AN ASSESSMENT OF THE CONSTRAINTS TO UNIVERSITY - INDUSTRY COLLABORATION (UIC) INNIGERIAN CONSTRUCTION SECTOR

BY

Godwin ODAWN
P13EVBD8092

A DISSERTATION SUBMITTED TO THE SCHOOL OF POSTGRADUATE STUDIES, AHMADU BELLO UNIVERSITY, ZARIA

IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE AWARD OF MASTER OF SCIENCEDEGREE IN CONSTRUCTION MANAGEMENT

DEPARTMENT OF BUILDING,
FACULTY OF ENVIRONEMENTAL DESGN
AHMADU BELLO UNIVERSITY,
ZARIA, NIGERIA

APRIL, 2016

AN ASSESSMENT OF THE CONSTRAINTS TO UNIVERSITY - INDUSTRY COLLABORATION (UIC) IN NIGERIAN CONSTRUCTION SECTOR

BY

Godwin ODAWN, B.Sc. Building (Unijos) 2010
P13EVBD8092

A DISSERTATION SUBMITTED TO THE SCHOOL OF POSTGRADUATE STUDIES, AHMADU BELLO UNIVERSITY, ZARIA

IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE AWARD OF MASTER OF SCIENCE DEGREE IN CONSTRUCTION MANAGEMENT

DEPARTMENT OF BUILDING,
FACULTY OF ENVIRONEMENTAL DESGN
AHMADU BELLO UNIVERSITY,
ZARIA, NIGERIA

APRIL, 2016

Declaration

I declare that the work in this thesis entitled “An Assessment of the Constraints to University - Industry Collaboration (UIC) in Nigerian Construction Sector” has been performed by me in the Department of Building, Faculty of Environmental Design, Ahmadu Bello University Zaria. The information derived from the literature has been duly acknowledged in the text and a list of references provided. No part of this thesis was previously presented for another degreeor diploma at this or any other Institution.

ODAWN Godwin _____ _____

Signature Date

Certification

This thesis entitled “An Assessment of the Constraints to University - Industry Collaboration (UIC) in Nigerian Construction Sector” by GodwinODAWN meets the regulations governing the award of the degree of M.Sc. Construction Management of the Ahmadu Bello University, and is approved for its contribution to knowledge and literary presentation.

Dr.Shehu Muhammad	_____	_____
Chairman, Supervisory Committee	Signature	Date
M. Z. Muhammad_____	_____	
Member, Supervisory Committee	Signature	Date
Dr. D. Kado _____	_____	
Head of Building Department	Signature	Date
Prof. K. Bala	_____	_____
Dean, School of Postgraduate Studies	Signature	Date

Acknowledgement

All praises be to the Almighty God who has made it possible for me to successfully complete my pursuit for a Master Degree. First, I wish to express my sincere gratitude to my supervisors; Dr.Shehu Muhammad and M. Z. Muhammad, for their invaluable advice, constructive criticism and encouragement, which has led to the successful completion of this work. I am also very grateful to the entire members of staff of the Department of Building, ABU, Zaria, for their relentless support and to all those who took out timeoff their busy schedule to provide the data needed for this work; members of staffs, department of Architecture, Building/Quantity Surveying and Civil Engineering of University of Lagos and University of Nigeria Nsukka and every other persons who responded to my questionnaires and those who availed themselves for my interview questions. God reward you all.I must also thank my entire family for their unconditional support and prayers throughout the period of this research work. Finally, my appreciation goes to the entire members of my class, for their contributions and for making my stay worthwhile.

Dedication

This thesis is dedicated to my parents Mr. /Mrs. Emmanuel Odawn, for their relentless effort in encouraging, praying and supporting me through this programme. May God reward them abundantly in Jesusname.Ultimately, I dedicate it to God Almighty for the grace He supplied me throughout this work. I can never forget this I must confess as a matter of fact.

Table of Contents

Declaration ii

Certification iv

Acknowledgement v

Dedication vi

Table of Contents vii

List of Tables x

List of Figures xi

List of Appendices xii

Glossary of Acronyms xiii

Abstract xiv

1.0 INTRODUCTION 1

1.1 Background To The Study 1

1.2 Statement of Research Problems 4

1.3 Justification of the Study 5

1.4 Aim and objectives 7

1.4.1 Aim 7

1.4.2 Objectives 7

1.5 Scope and Limitation 8

1.6 Significance of the Study 8

2.0 LITERATURE REVIEW 9

2.1 Introduction 9

2.2 Nigerian Construction Industry 11

2.3 Overview of Global Historical Development of University-Industry Collaboration. 13
2.4 Reason for University-Industry Collaboration in Nigeria 14
2.5 Role of the University in Innovation Process 15
2.6 Role of Industry's Research and Development in Innovation Process 18
2.7.1 Benefits and drawbacks university-industry collaboration 21
2.7.2 Motivations for UIC 23
2.8 Formation Process of University-Industry Collaboration 24
2.9 Types of University-Industry Collaboration 25
2.10 Barriers to the Operation of University-Industry Collaboration. 28
2.11 Needs for Universities-Construction Industries Collaboration. 32
2.12 Keys to Collaboration Success 33
2.13 Getting Research into Practice 34
2.14 Steps of Technology (innovation) Commercialization 37
3.0 RESEARCH METHODS 39
3.1 Research Design 40
3.2 Data Collection 41
3.2.1 Questionnaire Survey 41
3.2.1.1 Sampling and sample size 42
3.2.1.2 Data collection instrument. 46
3.2.1.3 Reliability and validity of data: 46
3.2.1.4 Administration of questionnaire: 47
3.2.2 Interview 47
3.2.2.1 Sampling and sample size 47
3.2.2.2 Data collection instrument. 48
3.2.2.3 Administration of interview 49

3.3 Data Analysis 49

3.3.1 Data measurement approach 49

3.3.2 Relative importance index (RII).....49

4.0 DATA PRESENTATION, ANALYSIS AND DISCUSSION OF RESULTS.....51

4.1 Background Information 53

4.2 Adoption and awareness of Universities - Industry Collaboration in Nigerian Construction Sector.....54

4.3 Needs for UIC for the Industry and University. 57

4.4 Barriers to UIC in Nigerian Construction Industry 64

5.0 SUMMARY CONCLUSION AND RECOMMENDATION 69

5.1 Summary of Major Findings 69

5.2 Conclusion.....70

5.3 Recommendations 70

5.4 Contributions to Knowledge 71

REFFERENCE.....72

APPENDICES.....80

List of Tables

Table 2.1 Formation Process of University-Industry Collaboration …….24

Table 2.2 A Typology of University-Industry Links, from Higher to Lower Intensity….29

Table 2.3 Factors affecting University-Industry Collaboration ……....32

Table 3.1 Sample size of respondents for questionnaire across the Universities…..…....43

Table 3.2 Sample size of respondents for questionnaire in the Industry ……....44

Table 3.3 Sample size of respondents for interview across the Universities ……...47

