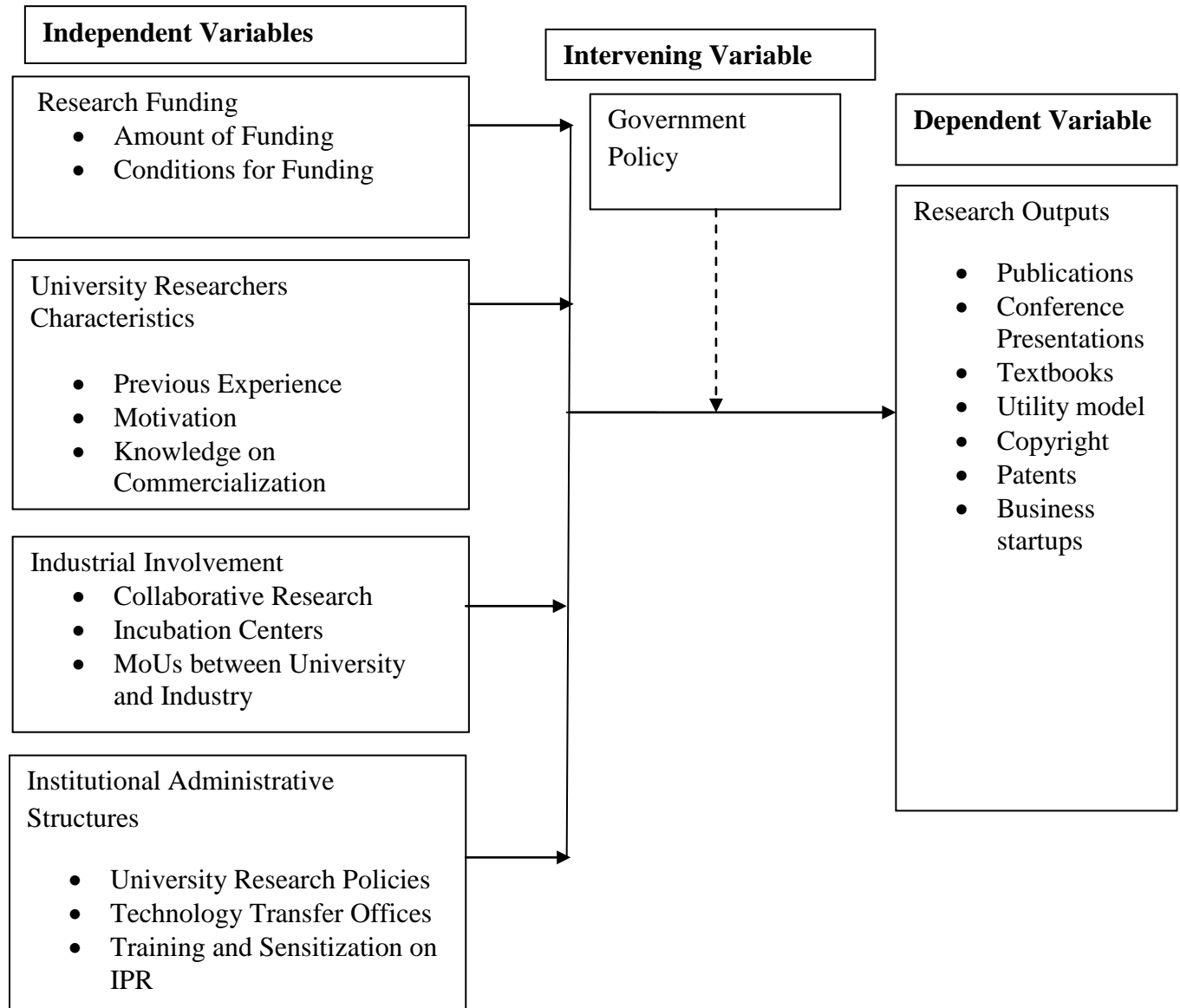


Figure 2: Conceptual Framework

2.9 Knowledge Gap

Chapter Two reviewed literature of the empirical works of authors on the variables under study. All the authors in the reviewed literature seem to agree that research funding influences Research outputs in Universities. All the authors also emphasize that University researchers' motivation towards commercialization is largely driven by benefits they will accrue. Only (Amanor-Boadu & Metla, 2008) looks at researcher knowledge and understanding of Commercialization and IP policies. All the authors seem to agree that University-Industry linkages are important to promote generation of research outputs and commercialization of University research results. All authors also seem to agree that University Research policies and Technology Transfer Offices influence University Researchers to generate research outputs. The literature reviewed however does not cover the University research projects funded by NACOSTI in Kenya through the Research Endowment Fund started in 2008. This research study therefore examines the research outputs of Selected Public Universities in Kenya who were funded under the Research Endowment Fund.

CHAPTER THREE

RESEARCH METHODOLOGY

3.1 Introduction

This chapter includes the research design adopted in the study, the target population, sample size and sample selection method, data collection tools, reliability and validity of the research instruments, data collection procedure, data analysis techniques and ethical considerations taken into account when carrying out the research study.

3.2 Research Design

Kombo and Tromp (2009) describe research design as the scheme or plan that is used to generate answers to research problems. This study employed a descriptive survey research design to describe the factors influencing research outputs in selected Public Universities in Kenya as factual and accurately as possible.

3.3 Target population

This refers to the entire group that the researchers wish to study and draw conclusions on (Borg & Gall, 1996). In this study the target population was 161 University researchers from University of Nairobi, Kenyatta University and Jomo Kenyatta University who received research funding from NACOSTI between the years 2008 and 2012.

3.4 Sampling size and Sampling Procedure

This section discusses how the sample size of University Researchers was determined as well as the sampling procedure.

3.4.1 Sample size

The research study focuses on the research projects in Selected Public Universities. The three Universities; University of Nairobi, Kenyatta University and Jomo Kenyatta University of Agriculture and Technology were selected from the other Public Universities in Kenya. The total number of Researchers from the sampled Universities was 161 as shown in Table 3.1.

Table 3.1 Sampling frame

	2008/2009	2009/2010	2010/2011	2011/2012	Totals
UoN	13	9	19	22	63
KU	8	5	16	19	48
Maseno	6	6	5	6	23
Egerton	7	5	16	8	36
Moi	7	6	12	5	30
JKUAT	7	7	19	17	50
MMUST	2	4	2	10	18

Source: NACOSTI Annual Reports

3.4.2 Sampling Procedure

The three Universities were considered for the sample because they received the largest share of the Research Endowment Fund between the years 2008 and 2012 as shown in Table 3.1. The sample size was determined from the population of University researchers using the Krejcie and Morgan Table (Krejcie & Morgan, 1970). Calculations were then done to get the proportion of University researchers included into the sample size as indicated in Table 3.2. The individual University Researchers were then selected through systematic random sampling where every 3rd Researcher was selected from a list of Researchers from each University provided by NACOSTI.

Table 3.2: Sample size

	Population size	Sample size
UoN	63	44
KU	48	34
JKUAT	50	35
Total	161	113

3.5 Data Collection Instruments

This research study used questionnaires as the main tool for data collection (Jackson, 2009). The questionnaire consisted of open and closed ended questions organized in five sections according to the variables identified in the research proposal. The first section of the questionnaire had close ended questions which concentrated on demographic details including age, gender, highest academic qualification, research experience and institutional affiliation of the University researchers. The second section of the questionnaire consisted of a set of questions based on Research funding and how it influences research outputs in Selected Public Universities in Kenya, the third section consisted of a set of questions based on University Researchers Characteristics and how they influence Research Outputs in selected Public Universities in Kenya, the fourth section consisted of a set of questions based on Industrial Involvement and how it influences Research Outputs in Selected Public Universities in Kenya and lastly the fifth section consisted of a set of questions based on Institutional Administrative Structures and how they influence Research outputs in Selected Public Universities in Kenya. The questions were set using Likert five- point scale of measurement on a continuum ranging from 1-5 where 1 corresponded to least possibility of occurrence while 5 corresponded to highest possibility of occurrence. The questionnaire is attached to this report as Appendix II. Secondary data was obtained from NACOSTI Monitoring and Evaluation reports as well as progress reports submitted by the researchers during the life of the research project. Triangulation was possible through multiple sources of data including questionnaires and literature reviews.

3.5.1 Pilot testing of the Research Instruments

A pilot study was carried out among 10% of the sample size to refine the questionnaires and remove ambiguity (Simon, 2011). This was done two weeks prior to the actual administration of the questionnaire to the respondents. The questionnaires were self administered through email to the respondents and appointments sought on when to collect them.

3.5.2 Validity of Research Instruments

A research instrument is valid if its measures what it is supposed to measure when the data collected through it accurately represents the respondent's opinions. The validity of the research instrument in this study was ascertained by conducting a pilot study in Moi and Egerton University. This erased any ambiguity and tailored the questions to the responses expected before the questionnaire was administered. Content validity of the research instrument was determined by seeking advice from the research supervisor and other experts.

3.5.3 Reliability of Research Instrument

The reliability of the research instrument was determined using the Split-half test in which 11 questionnaires were randomly distributed to two groups of University Researchers; from Moi and Egerton Universities. The scores from each of the 11 questionnaires were recorded. The questionnaires were grouped using the odd and even number approach. The split half reliability test was then carried out using SPSS. From the results, the research instrument was deemed to be reliable as the Spearman's Brown coefficient score was 0.941, the value of the Cronbach's Alpha was 0.839 for the 6 questionnaires and 0.917 for the 5 questionnaires, and the value for the Guttman Split- Half Coefficient was 0.920. Lance, Butts, and Michelis, (2006) recommend a reliability score of 0.8 and above. The results are presented in Table 3.3.

Table 3.3: Reliability Results

Cronbach's Alpha	Part 1 Value	.839
	N of items	6^a
	Part 2 Value	.917
	N of items	5^b
	Total N of items	11
Correlation between forms		.888
Spearman-Brown Coefficient	Equal Length	.941
	Unequal Length	.941
Guttman Split-Half Coefficient		.920

3.6 Data Collection Procedure

The questionnaires were administered to the researchers via emails then follow-up was done by telephone and personal visits. The respondents were given a period of two (2) weeks to fill in the questionnaires. After the questionnaires were received, data was cleaned then keyed in the computer before analysis. Desk top review of the Researchers final reports and monitoring and evaluation reports was carried out to obtain secondary data and also helped in verification through triangulation of data.

3.7 Data Analysis Techniques

The collected data was cleaned, organized into variables then coded and analyzed using Statistical Package for Social Sciences (SPSS) version 20 using descriptive statistics and organized into frequency tables and percentage tables which show finer details that can be viewed at a glance.