Table 3.4 Guide to degree of significance ……...49

Table 4.1 Breakdown of Questionnaire ……....51

Table 4.2 Summary of Interview Analysis on the Status of UIC in Nigeria…….55

Table 4.3 Ranking of Needs for which Industry Seek for Collaboration with University 57

Table 4.4 Ranking of Needs for which Universities seek for Collaboration with Firms...59

Table 4.5 Ranking of Barriers to University - Construction Industry Collaboration…....64

List of Figures

Figure 3.1. Research Design ……... 40

Figure 4.1 Part of the Construction Sector where the Respondents work ……...52

Figure 4.2 Respondent's profession ……53

Figure 4.3 Correlation between the reasons for UIC for Industry and for Universities...61

List of Appendices

Appendix A Benefits and Drawbacks of University-Industry Collaboration UIC - - 76

Appendix B Motivations of University-Industry Collaboration UIC - - - 79

Appendix C Barriers to University-Industry Collaboration - - - - - 81

Appendix D Guide to HODS' Interview- - - - - - - 83

Appendix E Sample of Questionnaire - - - - - - - 84

Appendix F Result of Reliability Analysis - - - - - - - 86

Appendix G Published Table for Sample Size - - - - - 88

Appendix H Dollar-Naira Exchange Rate - - - - - - - 90

Glossary of Acronyms

A	- - -	-Ahmadu Bello University, Zaria.
CAC	- - - -	-Corporate Affairs Commission
COREN	- - - -	-Chattered Institute of Registered Enginneers
FCT	- - - -	-Federal Capital Territory
GDP	- - - -	-Gross Domestic Product
GNP	- - - -	-Gross National Product
ICT	- - - -	-Information and Communication Technology
IP	- - - -	-Intellectual Property
IPR	- - - -	-Intellectual Property Right
IT	- - - -	-Information Technology
L	- - - -	-University of Lagos, Lagos.
MIT	- - - -	-Massachusetts Institute of Technology
N	- - - -	-University of Nigeria, Nsukka.
NIA	- - - -	-National Institute of Architects
NIOB	- - - -	-National Institute of Builders
NIQS	- - - -	-National Institute of Quantity Surveyors
NUC	- - - -	-National Universities Commission
Ph.D.	- - - -	-Doctor of Philosophy
PPPs	- - - -	-Public Private Partnerships
R&D	- - - -	-Research and Development
RII	- - - -	-Relative Important Index
SD	- - - -	-Standard Deviation
SMEs	- - - -	-Small and Medium Enterprises
SPSS	- - - -	-Statistical Package and Service Solution
UIB	- - - -	-University's Innovation Broker.
UIC	- - - -	-University – Industry Collaboration
UILO	- - - -	-University - Industry Liaison Office
USA	- - - -	-United States of America

Abstract

This research work is on University-Industry research Collaborations in Nigeria. It focused on three objectives which are to establish the status of these collaboration in Nigeria, to evaluate the collaboration needs of the parties, and to assess the barriers to the collaboration. To achieve these, mixed research methods; quantitative and qualitative approaches were applied concurrently to collect data from a sample drawn from construction firms in fourfast developing cities in Nigeria and three top ranking universities in Nigeria according to NUC. The study discoveredbased on the response of the interviewees, that UIC in Nigeria is not only low in adoption but also in awareness as 75% of them attested to this fact. Solving specific technical or design problems and improving production process/product quality constitute the main reasons why the industry prefer to collaborate with university with RII = 0.80 and 0.76 respectively. While on the other hand, the university would rather collaborate with industry primarily to gain knowledge about practical problems useful for teaching and to test the practical application of one's own research/theory each with RII = 0.78 and 0.76 respectively. The potential areas of collaboration for both the university and industry includes areas concerning dealing with technical and practical problems, Knowledge transfer, and innovations.The high impact barrier to the collaboration according to the practitioners include inadequate resources having RII of 0.81. While Poor Leadership/Top management commitment and support towards partnership is the top ranked barrier to UIC with RII = 0.80. Construction practitioners and academics seeks collaboration for different interest, but, they tend towards common themes. Government should make UIC promoting policies that mitigates the barriers.

CHAPTER ONE

1.0 INTRODUCTION

1.1 Background To The Study

According to Altbach (2013),Universities serve as academic institutions committed to the creation and dissemination of knowledge, in a range of disciplines and fields, and featuring the appropriate laboratories, libraries, and other infrastructures that permit teaching and research at the highest possible level. In other words, it provides a conducive environment for research and development, teaching and learning, where staffs and students will interact and compete effectively with their counterparts globally. The creation of reliable and public knowledge is central to the growth of construction organizations, leading to support from government and organizations for research to expand the pool of economically useful knowledge(Geuna, Steinmeuller, and Salter, 2003). According to Abeda (2010), in the developed countries such as USA some of the most prestigious universities (e.g.Massachusetts Institute of Technology) were established more than one century ago to support close research relationships between university and industry. In some other countries such as Malaysia, these type of universities are referred to as research universities. This research relationship however, is essential in contributing to the technological development and innovations in the industrial sector and enhancing its global competitive capability. The industry on the other hand should be responsible in collaborating with university for adoption and practice of the new technological ideas generated by the University researchers. It should also be responsible in providing funds for and in most cases initiating these research operations.

However, according toSalter, Bruneel, and D'Este, (2009), Collaboration between industry and universities faces significant challenges including the fact that these organizations are driven by different incentive systems. Universities are driven primarily to create new knowledge,publish and educate, whereas private organizations are focused on capturing valuable knowledge that can be leveraged for competitive advantage,Dasgupta and David, (1994). They also claim that universities are becoming increasingly proactive managers of their collaborations with industry, seeking to create valuable Intellectual Property (IP) for themselves. Consequently, in many developed countries, more and more interactions between universities and industry are becoming subject to measurement and management, leading to more formal, contractual exchanges based on codified rules and regulations. This is significantly altering the nature of the interactions between universities and industry, which in the past has relied largely on informal relations. Although both of these aspects have been acknowledged in literatures on university-industry (U-I) linkages, relatively few studies have investigated the nature of the barriers to Universities-Industry Collaboration (UIC),(Hall, Link and Scott, 2003).

Private firms often conflict with university researchers over the topic of research, timing and form of disclosure of research results. While researchers may be keen to disclose information to gain priority, firms may wish to keep secret or appropriate the information. Brown and Duguid, (2000) asserted that Academics wish to create ‘leaky’ knowledge so that their ideas will be acknowledged by their peers while firms want the knowledge to be ‘sticky’ so that they can control a resource that is not accessible to their

competitors. University researchers are also likely to select research topics that are perceived by their peers to be interesting and valuable, while firms are likely to select topics and problems that are perceived as being valuable for the development of new products and services for their customers (Nelson, 2004). However, against this background of frequent fall back on the age-old norms and roles of these two entities, in developing nations, there is presently an increasing international competition and rapid technological changes. Governments becoming more actively involved in encouraging collaborations as a means of improving innovation efficiency and consequently enhancing increasing creation of wealth.