3.8 Ethical Considerations

The approval to carry out the research was sought from the University of Nairobi which facilitated application for a research permit from the National Commission for Science, Technology and Innovation. Request to use data on University researchers funded by NACOSTI was made through a letter written to the Chief Executive Officer, NACOSTI. An invitation to the sampled University researchers was made to seek their informed consent to participate in the research study with an assurance that every information they gave was to be treated with confidentiality and only used for the research study. There was no manipulation of data which may mislead conclusions and recommendations of the study. All quotes and references used in the research study were well cited.

3.9 Operationalization of Variables

Variable	Indicators	Data Collection Instruments	Scale	Analysis Tool
To determine how Research Funding influence Research outputs in Selected Public Universities in Kenya	<ul style="list-style-type: none"> • Amount of research funding • Conditions for Funding 	Questionnaire	Ordinal	Descriptive Statistics Frequency Tables Percentage Tables
To establish how University Researchers characteristics influence Research outputs in Selected Public Universities in Kenya	<ul style="list-style-type: none"> • Knowledge on Commercialization • Previous Experience • Motivation 	Questionnaire	Ordinal	Descriptive Statistics Frequency Tables Percentage Tables
To investigate how Industrial involvement influence Research Outputs in Selected Public Universities in Kenya	<ul style="list-style-type: none"> • Collaborative Research • Incubation Centers • MoUs between University and Industry 	Questionnaire	Ordinal	Descriptive Statistics Frequency Tables Percentage Tables
To examine how Institutional Administrative Structures influence Research Outputs in Selected Public Universities in Kenya	<ul style="list-style-type: none"> • University Research Policies • Technology Transfer Offices • Training and Sensitization on IPR 	Questionnaire	Ordinal	Descriptive Statistics Frequency Tables Percentage Tables

Table 3.4: Operationalization of variables

CHAPTER FOUR

DATA ANALYSIS, PRESENTATION, INTERPRETATION AND DISCUSSION

4.1 Introduction

This chapter presents the results and discussions of the findings of the research study. It includes the questionnaire response rate, demographic characteristics of the respondents, Research outputs of Selected Universities in Kenya, measure of commercialization, Research Funding and commercialization, University Researchers Characteristics and Research outputs, Industrial Involvement and Research outputs and Institutional Administrative Structures and Research outputs

4.2 Questionnaire Return Rate

The study realized a response rate of 66%; Nulty (2008) found response rates of 60% and above to be adequate for surveys. The data was analyzed using SPSS version 20 to produce the descriptive statistics. Frequency tables and percentage tables were used to describe the data.

4.3 Demographic Characteristics of the Respondents

The male respondents were 39 representing 52% of the respondents while the female respondents were (36) representing 48% of the respondents. Respondents within the age group 30-34 years were 6.7% (n=5), the group within 35-40 years of age were 24% (n=18), the age group 40-44 years represented 32.0% (n=24) while the age group 45 years and above were 37.3% (n=28). According to the study findings, 20% (n=15) of the respondents had research experience of between 1 to 5 years, 33.3 % (n=25) of the University researchers had research experience between 5-10 years while 46.7% (n=35) had research experience of over 10 years. Responses from University Researchers who were PhD holders accounted for 61.3% (n=46), Master's degree holders were 27 (36%) while Post doctorate degree holders were 2(2.7%) of the respondents. The respondents who received their funding from NACOSTI in 2009 were 18.7 % (n=14), those who received funding in 2010 were 16 %(n=12), those who received funding in 2011 were 42.7 %(n=32), while those who received funding in 2012 were 21.3 %(n=16).

4.4 Research Outputs of Selected Universities in Kenya

The research outputs studied include publications in refereed journals, conference presentations, policy briefs, text books, patents, utility model, copy right, industrial design, trademark and business startup.

Table 4.1: Research Outputs of Selected Universities in Kenya

	Frequency	Percentage
Publication in Refereed Journal	15	20.0
Business Start up	2	2.7
Conference Presentation, Publication in Refereed Journal	26	34.7
Publication in Refereed Journal, Copyright	1	1.3
Conference Presentation, Publication in Refereed Journal, Utility model	4	5.3
Publication in Refereed Journal, Textbook, Policy Brief, Conference Presentation, Utility Business start-up	1	1.3
Publication in Refereed Journal, Textbook, Conference Presentation	5	6.7
Policy Brief, Conference	1	1.3
Policy brief	3	4.0
Conference presentation	11	14.7
Trademark	1	1.3
Conference presentation, Publication in Refereed Journal, Patent	1	1.3
No response	4	5.3
Total	75	100

Table 4.1 shows frequencies of respondents' response on the outputs of their Research Results. Most of the University researchers, 34.7% (n=26) had made conference presentations and published in Refereed Journals the findings of their research, 20% (n=15) of the respondents had only published in refereed Journals, 2.7% (n=2) had a business startup, 1.3% (n=1) had published in refereed journals and had a copyright, 5.3% (n=4) had published in refereed journal, had made conference presentation and had a

utility model, 1.3% (n=1) had Published in refereed journal, had published a text book, policy brief, had made conference presentation, developed a utility model and had a business startup, 6.7% (n=5) had published in refereed journals, had a textbook and had made conference presentation, 1.3% (n=1) had developed a policy brief and made conference presentation. 4.0 %(n=3) had developed a policy brief, 14.7 % (n=11) had only made conference presentation of their research results; 1.3 %(n=1) had a trademark, 1.3 %(n=1) had made conference presentation, had published in refereed journals and had a patent, 5.3 %(n=4) gave no response to this question.

The results agree with results of study done by Mathooko (2010) on evaluation of strategies and mobilizing resources for research and enhancing outputs in Public and Private Universities in Kenya who realized that between 2004-2008, over 90% of lecturers in Public Universities had not patented any research outputs and that many of the R&D institutions in the country, Universities included, carry out research with no end user benefit in mind.