Tina, (2002)revealed that Collaboration between University and Industry provides companies with the means by which to advance technologically, at lower cost and with less inherent risk. It also provides access to a greater breadth and depth of knowledge and technologies than would normally be possible through internal development as well as additional public and private funding, and increasingly, licensing and patenting income for universities as a result of technology transfer activities. On the other hand, these considerable potential benefits are often not realized in practice. The major reason is that collaborations between these diverse organizations, need huge management effort in order to be successful (Dodgson, 1991). Given the substantial investment (both public and private) currently being made in collaborative research activities in some of the developed nations, it is clearly important to ensure that collaborations are managed effectively, and the benefit achieved maximized. According to Julio, Edward, Edward and William (2010), Universities can be major resources to company's innovation

strategy. Collaboration between university researchers and companies can result in project outcomes that have a major impact on a company's competitiveness or productivity.

Hence, the purpose of this research was to assess university-industry collaboration in nigerian construction sector in orther to identify the major obstructions to it and make appropriate recomendations. To fulfill this purpose, a quantitative research surveyed lecturers and practitioners in the northern and southern Nigeria.

1.2 Statement of Research Problems

Every year in Nigerian Universities, Research Institutes, even Polytechnics and colleges of Education, numerous researches and student projects are conducted and churned out. According to John (2007), typically, research is divorced from implementation, which has led to a growing need of literature about how to get research into practice. Some claim that the subjects researched on in the Universities are of no relevance to the industrial sector (Salter, *et al*, 2009).

According to Isa, Jimoh and Achuenu (2013), the econnomy of Nigeria has consistently remained weakand narrow for a number of years now.In 2012,1 USD = ₦155.9182 but on 3 November 2016, 1 USD = ₦ 314.2181in-between these times, the value of naira has consistently been falling. Primary production activities account for over 90% of foreign exchange earnings and 75% of employment (NPC, 2011). In contrast, secondary activities comprising manufacturing and construction, which traditionally have greater potential for employment generation, broadening the productive base of the economy and generating sustainable foreign exchange earnings and government revenues account for

mere 4.14 and 2.0% of gross output, respectively. Challenges such as thisis resolvable easily through research and innovations. This point to the need to establish or encourage strong links between the Academia and the Industrial sectorin Nigeria and to translate results of research into industrial processes. Giving significant attention to technological ideas and innovations through stimulating, funding and implementing important research projectshelps to fast-track the economic development of developing nations. This is in line with the assertion of Ahmad and Azhar, (2004)thata close collaboration of researchers and construction industry practitioners ensures that research results obtained is acceptable and applicable in industrial processes.

According to Abeda (2010), developing countries should promote relationships between university and industry and the important techniques should be adapted to evaluate the research collaboration that can identify those elements in which they are weak in order to stimulate innovations seeing that it is an important means to industrialisation which is a key to economic growth.The implication of lack of this collaboration is the converse of these benefits. Generally, it slows down industrialization and reduce the competitive performance of both parties

1.3 **Justificationof the Study**

Nigeria now is experiencing severe economic recession such as has not happened in the past twenty years. Part of the cause of this is traceable to the dependence on mono economic system. Government policy presently is encouraging a diversification of economy and industrialization is part of the solution to this economic problems. The construction industry is one of the major industries operating in the country and this

industry needsa high level of innovations. Partnership between university and industry has been considered as one of the main factors contributing to successful innovation and growth in the past two decades (Abeda, 2010). According to Kothari and Garg, (2014), Developing mechanisms of a University – Industry interaction programme helps the academia to get ideas from practitioners on what needs to be researched and taught, also help the practitioners to apply research done by the academics. This is to say, to increase the number of fundamental innovations and for the technological development, frequent collaboration and cooperation of university-industry is crucial. Without this link, the researcher will have no or little idea on the salient issues or needs of the industry that needs to be researched and thereby base their research on issues that are not really relevant to the industry which is detrimental to the economy.

There are severalbenefits that can be generated from these linkage. They fall under different category; Economic, (benefits that feed into the overall economy), Institutional, (those enjoyed by Universities and Industry),and Social (Benefits including those that 3relates to communal activity or promote sociability). These benefitscreatesbusiness opportunities,promote economic growth/enhancement of wealth creation, acquisition of or access to up-to-date equipment advancement of new technologies, servicesby the university to the community, enhancement of company's reputation by becoming more socially responsible business and lot more. According to Albert, B, J Mireia and M. Cornelia, (2010), financial rewards might even have a positive impact on the production of basic research because basic and applied research efforts might be complementary or because they might induce a selection of riskier research programmes..

Low level link between Universities and Industry results in drawbacks in various areas such as abandonment of long-term basic research in favour of results oriented, short term, applied research and technology transfer.

1.4 Aim and objectives

1.4.1Aim

The aim of this research is toassess the constraints toUniversity-Industry Collaboration (UIC) in the Nigerian Construction Industry with a view to enhancing research work in the University and improvingindustrialisation in Nigeria.

1.4.2Objectives

Inorderto achieve this aim, the following specific objectives have been set-up. Which are to:

1. Assess the adoption and awareness of university – Industry Collaboration in Nigerian Construction Sector.
2. Assessthe needs of the academics and practitioners forUniversity-Industry Collaborationin Nigerian Construction sectorand identify potential preferred areas for the collaboration.
3. Evaluate the barriers to Universities - Industry Collaboration in Nigerian Construction sector

1.5 Scope and Limitation

This study was restricted to data relatedto University-Industry Research Collaborations within the past ten years; between the years two thousand and six (2006)and two thousand and sixteen (2016).It was limited to only first generation federal universities and construction companies operating in four major cities in Nigeria – Lagos, Abuja, Port Harcourt, and Enugu.

The limitations of the study includes the fact that exploratory method were adopted and purposive sampling technique was also adopted which has a tendency of being bias, hence, care was taken in generalising the result.

1.6 Significanceof the Study

The findings of this study will redound to the benefit the society considering the fact that little or none of theconstruction related research output being turned out annually from our universities today across the nation are being adopted in the industrial processes and the major goal of any research venture is to solve one particular problem or the other.High impact research ventures as a matter of fact are usuallyfinancially demanding such that the researchers can barely meet up with the demand. The Nigerian construction industry ought to have become highly competitive in the international market today. The recession in the Nigerian economy today is a pointer to the need to boost industrialization and this is best achieved by enhancing university-industry collaboration state.The findings and recommendations from this research, adopted will help practitioners to derive the best from the academics and make more profit. It will enhance research work in the universities and also improve the nation's economy.Policy makers will be able to

make policies that diminish the major barriers to university-industry collaboration and researchers can identify knowledge gap for further research in this area.

CHAPTER TWO

2.0 LITERATURE REVIEW

2.1 Introduction

Universities-Industry Collaboration (UIC) refers to the interaction between any parts of the higher educational system and industry aiming mainly to encourage knowledge and technology exchange (Samuel and Omar, 2015). The collaboration defined by Winer and Ray (1994) is: "A mutually beneficial and well-defined relationship entered into by two or more entities to achieve results they are more likely to achieve together than alone." Successful collaboration includes several key elements. Collaboration should:

1. Be mutually beneficial-Successful Collaboration usually includes a "win-win" situation,
2. Be a well-defined relationship-Successful collaboration usually includes congruent expectations of all participants in terms of roles, guiding values and end-in-mind,
3. Include multiple entities-A successful collaboration recognizes the value of different perspectives and the importance of allowing for those differences,
4. Achieve results together that would not likely be achieved alone - Collaboration is work in and of itself. For it to be worthwhile, collaboration needs to result in greater benefits than costs. Remember, the whole is greater than the sum of the parts.

The collaboration is increasingly perceived as a vehicle to enhance innovation through knowledge exchange (Samuel and Omar, 2015). To increase the number of fundamental

innovations and for the technological development frequent collaboration and cooperation of university-industry is crucial. The importance of university-industry research collaboration has risen steadily as a consequence of growing complexity, risk and cost of innovation. The improvement in the relationship between science and technology, the integration of science and industry, the appearance of industries based on science, the use of science as a means to produce competitive advantages on the part of the firms, as well as the globalization of the economy and internationalization of technology, are some of the reasons which justify the cooperative relationship and strong collaboration between firms and research organizations (Winer and Ray, 1994). National economies somehow depends on research implication, that's why most nations reserve big amount of their annual budget for their education, especially on research aptitudes. A very huge number of research activities every year is going on in all developed and developing countries, but all the researches are not commercialized thus leaving some weaknesses on the university-industry collaboration (UIC).

The evaluation of university-industry collaboration and the maturity of any nation's technology transfer are no doubt very important and a powerful means discussed by practitioners as well as by scholars (Dorota, 2009). University research Centre is one of the most attractive external sources of technology for the industry, in an industrialized country; there exist a strong collaboration between university and industry to facilitate the exchange of technology (Dorota, 2009). The mere presence of traditional economics inputs of land, labour and capital is no longer enough to ensure economic growth in a nation. What is now important is the rationale application of these resources to productive

purposes by means of technology. Both the industrialized and developing nations recognize the fact that university- industry research collaboration plays a significant role in economic growth and the improvement of living standards of their countries. It is widely acknowledged that transfer of technology has played a key role in the economic and industrial development of any nation, (Thorpe and Ryan, 2006). Despite the great importance of university-industry collaboration, there have been some major constraints to successful collaborations. Therefore it is necessary for the developing countries to promote the relationship between University and Industry and should also identify and improve those elements in which they are weak, such as developing an appropriate industrial and technological infrastructure. As the matter of fact, the first generation of any commercialized product in infancy stage is always incubated in research centre and the final place just before commercialization is R&D of industries. University research is normally education based but industry demands commercial based research, thus most of the research seems to be useless and shelved in the library for the references leading towards the wastage of resources every year (Winer and Ray, 1994). To avoid such problems, we need strong collaboration. Periodically, evaluation of the research collaboration is also one of the key steps to strengthen the linkage. However other important techniques should also be adapted to develop their existing collaboration.

2.2 Nigerian Construction Industry

According to Mbamali and Okotie, (2012), Organized Construction Practice in Nigeria dates back to the 1930s when the very few construction activities of significance in the country were handled by the Public Works Department (PWD) and the Royal Army

Engineers which was later transformed into the Nigerian Army Engineers. Direct labour was the mode of construction project delivery at this time. Construction contracting in Nigeria began in the 1940s with a few British and Italian companies coming into operation (Olowo-Okere, 1985). Nigeria's independence in 1960 brought an upward trend in construction activities and until the late sixties, most of the available construction organizations were over-stressed with contracts. Idoro (2009), claim that Construction contracting in Nigeria witnessed an overwhelming upsurge during the "oil boom" of the 1970s and up to the end of the second republic in 1983, all through this period, Construction project depended heavily on the use of direct labour. The period also witnessed a high level of degeneration of standards in the project delivery process and lack of innovations.

Projects were poorly conceived, carelessly planned and shabbily executed. The result was unreasonably high time and cost overruns, low quality, process and widespread abandonment. Government reports commissioned in recent years identified such problems as poor rates of investment in research and development, fragmented supply chain and lack of coordination between Academia and industry in research activities as responsible for lack of innovation in the industry"(Dulaimi, 2002). The result is the delay of project execution and poor production quality and high level of difference between the designed and constructed products.

2.3 Overview of Global Historical Development of University-IndustryCollaboration.

Historically, University Researchers in developed countries have collaborated with industrial scientists on marketable projects. UIC have had a long history (Bower, 1993), (Oliver, 2004) as one means of building organizations' knowledge stock (Cricelli and Grimaldi, 2010). Of late, there has been a substantial increase in these collaborations in several developed nations including: Japan (Woolgar, 2007), Singapore (Lee and Win, 2004), and European Union Countries (Barrett, Austin and Mccarthy, 2000); (Gertner, Roberts and Charles, 2011); (Powers, 2003). This increase has been attributed to a combination of pressures on both industry and universities. News coverage at the turn of the twenty-first century might lead one to believe that this is a current phenomenon. However, science historians have traced collaborations between European companies and university researchers back to the 1800s(Jan, Blazej and Ewa, 2010).

Traditionally, industry sought partnerships with universities as a means to identify and train future employees. As global economies shifted, companies wanted access to faculty who created the cutting edge knowledge and technology central to university research. Knowledge creation and technology development require considerable capital investments, historically provided by Governments (Dorota, 2009). The interdependent research relationships between universities and companies enable both entities to sustain growth in their areas. While companies rely on university researchers for product innovations, faculty gain prestige through increased external research funds. Just as industry needs innovative ideas to ensure profits, researchers need additional research dollars to sustain faculty productivity (Mieczyslaw and Przempyslaw, 2009).

2.4 pReason forUniversity-Industry Collaboration in Nigeria

The partnership between (U-I) is considered as one of the main factors contributing to successful innovation and growth in the past two decades (Izaidin and Ismail, 2009). There is a growing need for collaborative research that addresses the complex questions that matter most in Nigeria. High quality innovative research in ICT has the potential to transform the Construction industry in Nigeria completely and can also address the complex and pressing issues that confront Nigeria today. These problems relates to Security, Graduate Employments,Food Security, e-government (automation of government operations and development of a unified government portals that brings together all tiers of government services), Power and Energy, Water, Infrastructure such as Roads, Rails and even Water transportation. Through collaborative research breakthrough in IT breakthroughs that can lead to public safety, new medical treatments, agricultural improvements, healthier foods and sustainable national development can be achieved.