4.5 Measure of Commercialization

According to the research study, Commercialization was measured by the following research outputs; utility model, patent, copyright, industrial design, trademark and business start up. University researchers who had utility model, patent or copyright were considered to have semi-commercialized their research results while University researchers who had Industrial design, Trademark or Business startup were considered to have fully commercialized their research results. This is because utility model, patent and copyright are IP protection made in the early stages of the Commercialization process while industrial design and trademark protect commercial products whereas business startups are well established income generating ventures.

Table 4.2: Level of Commercialization of University Research Results

	Frequency	Percentage	Cumulative Percentage
Fully Commercialized	4	5.3	5.3
Semi-Commercialized	4	5.3	10.7
No	65	86.7	97.3
No response	2	2.7	100.0
Total	75	100.0	

Table 4.2 shows the frequency of the respondents and the level of commercialization of their research results. 4 University Researchers had fully commercialized their research results while 4 University Researchers had semi-commercialized their research results.

Further comparison was made between the Measure of Commercialization and the Highest Degree of University Researcher.

Table 4.3: Measure of Commercialization and Highest Degree of Researcher

Highest Degree of Researcher	Masters	PhD	Post Doc	Total
Fully Commercialized	2	2	0	4
Semi-Commercialized	1	3	0	4
None	23	40	2	65
No response	1	1	0	2
Total	27	46	2	75

Table 4.3 shows frequencies of responses on relationship between Highest Degree of University researchers and the Level of Commercialization of their Research Results. 2 University Researchers with Masters Degree had fully commercialized, 2 Researchers with PhD Degree had fully commercialized while no researcher with Post Doctorate Degree had fully commercialized. 1 Researcher with Masters Degree had semi-commercialized, 3 Researchers with PhD Degree had semi-commercialized while no Researcher with Post-Doctorate Degree had semi-commercialized. This indicates that University Researchers with Masters and PhD degrees were more prone to commercialization efforts than University Researchers who had Post Doctorate degrees. This may indicate that research productivity declines as an individual's academic experience increases as indicated by Migosi (2012). The decline may be caused by decline of extrinsic motivation as a result of attainment of tenure, promotion and proximity to retirement.

Further comparison was made between the Measure of Commercialization and the Age of the University Researcher.

Table 4.4: Measure of Commercialization and Age of University Researcher

Age of University Researcher	Frequency				Total
	30-34 years	35-40 years	40-44 years	45 years and above	
Fully Commercialized	1	0	1	2	4
Semi-Commercialized	0	1	2	1	4
None	3	17	20	25	65
No response	1	0	1	0	2
Total	5	18	24	28	75

Table 4.4 shows the relationship between the age of University Researchers and their Level of Commercialization. In the age group 30-34 years, 1 University Researcher had fully commercialized their research results and none had semi commercialized. In the age group 35-40 years, no University researcher had fully commercialized while 1 University researcher had semi-commercialized. Under the 40-44 years age group, 1 researcher had fully commercialized while 2 had semi-commercialized. Under the 45 years and above age group, 2 University researchers had fully commercialized their research while 1 researcher had semi-commercialized. This indicates that older University researchers are more likely to commercialize their research results as compared to younger University researchers. This may be due to the experience and a network established by older University Researchers as compared to their junior counterparts and agrees with findings of study by Migosi (2012) that older University researchers perceive research more positively than junior researchers.

Further comparison was made between the Measure of Commercialization and the University of Researcher.

Table 4.5: Measure of Commercialization and University of Researcher

University of Researcher	Frequency			Total
	UoN	KU	JKUAT	
Fully Commercialized	2	2	0	4
Semi-Commercialized	2	0	2	4
None	25	20	20	65
No response	2	0	0	2
Total	31	22	22	75

Table 4.5 shows the relationship between University of the Researcher and their level of Commercialization. 2 researchers from UoN had fully commercialized their research while 2 had semi-commercialized. 2 researchers from Kenyatta University had fully commercialized their research while none had semi-commercialized. JKUAT had no researcher who had fully commercialized their research results while 2 researchers had semi-commercialized their research results. The latest Webometric ranking of World Universities, January 2015 results places the University of Nairobi (7th) ahead of Kenyatta University (38th) and JKUAT (44th) out of 855 Universities in Africa. Commercialization of University Research Results is one of the indicators measured by the Webometric ranking and this agrees with the results of the study.

4.6 Research Funding and Research Outputs

The indicators studied include the amount of research funding and approvals. The respondents were requested to indicate if the research funding received was enough for their budget items, enabled them to translate their research results and if they received additional funding to enable them translate their research results.

Table 4.6: Amount of Research Funding and Research Outputs

	Frequency	Percentage	Cumulative Percentage
The Funding received covered all budget items	16	21.3	21.3
The Funding received enabled me to Translate my research results	18	24.0	45.3
I used part of my research funding to Translate my research results	26	34.7	80.0
I received funding assistance from the University to translate my research results	6	8.0	88.0
No response	9	12.0	100.0
Total	75	100.0	

The Table 4.6 shows frequencies and percentages of respondents' response on the amount of research funding and how it influences research outputs in selected public Universities in Kenya. Most of the University researchers, 34.7% (n=26) agreed that they used part of their research funding to translate their research results, 24.0%(n=18) agreed that the funding received enabled them to translate their research results, 8.0%(n=6) agreed that besides the research funding for, they received funding assistance from their University to translate their research results, 21.3%(n=16) agreed that the funding received was enough to cover all their budget items while 12.0%(n=9) gave no response to this question.