According to (Ibidapo-Obe, 2014), one of the key reasons why this collaboration is important is that no one sector is a repository of all knowledge and skills. Modern research is increasingly complex and demands a wide range of expertise and experience. Thus, it is necessary to form research collaboration across the three sectors. Further, it is clear that the academia do not have the necessary financial muscle to fund high impact research efforts alone. The rising financial costs of conducting high quality research suggest the need to pool resources across sectors. This therefore calls for partnerships between the academia, the industry and even the government. Such collaborative efforts

would help in increasing the number, frequency and diversity of research endeavours to cater for the various segments of the society.

2.5 Role of the University in Innovation Process

According to Isabel, Rosane and Evando (2013), Universities are an important source of information for industrial innovation processes: a number of innovative firms rates university knowledge as a key factor in innovation process. Universities are particularly relevant source of knowledge for electronic equipment, instruments, chemicals, the pharmaceuticals, automobile, oil and coke, metals and beverages industries. The role of Universities in innovation includes but not limited to:

I. Research and Development: The way in which research and technology development is conducted in most countries is changing dramatically. Every year in and out of Nigerian Universities, Research Institutes, even Polytechnics and colleges of Education, numerous researches and student projects are conducted and are unfortunately churned out. One only needs to visit exhibition stands during convocation ceremonies to observe how many models and designs are displayed to convince sceptics of how much initiative is put into new innovations. In Building and construction, there are displays and researches into new techniques, processes, products, etc., and the long list from the Nigerian building and road research Institute is just an example (Ibidapo-Obe, 2014). Therefore, fundamentally important in our discussion is to define the platform for the development of a partnership between the industry and the research community, internationalization, the stronger emphasis on integrated topics and approaches as opposed to the traditional emphasis on technical

research, and the dominant role of electronic communication. There could be need for an ever growing emphasis on building and construction research and development (R&D) programs on topics related to information technology (IT) and sustainable construction. Unfortunately in Nigerian research institutes, companies, and universities active in the field of building and construction R&D, none is striving for active roles and more innovative attitudes concerning the development of a partnership between industry and the research community, and the development of international collaboration (Ifeanyi, 2010).

II. Commercializing Research Wisdom for Transformation: Whether one is working in the construction industry or teaching at the university, transferring new knowledge to a diverse group of people is the ultimate challenge. It is imperative that we learn how to implement this new knowledge to the academic student or the industry professional(Office of the Technology Commercialisation, University of Texas, 2015). An example of how to achieve educational success through academia to industry transfer is through short courses and continuous professional development where conventional classroom procedures are circumvented and some of the educational barriers by-passed. When companies are driven by competitive markets to keep cost down and investment low, only a few of the new research products are implemented. The incentives to implement and to make changes are not generally part of the company culture. Some school of thoughts have also been taking snipes at perceived difficulties caused by Codes and Standards. The systemic view of governmental regulatory organizations is to protect and the drive to protect has built-in barriers to notaccepting change. The proof that something will work usually rests

with the designer or builder who is attempting to implement. The buyer of the new innovation is the funding agent. The beneficiary of most changes is the user. This divided responsibilities and coordination of cost, benefits, and funding between players makes standardization a significant coordination barrier that the academia needs to take into consideration.

III. Information (Overload) Management: The overload of information relating to the Building and construction industry that are available makes identification, collection, distribution, and assimilation of new information almost an impossible task. The e-mail and web have added to the overload of data received from employees, customers, professional societies, the phone, and printed hard copy. How to Locate, Screen, and Selectthe appropriate information challenges industry and how to StreamlineInformation to the basics is an important area of attention for the academia especially in Nigeria where hardly much is available through local initiative(Anumba, Egbu and Carrillo, 2005). Most of our information and standards are actually from a collation of sources from different countries; in particular Britain, USA, Japan, Germany, Italy, etc. We have so much data that we cannot find what we need. The recognition that a local champion is needed to implement change may be the first organizational barrier. It appears that few companies have a formal system to introduce innovation into their company (Matawal, 2011). Many company cultures operate in a competitive market with a lean management style and under a compressed schedule. Changes are not promoted and may be resisted. An implementation program allows the introduction of new information and changes.

IV. Preparing Students for Leadership Roles:Great leaders move workers and inspire them to do their best. That said, it is important to prepare effective leaders for workplaces to empower and influence people to achieve business and team goals (eLearning Industry, 2015).There is no question that the construction industry needs leaders who are innovation inclined. Its greatest need is leadership, and its greatest need in the 21st century will continue to be innovative leadership. Where are the leaders going to come from, if not from the university construction programs? How are the university construction programs of the future going to prepare students for leadership in the industry? Do today's education systems instil the leadership qualities that will be required in the future? How do we measure what ought to be done to prepare for future leadership? According to

V. Teaching a Larger Number of Students and Practitioners**:** Construction management education must be made available to a larger audience, including full and part-time students, on- and off-campus students, and constructors who may not have direct access to a university campus. What are the best ways to use the internet, television, off-campus sites, and cable access to support construction education? (Matawal, 2011).

2.6 Role of Industry's Research and Development in Innovation Process

Osofisan (2007) stated that in many developing countries, the construction sector which the building industry belongs is one of the biggest contributors to the Gross National Product (GNP). Ukaegbu, (1991)asserted that Nigeria differs from the history of its counterparts in advanced countries particularly the west. While industries in the west aim

at generating, accumulating and reproducing capital, Nigerian industry is premised on "import substitution", whereby industrial equipment and raw materials are transported into Nigeria, installed and used for routine production activities, either by multinational corporations, the state, or indigenous private business men. Although Nigerian iron and steel industries were programmed to produce a mix of finished products, it was later realized that the programme did not include the production of sheet metal, an important component of the vehicle assembly industry (Ifeanyi, 2010). According to him, the implication of this singular omission for Nigeria is technological dependence through continued importation of finished parts. The construction industry plays a strategic role in the Nigerian Economy. The industry is unique in the sense that it is a major contributor to rest of the economy, which spurs the other industries to produce. According to Akindoyeni, (2004), "In the industrialized countries the construction industry can be responsible for up to 20% of the Gross Domestic Product (GDP) and employs up to 12% of the total labour force". He stated further that "Nigeria is striving to reach this happy state of affairs, but even at this sub-optimal state of development, the industry is responsible for 61% of the GDP and employs up to 20% of a labour force". This means it is a significant industry within the Nigerian economy. It is therefore, evident that the Nigerian construction industry is a large industry and does contribute largely to the economic growth of the nation but the elements, especially of materials and technology that make up the construction process are not proudly Nigerian.

The high rate of importation of construction materials and equipment and most times borrowed technologies reveal that innovation on these aspects are on the low level. Also

even in the management sector of the industry, especially as it affects information and communication, the use of IT is still questionable. (Osofisan, 2007), criticized the Nigerian construction industry to be one of the slowest to integrate technological advancement. She added that the issue of IT in the building industry is hence relatively limited compared to other sectors. She however acknowledged that IT implementation across all sector of the building industry may be more difficult than in other industries and thus advocated the need for innovation and process improvement in order to remain competitive in today digital economy. Construction projects require high integration of different people and professionals and this in turn demands heavy exchange of data and information between and among project participants on a daily basis. This makes the industry one of the most information intensive industry, requiring close coordination among a large number of specialized but independent organizations and individuals.

The issue of procurement of construction projects in Nigerian Construction industry has really not been supportive towards the march to innovation. Our method of procurement system is still of the old traditional method of procuring construction work. This method does not support or facilitate innovation and innovative integration into the industry. Nigeria should begin to think and research on these new innovative procurement methods. Environmentally, innovative issues are good on paper, but there is no actualization of its implementation towards construction process. There is a disturbing question of R & D in the industry. Most acclaimed R & Ds developed in the industry are innovations already developed and exhausted in other countries (Bako, 2005). A lot of factors have been identified as being responsible for all these drawbacks towards

innovation, ranging from political structure of the country, culture, system of government, lack of value and integrity, lack of investment in R&D, educational standards, poverty, government regulations etc. All these factors, one way or the other inhibit innovation in the Nigerian construction industry.

2.7 Benefits, Drawbacks and Motivations for University-Industry Collaboration

2.7.1 Benefits and drawbacks university-industry collaboration

Universities collaborating with industry has a lot of benefits. However, it has controversial side effects on the production of scientific research itself. (Nelson, 2004), contended that industry participation might delay or suppress scientific publication and the diffusion of preliminary results, endangering the "intellectual commons" and the practices of "open science" (Dasgupta and David, 1994). (Florida and Cohen, 1999), asserted that industry collaboration might come at the expense of basic research: growing ties with industry might be affecting the choice of research projects, "skewing" academic research from a basic towards an applied approach.

Faculties contributing to knowledge and technology transfer, on the other hand, maintain that industry collaboration complements their own academic research by securing funds for graduate students and lab equipment, and by providing them with ideas for their own research (Lee, 2000). Financial rewards might even have a positive impact on the production of basic research because basic and applied research efforts might be complementary (Thursby and Thursby, 2007) or because they might induce a selection of

riskier research programs (Banal-Estañol and Macho-Stadler, 2010). These claims bring forward two questions for empirical research:

1. Does collaboration with industry affect researchers' productivity in terms of publication rates?
2. Does collaboration with industry shift the focus away from basic research?

Previous research has investigated these questions using patents and licensing and the formation of start-up companies as measures of industry collaboration. Collaborative links through joint research, consulting or training arrangements are far more important transmission channels for the industry than patents, licenses and spin-offs (Cohen and Walsh, 2002).

Similar to any other type of inter-organizational relationship, UIC has its own benefits and drawbacks for both parties. Regarding benefits, several studies e.g. (Lee, 2000) have linked motivations to benefits subsequently realized in UIC. However, not all benefits could be signalled by the motivations. All realized benefits by universities and industry can be coded under three headings:

(i) Economic Benefits (i.e. benefits that feed into the overall economy);

(ii) Institutional Benefits (i.e. benefits derived by Universities and Industry); and

(iii) Social Benefits (i.e. benefits that relate to communal activity or promote sociability).

By contrast, several drawbacks have been identified in literature, where some researchers argue that although the benefits of UIC clearly outweigh any dangers, it is important for both the universities and industry, particularly the universities, to recognize the possible

drawbacks, so that protective action can be taken to put in place well-developed policies and administrative procedures (Harman and Sherwell, 2002) to mitigate against failure and ensure the success of the relationship. Importantly, the drawbacks have been classified into four categories considered to be apposite:

(1) Deviation from Mission or Objective;
(2) Quality Issues;
(3) Conflicts; and
(4) Risks.

This is shown in a tabular form in appendix A.

2.7.2 Motivations for UIC

Considering the work of Oliver, (1990), which suggested six critical likelihoods as generalizable determinants of inter-organizational relationships. These contingencies can be perceived as underpinning organizations' interest to interact with one another. Oliver noted that although each determinant alone was sufficient to cause a relationship formation, the determinants might also interact or occur concurrently when organizations decide to form an inter-organizational relationship. On the other hand, the six contingencies seemed to correlate very well with strategy motives for alliances (Kyrgidou and Spyropoulou, 2013). These likelihoods, therefore, were used to categorize the motivations for UICs identified from the studies. Although some of the motivations identified could belong to more than one determinant, they have been placed under the determinant as shown in the Table in appendix B.

2.8 Formation Process of University-Industry Collaboration

How are UIC formed and operationalized? Several models are presented in literatures on the process of UICs formation (Tuten and Urban, 2001). One model, which can be considered relevant for adaptation for UICs formation, is (Mitsuhashi, 2005) model for business-to-business alliance formation. He defines alliance formation in five steps, beginning with the definition of the alliance opportunities and ending with making the deal. A modified version of this model is presented in Table 2.3. The number of phases or steps that the formation of a particular organizational form of UIC would go through was found to depend on its degree of formality and complexity.

Table 2.1: Formation Process of University-Industry Collaboration

Stages	**Steps**
Formation process	
Stage 1: Partnership Identification	Establish the purpose, Obtain general knowledge of the capabilities of potential partners, Consider pre-existent relationships.
Stage 2: Make Contact	Identify prospective partners.
Stage 3: Partner Assessment and Selection	Objectively assess the strategic interests of the potential partners, Analyze actual versus professed capabilities of potential partners, Determine and organize the appropriate mix of partners, Choose the partners.
Stage 4: Partnership Negotiation	Define the partnership, Define and agree on the partnership's documented purpose or mission/vision, Determine the specific common goals/objectives for the particular effort, Define the organizational structure of the partnership, Define the management and administration of

	the partnership with clearly defined responsibilities, Agree on the plan, Specify the milestones, Identify the measures/indicators for success Specify the interim and/or final deliverables.
Stage 5: Agreement Signing	Preparation and signing of collaboration agreement and/or intellectual property agreement.

Source: Samuel and Omar(2015)

2.9 Types of University-Industry Collaboration

According toKoschatzky and Stahlecker(2010)**,** there are many types of University-Industry Collaboration, each having different objectives, Scopes and Institutional arrangements. Collaboration may be more or less intense and may focus on training or research activities. Collaboration may be formal or informal, from formal equity partnerships, contracts, research projects, patent licensing, and so on, to human capital mobility, publications, and interactions in conferences and expert groups, among others (Hagedoorn, *et al*, 2000). In the work of Blackman and Seagal, (1991), it was asserted that the task of creating a typology that shows all the possible links that could occur between universities and industry is an extremely tough one. However, according to University-Industry Liaison Office (UILO) (2015), University-Industry Collaboration can be categorized under the following;

1. Collaborative Research Agreements - Provide for the conduct of directed, collaborative, or joint research of mutual interest to the researcher and the company with shared rights and access to the results.