Table 4.7: Coordination of Funding

	Frequency	Percentage	Cumulative Percentage
Received Funds without delay	12	16.0	16.0
Delay in Funds remittance by University	25	33.3	49.3
Late release of funds from NACOSTI	30	40.0	89.3
No response	8	10.7	100.0
Total	75	100.0	

Table 4.7 shows frequencies and percentages of responses on the ease with which the University researchers received Research Funding. 12(16.0%) indicated that they received funding without delays; 25(33.3%) indicated that they experienced delays at the University; 30(40.0%) indicated that the funds were released late while 8(10.7%) gave no answer to this question.

4.7 University Researchers Characteristics

The indicators studied include previous experience, motivation and knowledge on commercialization.

Table 4.8: Previous Experience and University Research outputs

	Frequency	Percentage	Cumulative Percentage
Yes	40	53.3	53.3
No	21	28.0	81.3
No response	14	18.7	100.0
Total	75	100.0	

Table 4.8 shows frequencies and percentages of responses on previous experience and how it influences research outputs. University researchers who agreed that previous experience influences research outputs were 53.3 % (n=40), those who disagreed were 28.0 % (n=21) while 18.7 % (n=14) gave no response to this question. The findings mirror Ambos, Makela, Julian, & D'Este, (2008) findings that researcher previous experience is important in generation of research outputs.

Further studies were done on different motivations towards generation of research outputs.

Table 4.9: University Researcher Motivation

Indicators	Frequency and Percentages				
	Not Important	Somewhat Important	Uncertain	Important	Very Important
Recognition	3 (4.0%)	8 (10.7%)	15(20.0%)	33(44.0%)	19 (25.3%)
Job-satisfaction	2(2.7%)	9(12.0%)	14(18.7%)	30(40.0%)	17(22.7%)
Extra Income	4(5.3%)	10 (13.3%)	14(18.7%)	23(30.7%)	23(30.7%)
Requirement	12(16.0%)	16(21.3%)	20 (26.7%)	16(21.3%)	10(13.1%)
Opportunity	2(2.7%)	5(6.7%)	17(22.7%)	31(41.3%)	19(25.3 %)
Promotion	-	9(12.0%)	8 (10.7%)	26(34.7%)	32 (42.7%)

Table 4.9 shows frequencies and percentages of participant response on how important Research Outputs were. 32(42.7%) of the researchers agreed that research outputs were very important for them to be promoted, 23(30.7%) agreed that research outputs were important for extra income, 33(44.0%) agreed that research outputs were important for recognition within the academic community, 31(41.3%) agreed that they would consider research outputs as important if there was an opportunity to generate them and 20(26.7%) agreed that research outputs were important if it was a requirement by University to generate them. These results agree with Leisyte (2011) and Goktepe-Hultein (2008) who found out that motives behind research outputs and commercialization for University researchers were primarily focused on their reputation and recognition factors and that financial gain or economic gain factors were secondary. Lam, 2010 concludes that University researchers driven by “ribbon” factors (reputational/career rewards) are traditional while Researchers who are entrepreneurial in nature are driven by “gold” factors (financial rewards).

Table 4.10: Knowledge and Entrepreneurial skills and Research Outputs

	Frequency	Percentage	Cumulative Percentage
Very Low Extent	3	4.0	4.0
Low Extent	4	5.3	9.3
Uncertain	18	24.0	33.3
Great Extent	19	25.3	58.7
Very Great Extent	31	41.3	100.0
Total	75	100.0	

Table 4.10 shows frequencies and percentages of responses given on extent to which knowledge and entrepreneurial skills influence Research Outputs in Universities. 41.3% (n=31) of the respondents indicated knowledge and entrepreneurial skills influence Research outputs to a very great extent, 25.3% (n=19) of the respondents indicated to a great extent, 24.0% (n=18) were uncertain, 5.3% (n=4) indicated to a low extent while 4.0% (n=3) indicated to a very low extent. The results agree with Goktepe-Hulteiu(2008) who found out that establishing an entrepreneurial culture within the University together with entrepreneurial training are key motivators for researchers to have a commercialization mindset.

4.8 Industrial Involvement and Research Outputs in Universities

The indicators studied include collaborative research and incubation centres, and MoUs between University and Industry.

Table 4.11: Number of Researchers who partnered with Industry during their Research

	Frequency	Percentage	Cumulative Percentage
Researchers who Partnered	33	44.0	44.0
Those who did not	36	48.0	92.0
No response	6	8.0	100.0
Total	75	100.0	

Table 4.11 shows frequencies and percentages of responses on collaborative research between University Researchers and Industry. 48.0% (n=36) of the respondents indicated that they did not work with anyone from Industry during their research, 44.0% (n=33) indicated that they had collaborative research while 8.0% (n=6) gave no response to this question. The results may explain why there were low commercialization efforts among the University researchers and agree with D'Este and Patel (2007) findings that previous collaborative research with industry influences their research outputs and is significantly important for University researchers to engage in commercialization.

Table 4.12: University-Industry Linkage and Research outputs

	Frequency	Percentage	Cumulative Percentage
Yes	63	84.0	84.0
No	6	8.0	92.0
No response	6	8.0	100.0
Total	75	100.0	

84.0% (n=63) of the respondents agreed that university-industry collaborative research would enhance their research results as indicated in Table 4.12. The results agree with Keerati-angkoon, Pichyangkura, & Chandrachai(2012) whose study found out that linkage between University and Industry strongly influence Research outputs in Universities and Gulbrandsen and Smeby, 2005 who found that Researchers who have a prior interaction with the industry have a greater urge towards commercial outputs.

Table 4.13: University Incubation Centres and Research Outputs

	Frequency	Percentage	Cumulative Percentage
Disagree	3	4.0	4.0
Uncertain	14	18.7	18.7
Agree	21	28.0	50.7
Strongly Agree	34	45.3	96.0
No response	3	4.0	100.0
Total	75	100.0	

Table 4.13 shows frequencies and percentages of University Researchers response to how Incubation Centres influences their Research Outputs. 45.3% (n= 34) of the respondents strongly agreed that Incubation centres influence their Research outputs, 28.0% (n=21) agreed, 18.7% (n=14) were not sure, 4% (n=3) disagreed while 4% (n=3) gave no response to this question.

Table 4.14: MoU between University and Industry

	Frequency	Percentage	Cumulative Percentage
Agree	39	52.0	52.0
Disagree	29	38.7	90.7
No response	7	9.3	100.0
Total	75	100.0	

Table 4.14 shows the frequencies and percentages of responses on how MoUs between University and Industry influence Research Outputs. 39(52.0%) of the researchers agreed that MoUs between University and Industry enhance Research Outputs, 29(38.7%) disagreed while 7(9.3%) gave no response to this question.

4.9 Institutional Factors and Commercialization

The indicators studied include University research policies, technology transfer offices, training and sensitization on IPR.

Table 4.15: University develop Policy on Commercialization

	Frequency	Percentage	Cumulative Percentage
Disagree	2	2.7	2.7
Uncertain	20	26.7	29.3
Agree	24	32.0	61.3
Strongly Agree	26	34.7	96.0
No response	3	4.0	100.0
Total	75	100.0	

Table 4.15 shows the frequencies and percentages of participant response on how University Policies influence Research Outputs. 34.7%(n=26) strongly agreed, 32.0%(n=24) agreed, 26.7%(n=20) were not sure, 2.7%(n=2) disagreed while 4.0%(n=3) gave no response to this question. The results agree with Farsi, Modarresi, & Zarea, (2011) that University Research policies influence research outputs.

Table 4.16: University to establish well managed Technology Transfer Offices

	Frequency	Percentage	Cumulative Percentage
Disagree	8	10.7	10.7
Uncertain	11	14.7	25.3
Agree	24	32.0	57.3
Strongly Agree	29	38.7	96.0
No response	3	4.0	100.0
Total	75	100.0	

Table 4.16 shows frequencies and percentages of participant response on how University Technology Transfer Offices influence Research Outputs. 38.7% strongly agreed, 32.0% agreed, 14.7% were not sure, 10.7% disagreed while 4.0% gave no response to this question. The results agree with Amanor-Boadu and Metla (2008) who found out that University Research policies and Technology Transfer Offices significantly influence University Researchers to generate outputs from their Research results

Table 4.17: University training and sensitization on IPR and Research Outputs

	Frequency	Percentage	Cumulative Percentage
Uncertain	13	17.3	17.3
Agree	30	40.0	57.3
Strongly Agree	27	36.0	93.3
No response	5	6.7	100.0
Total	75	100.0	

Table 4.17 shows frequencies and percentages of participant response on how training and sensitization on IPR influence research outputs of University Research Results. 40% agreed, 36.0% strongly agreed, 17.3% were not sure while 6.7% gave no response to this question.

CHAPTER FIVE

SUMMARY OF THE FINDINGS, CONCLUSIONS AND RECOMMENDATIONS

5.1 Introduction

This chapter entails the summary of the research findings, conclusions of the study, recommendations and suggestions for further studies.

5.2 Summary of the Findings

The questionnaire return rate was 66%. 113 questionnaires were distributed but 38 questionnaires representing 34% were not returned.

The male respondents were 39 representing 52% of the respondents while the female respondents were (36) representing 48% of the respondents. Respondents within the age group 30-34 years were 6.7% (n=5), the group within 35-40 years of age were 24% (n=18), the age group 40-44 years represented 32.0% (n=24) while the age group 45 years and above were 37.3% (n=28). According to the study findings, 20% (n=15) of the respondents had research experience of between 1 to 5 years, 33.3 % (n=25) of the University researchers had research experience between 5-10 years while 46.7% (n=35) had research experience of over 10 years. Responses from University Researchers who were PhD holders accounted for 61.3% (n=46), Master's degree holders were 27 (36%) while Post doctorate degree holders were 2(2.7%) of the respondents. The respondents who received their funding from NACOSTI in 2009 were 18.7 % (n=14), those who received funding in 2010 were 16 %(n=12), those who received funding in 2011 were 42.7 %(n=32), while those who received funding in 2012 were 21.3 %(n=16).

Most of the research outputs from the University Researchers surveyed were publications and conference presentations; conferences and publications in refereed journals accounted for 34.7%; publications in refereed journals accounted for 20.0% ; conference presentations accounted for 14.7%; 2.7% had a business startup; 1.3% had published in refereed journals and had a copyright; 5.3% had published in refereed journal, had made conference presentation and had a utility model, 1.3% had published in refereed journals, had published a text book, policy brief, had made conference presentation, developed a utility model and had a business startup; 6.7% had published in refereed journals, had a textbook and had made conference presentation; 1.3% had developed a policy brief and

made conference presentation; 4.0% had developed a policy brief; 1.3% had a trademark; 1.3% had made conference presentation, had published in refereed journals and had a patent; 5.3% gave no response to this question.