2. Grants-in-Aid-Are essentially donations to one or more researchers, normally to conduct research in an area that is of mutual interest to both the donor and the researcher.
3. Service Contracts - Are solely for testing, evaluation or analysis of materials or compounds owned by the Sponsor with no intellectual input or value-added by the University.
4. Research Agreements-Which may take the form of:
    (a) Investigator-Initiated Research Agreements; involving research using human subjects, where the protocol is produced by the Principal Investigator or
    (b) Sponsor-Initiated Research Agreements; which are a special form of Fee-for-Service Arrangement that involve a trial using human subjects.
5. Research Consortia - In which multiple member Companies work together with the University researchers to develop a research program or project and then share access to research outputs such as papers, reports and software.
6. Government and Non-Profit Contracts and Agreements - with legal terms and conditions in the form of contractual deliverables or intellectual property terms.

Research partners can also interact with the University expertise and personnel via:

7. Personal Consulting Arrangements; which are private arrangements between individual faculty researchers and a company on a fee-for-service basis; or
8. Student Educational Projects; which provide opportunities for industry to engage with undergraduate and graduate students in educational projects.

9. Student Co-ops and Internships; which provide valuable opportunities for students to get hands-on work experience and for industry partners to access talented personnel for short-term hiring periods (University-Industry Liaison Office (UILO), 2015).

According to Jose (2013). It is useful to differentiate between short-term and long-term collaboration. Short-term collaborations generally consist of on-demand problem solving with predefined results and tend to be articulated through contract research, consulting, and licensing. Long-term collaborations are associated with joint projects and public-private partnerships (including private-funded university institutes or chairs, joint university-industry research centres, and research consortia), often allowing firms to contract for a core set of services and to periodically re-contract for specific deliverables in a flexible manner. Longer term collaborations are more strategic and open-ended, providing a multifaceted platform where firms can develop a stronger innovative capacity in the long run, building upon the capabilities, methods, and tools of universities.

Table 2.2: A Typology of University-Industry Links, from Higher to Lower Intensity

High (Relationships)	Research partnerships	Inter-organizational arrangements for pursuing collaborative R&D, including research consortia and joint projects.
	Research services	Research-related activities commissioned to universities by industrial clients, including contract research, consulting, quality control, testing, certification, and prototype development.
	Shared infrastructure	Use of university labs and equipment by firms, business incubators, and technology parks located within universities.
Medium (Mobility)	Academic entrepreneurship	Development and commercial exploitation of technologies pursued by academic inventors through

		a company they (partly) own (spin-off companies).
	Human resource training and transfer	Training of industry employees, internship programs, postgraduate training in industry, secondments to industry of university faculty and research staff, adjunct faculty of industry participants.
Low (Transfer)	Commercialization of intellectual property	Transfer of university-generated IP (such as patents) to firms (e.g., via licensing).
	Scientific publications	Use of codified scientific knowledge within industry.
	Informal interaction	Formation of social relationships (e.g., conferences, meetings, social networks).

Source: Adapted from Perkmann and Walsh, (2007), Tables 2 and 3.

Santoro and Gopalakrishnan, (2000) however suggest four classifications for UICs, including:

1. Research Support (i.e. Endowment/Trust Fund),
2. Cooperative Research (i.e. institutional agreements, group arrangements, institutional facilities, informal Intentions),
3. Knowledge transfer (i.e. Hiring of Recent Graduates, Personal Interactions, Institutional Programs, Cooperative Education) and
4. Technology Transfer (i.e. Product Development and Commercialization Activities through University Research Centres).

2.10 Barriers to the Operation of University-Industry Collaboration.

Several factors that either facilitate or inhibit the operation of UICs are found in most of the literatures on University-Industry Collaboration (UIC)(Samuel and Omar, 2015) which confirmed the finding by many researchers that the literature on the factors that facilitate or inhibit UIC is indeed abundant (Salter, *et al*, 2009); (Cricelli and Grimaldi,

2010). The factors were found, if correctly managed, to have a positive effect on the perceived success of knowledge and technology exchange. On the other hand, where the same factors were neglected or mismanaged, there tended to be a corresponding negative impact on the perceived success of knowledge and technology exchange. These factors are summarized under the following seven categories or sub-headings as shown in table 2.5:

1. Capacity and Resources;
2. Legal Issues, Institutional Polices and Contractual Mechanisms;
3. Management and Organizational Issues;
4. Issues relating to the Technology;
5. Political Issues;
6. Social Issues; and
7. Other Issues.

The variety of factors confirmed Barnes, Pashby and Gibbons, (2002)'s view that the success of a collaborative project is governed by a complex interaction of factors as well as the cumulative result of negative and positive impacts from those factors. In addition, of the total number of the factors identified, there are more factors in the management and organizational category than in any one of the other categories, which agreed with Siegel in Siegel, Waldman and Link(2003) that organizational and managerial issues were critical factors that facilitate or inhibit such relationships between Universities and Industry.

Table 2.3: Factors affecting University-Industry Collaboration

Capacity and Resources	Adequate resources (funding, human and facilities) Incentive structures for university researchers Recruitment and training of technology transfer staff Capacity constraints of SMEs
Legal issues, and Contractual Mechanisms	Inflexible university policies including intellectual property rights (IPR), patents, and licenses and contractual mechanisms Treatment of confidential and proprietary information Moral responsibility versus legal restrictions (research on humans)
Management and Organization Issues	Leadership/Top management commitment and support Collaboration champion Teamwork and flexibility to adapt

	Communication
	Mutual trust and commitment (and personal relationships)
	Corporate stability
	Project management
	Organization culture (cultural differences between the world of academia and of industry)
	Organization structure (university administrative structure and firm structure)
	Firm size (size of organization)
	Absorptive capacity
	Skill and role of both university and industry boundary spanners
	Human capital mobility/personnel exchange
Issues Relating to the Technology	Nature of the technology/knowledge to be transferred (tacit or explicit; generic or specialized; academic rigor or industrial relevance)
Political Issues	Policy/legislation/regulation to guide/support/encourage UIC (support such as tax credits, information networks and direct advisory assistance to industry)
Social Issues	Enhancement in reputation/prestige
Other Issues	Low level of awareness of university research capabilities
	Use of intermediary (third party)
	Risk of research
	Cross-sector differences/similarities
	Geographic proximity

Source: Samuel and Omar, (2015)

However, (Abeda, 2010) Identified the following as the constraint of Universities-Industry Collaboration (UIC):- Education and training, Meeting with industry, Culture difference, Number of Memos sign per year, Communication Research agreement, Conflict of Intellectual property right, Laboratories facilities, Fund and Financial Matter, Trust between university and industry, Mission and goals, Consultancy, Completion of in-time Ph.D., Public Policies, Technical assistance, Time constraints, and Technological competencies.He further highlighted the following as the Tangible Outcomes: - Doctoral Thesis, Masters Dissertation, Commercialized Product, Licensed or non-Licensed Product, ISI Research Paper, Conference Research Paper.

2.11 Needs for Universities-Construction Industries Collaboration.

The reasons firms seek collaboration with university faculty are many and complex. The list below incorporates items that appear frequently in the literature on university-industry collaboration.