Research funding was found to influence Research outputs in selected public Universities in Kenya. 34.7% of the University researchers agreed that they used part of their research funding to generate outputs from their research results. 24.0% agreed that the funding received enabled them to translate their research results, 8.0% agreed that besides the research funding, they received funding assistance from their Universities to generate outputs from their research results, 21.3% agreed that the funding received from NACOSTI was enough to cover all their budget items while 12.0% gave no response to this question.

University researcher's characteristics were found to influence Research outputs in selected public Universities in Kenya. 53.3% of the University researchers agreed that previous experience influences Research Outputs in Universities. 41.3% of the respondents indicated that knowledge and entrepreneurial skills greatly influences Research Outputs. On motivation 42.7% of the researchers agreed that research outputs were very important for them to be promoted, 30.7% agreed that research outputs were important for their extra income, 44.0% agreed that research outputs were important for their recognition within the academic community, 41.3% agreed that research outputs were important if there was an opportunity to generate them and 26.7% agreed that research outputs were important if it was a requirement by University to generate them.

Industrial Involvement factors were found to influence Research outputs in selected public Universities in Kenya. 48.0% of the respondents indicated that they did not work with anyone from Industry during their research. 84.0% of the respondents agreed that university-industry collaborative research would enhance generation of research outputs in Universities. On incubation centres, 45.3% of the researchers strongly agreed that Incubation centres influence Research outputs, 28.0% agreed that Incubation centres influence their Research outputs, 18.7% were not sure, 4% disagreed while 4% gave no response to this question. On MoUs between Universities and Industry, 52.0% of the researchers agreed that MoUs between University and Industry enhance Research Outputs, 38.7% disagreed while 9.3% gave no response to this question.

Institutional Administrative Structures were found to influence Research Outputs in selected public Universities in Kenya. 34.7% of the researchers strongly agreed that University Policies influence research outputs, 32.0% agreed, 26.7% were not sure, 2.7% disagreed while 4.0% gave no response to this question. 38.7% strongly agreed that University Technology Transfer Offices influence Research Outputs, 32.0% agreed, 14.7% were not sure, 10.7% disagreed while 4.0% gave no response to this question. On training and sensitization on IPR, 40% of the Researchers agreed that training and sensitization on IPR influence Research outputs, 36.0% strongly agreed, 17.3% were not sure while 6.7% gave no response to this question.

5.3 Conclusions

The first objective of this research study was to determine how research funding influences Research Outputs in Selected Public Universities in Kenya. Majority of the respondents agreed that amount of funding and coordination of funding influence Research outputs in selected public Universities in Kenya. The second objective of this study was to establish how University Researchers characteristics influence Research outputs in selected public Universities in Kenya. Majority of the respondents agreed that reputation and recognition factors motivate University Researchers to generate research products as compared to financial factors.

The third objective of this study was to investigate how Industrial involvement influence Research outputs in Selected Public Universities in Kenya. Majority of the respondents agreed that linkage between University and Industry strongly influence Research outputs. The fourth objective of this study was to examine how Institutional Administrative Structures influence Research outputs of selected public Universities in Kenya. Majority of the respondents agreed that training and sensitization on IPR, technology transfer offices and development of policy on Commercialization influences Research outputs in Universities in Kenya.

The research findings indicate that Research outputs in selected public Universities in Kenya is influenced by Research Funding, University Researcher's Characteristics, Industrial Involvement, and by Institutional Administrative Structures. This research study attempted to examine research outputs in Kenyan Public Universities albeit to a small extent. More comprehensive research is necessary to provide a clearer picture of the status of Research outputs in Kenyan Universities.

5.4 Recommendations

1. Increasing research funding to Public Universities in Kenya beyond the final report.
2. University researchers should explore how their research can impact the economy as a way of giving back to the society and also how they can benefit through Commercialization.
3. Universities should support Researchers by creating linkages with Industry through formal collaborative research efforts.
4. University to Sensitize researchers on IPR and Commercialization of their Research Results and to enable them develop commercial products from their Research and move beyond publications and conference presentation stage.
5. Fast-track the development of a National Commercialization policy and guidelines touching on IP protection, ownership and benefit sharing of results policies to encourage Commercialization of publicly funded research through Kenya National Innovation Agency established by the ST&I Act, 2013 but which is not operational

5.4.1 Suggestions for Further Studies

Based on the findings and conclusions, the research study recommends the following areas for future studies;

1. Determinants of Commercialization of University Research Results in Public Universities in Kenya
2. The Influence of Academic Research on Economic Development in Kenya

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APPENDICES

APPENDIX I: Letter of Transmittal of Data Collection Instrument

Claris Awuor Adoyo
School of Distance and Continuing Education
University of Nairobi
P.O. Box 30197
Nairobi

Dear Respondent,

RE: REQUEST FOR YOUR PARTICIPATION IN A RESEARCH STUDY

I am a Masters student in the School of Distance and Continuing Education of the University of Nairobi. I am carrying out a research study on *Factors influencing Research Outputs in Public Universities in Kenya: The Case of Selected Public Universities* in partial fulfillment of the requirement for Master of Arts in Project Planning and Management.

As a recipient of Research Grants from NACOSTI, I am glad to inform you that you have been selected to form part of this research study. Therefore, I kindly request your assistance in completing the attached questionnaire which forms a major input of the research study.

I assure you that all the information and data you may provide will be treated with uttermost confidentiality and will only be used for the research study. I will follow up this email with a telephone call to confirm when you will have the questionnaire ready for collection. Your kind cooperation will go a long way in ensuring the success of this project.

Thanking you in advance,

Yours Sincerely,

Claris Adoyo
University of Nairobi

Encl.

APPENDIX II: Questionnaire for Public Universities Researchers

SECTION A: Demographic Characteristics of Respondents

Please tick where appropriate

- 1. Please indicate your gender: Male Female

- 2. What is your age bracket:
 Below 30 years 30-34 years 35-40years
 40-44 years 45 years and above

- 3. Indicate your highest academic qualification level
 Degree Masters PhD Diploma Certificate

- 4. Please indicate your research specialty
.....

- 5. How long have you been involved in research?
 Less than 1 year 1-5years 5-10 years over 10 years

- 6. Indicate when you received research funding from NACOSTI
.....

SECTION B: Amount of Research Funding

- 1. How much did you receive for your research project from National Commission for Science, Technology and Innovation(NACOSTI)
.....

- 2. In your opinion was this funding level enough?
 Yes No
 If your answer is No, Please explain
.....
.....

- 3. Does your University have Internal Monitoring & Evaluation mechanisms to ensure timely project implementation?
 Yes No

4. Were you able to complete your project in time?

Yes No

If your answer is No, Please explain why

.....
.....

5. Do you think the NACOSTI disbursement process is efficient?

Yes No

If your answer is No, Please explain

.....
.....
.....

6. Have you been able to translate your research results since completion of the research project into any products?

Yes No

If yes, please tick all as appropriate

- Publication Refereed Journal
- Textbook
- Policy Brief
- Conference presentation
- Patent
- Utility model
- Copyright
- Industrial design
- Trademark
- Business startup

Any other, please indicate.....

7. Please tick as appropriate

The Funding received was enough to cover all budget items	
The Funding received enabled me to translate research findings	
I used part of my research funding from NACOSTI to translate my research findings	
I received funding assistance from University to translate my research findings	

8. What advice or recommendation do you have on how to improve the disbursement process in future?

.....

SECTION C: University Researcher Characteristics

1. Have you commercialized your research results before? Yes No

If your answer is No, please proceed to Question 4

2. Do you think this experience would influence your commercialization efforts now or in the future?
 Yes No

3. How did you learn about Commercialization? Please select from the options below

Sensitization by University.....

Own Initiative.....

4. In a scale of 1-5, kindly indicate the extent to which the following factors influence Research Outputs of Universities in Kenya;

- 1. Very Low Extent
- 2. Low Extent
- 3. Uncertain
- 4. Great extent
- 5. Very great Extent

Knowledge on Commercialization and Entrepreneurial skills	
Funds set aside for Commercialization	
Policy compelling Researchers to Commercialize their Research Results	
Interaction with the Industrial/Business Sector	
University support to carry out Research	
University Intellectual Property Policy	

5. Rate the following reasons why you would generate research outputs according to your level of importance

1. **Not Important**
2. **Somewhat Important**
3. **Uncertain**
4. **Important**
5. **Very important**

For recognition and reputation	
For job satisfaction	
For extra income	
Requirement by University	
Opportunity to do so	
Promotion	

SECTION D: Industrial Involvement

1. Does your University have any formal linkage with the industrial sector towards supporting research outputs and commercialization?

Yes No

2. Does your University participate in joint/ collaborative research with the Industrial Sector?

Yes No

3. Does your University have a Technology Transfer Office?

Yes No

4. In your opinion, does the existence of the Technology Transfer Office encourage Commercialization of Research Results in your University?

Yes No

Please explain.....

.....
.....

5. During your research, did you work with anyone from Industry?

Yes No

6. Were all the needed equipments for your research available at the University?

Yes No

7. If No, please explain how you accessed them?

.....
.....

.....
.....
8. a) As a Researcher, do you think University-Industrial linkages have any influence on research outputs and Commercialization of University Research Results?

Yes No

b) How, please explain

.....
.....
.....
.....

SECTION E: Institutional Administrative Structures

1. Is there a policy to guide research outputs and Commercialization of Research results in your University?

Yes No

2. Is there Monitoring Mechanism within the University to ensure this is adhered to?

Yes No

3. How many teaching/research hours are allowed for University Researchers per week

i. Teaching hours.....

ii. Research hours.....

4. a) Do you think the time allocated for Research is enough?

Yes No

b) Why? Please explain.....

.....
.....

5. Are there any motivation/incentives offered by your University when you publish or acquire intellectual property of your research results?

Yes No

If yes please indicate

.....
.....

6. Do you think this could motivate more researchers to commercialize their Research Results?

Yes No

7. In a scale of 1-5, kindly indicate the degree to which you agree or disagree with the following statements on how your University can Increase research outputs and Commercialization of Research Results;

1. **Strongly Disagree**
2. **Disagree**
3. **Not sure**
4. **Agree**
5. **Strongly Agree**

Offer Incentives to Publish	
Pay for Patents developed by Researchers at University	
Provide Financial Support for Commercialization	
Develop policy on Commercialization	
Training and Sensitization on Commercialization and IPR	
Allocate enough time to Concentrate on Research	
Offer Incentives to those who have Commercialized their Research Results	
Monitoring to ensure all Researchers Commercialize viable Research Results	
Seek partnership with Industry to help in Commercialization efforts	
Establish well managed Technology Transfer Offices	
Establish Incubation Hubs/Centres	
Mainstream Entrepreneurial skills in University Curriculum	

Thank you for taking time to fill out this questionnaire.