1. To solve specific technical or design problems
2. To develop new products and processes (innovation), (Bercovitz and Feldman, 2008).
3. To conduct research leading to new patents
4. To improve product quality
5. To reorient R&D agenda
6. To have access to new research via seminars and workshops.
7. To maintain an ongoing relationship and network with the university
8. To conduct ‘‘blue sky’’ research in search of new technology(D'Este & Perkmann, 2010)
9. To conduct fundamental research with no specific applications in mind
10. To recruit university graduates (Yong, 2000).

The reasons why Universities Collaborates with Industry includes;

1. To supplement funds for one’s own academic research
2. To test the practical application of one’s own research and theory(D'Este & Perkmann, 2010)
3. To gain insights in the area of one’s own research
4. To further the university’s outreach mission

5. To gain knowledge about practical problems useful for teaching
6. To create student internships and job placement opportunities
7. To secure funding for research assistants and lab equipment(D'Este & Perkmann, 2010)
8. To look for business opportunity (Yong, 2000).

2.12Keys to Collaboration Success

I. Define the project's strategic context as part of the selection process.
   1. Use your company research portfolio to determine collaboration opportunities.
   2. Define specific collaboration outputs that can provide value to the company.
   3. Identify internal users of this output at the working level; executive champions are not a substitute for this requirement.

II. Select boundary-spanning project managers with three key attributes:
   1. In-depth knowledge of the technology needs in the field
   2. The inclination to network across functional and organizational boundaries
   3. The ability to make connections between research and opportunities for product applications

III. Share with the university team the vision of how the collaboration can help the company.
   1. Select researchers who will understand company practices and technology goals.
   2. Ensure that the university team appreciates the project's strategic context.

IV. Invest in long-term relationships.
   1. Plan multiyear collaboration time frames.

2. Cultivate relationships with target university researchers, even if research is not directly supported.

V. Establish strong communication linkage with the university team.

1. Conduct face-to-face meetings on a regular basis.
2. Develop an overall communication routine to supplement the meetings.
3. Encourage extended personnel exchange, both company to university and university to company.

VI. Build broad awareness of the project within the company.

1. Promote university team interactions with different functional areas within the company.
2. Promote feedback to the university team on project alignment with company needs.

VII. Support the work internally both during the contract and after, until the research can be exploited.

1. Provide appropriate internal support for technical and management oversight.
2. Include accountability for company upptake of research results as part of the project manager role (Julio, *et al*, 2010)

2.13Getting Research into Practice

When a new technology appears out of research work, and common sense along with testing validates its value, why is it not adopted quickly? Well, it appears there is no cogent reason (Robert, 2013). If a technology innovation (the two words can be used interchangeably because a new technology is actually an innovation) is truly disruptive, it can be resisted for any reason really. Disruption brings some discomfort, yet intuitively,

change will happen. The only choice really is how to go about implementing the new technology and manage it. It is better to take a barrier roll call and deal with each as best as possible.There are some barriers to the adoption of technology and innovation in both public and private organizations that must be well managed in getting research into practice. According to Darrel L Butler andSellbom in (Darrel and Sellbom, 2015). The issue of adoption of any new technology does come down to a comparison of costs and benefits, however that evaluation is thereby impacted by specific drawbacks that create a chasm, a seemingly huge gap or barrier that impedes progress. These barriers includes:

1. Lack of leadership/support for innovation
2. Comfort level – effect of disruption
3. Time to make changes and adjust
4. Understanding of and ability to implement
5. Social implications – changes in collaboration communication styles
6. Current processes or procedures
7. Budgetary priorities
8. Difficulty/availability/time for training
9. Resistance to learning new technology
10. Work stress/overload
11. Cost
12. Proof of value
13. Reliability – will it continue to provide value?
14. User acceptance
15. Performance.

Other barriers according to Jeffrey, (2011)includes:

16. Ideas don't solve an important problem for a customer
17. Ideas take too long to get to market/Shifts in needs
18. Ideas underfunded or poorly launched
19. Ideas require too much work to adopt.

These barriers should be properly managed to enhance innovation diffusion and adoption. According to (John, 2007), generally, in getting research into practice it is imperative to start by First, Getting Practice into Research,to ensure the relevance of the researches carried on practical issues. He then claimed that discovering ways to increase access to and delivery of interventions is a major challenge. Research is not naturally implemented. However, operational research is best prioritized, designed, implemented and replicated from within national programs. The current model for most international service research is based on the assumption that the research Community discovers solutions and then tries to market them to busy decision-makers and practitioners. The problem of failing to get research into policy and practice is well known. Much debate focuses on the effectiveness of different approaches to dissemination and behaviour change (Bero, et al., 1998); (Siddiqi and Robinson, 2006) etc. This is a significant issue when trying to influence individual practitioners. Another focus is on developing the capacity of research institutions in developing countries, with the expectation that this will increase the relevance and local Ownership of results (Sitthi-Amorn and Somrongthong, 2000). These two approaches are necessary but not sufficient. The aim should not be to perfect techniques of feeding results to decision-makers, but to start from the perspective of the decision-makers even before devising the questions. This means “getting practice into

research". This approach however, is not appropriate for research into new and untried practice where efficacy has not been established, but should become the norm for operational research, by which we understand research into how an intervention is implemented.

2.14Steps of Technology (innovation) Commercialization

Step1: Research leading to new technology**:** - Observations and experiments during research activities often lead to discoveries and inventions that may have commercial applicability.

Step 2: Disclosing an Invention

The discoveries and inventions are formally disclosed by the inventors submitting a confidential Invention Disclosure form to University's Innovation Broker (UIB). Meaning there should be a channel through which these inventions are diffused – (UIB)

Step 3: Market assessment

University's Innovation Broker (UIB) assesses a disclosed invention and develops a preliminary commercialization strategy. Based on this assessment, the University's Innovation Broker (UIB) determines whether to assert the university's rights in the disclosed invention. The assessment and determination is performed in conjunction with inventors, outside counsel, and/or advisors as appropriate.

Step 4: Patenting and other legal protection

If the university's rights are asserted in an invention that appears suitable for patenting, the University's Innovation Broker (UIB) will engage outside counsel to pursue patent

protection for the invention. When appropriate, the university may utilize copyright, trade secret, or trademark rights to commercialize university inventions or works of authorship.

Step 5: Prospecting

The University's Innovation Broker (UIB) proactively approaches companies, entrepreneurs, and investors who have been identified as potentially suitable partners to bring the technology to market. The University's Innovation Broker (UIB) also showcases available technologies online and at appropriate conferences. In addition, faculty publications, presentations, or academic renown may result in third-party licensing interest.

Step 6: Negotiation/due diligence

According to the Office of Technology Commercialisation, University of Texas, (2015), marketing activities may result in one or more parties requesting an in-depth examination of the technology. This can involve signing a non-disclosure agreement and additional discussions with the inventors. Interested prospects will present a plan for commercial-ization and negotiate business terms with University's Innovation Broker (UIB).

Step 7: Licensing

When the university and the commercialization partner are ready to move forward, the University's Innovation Broker (UIB) prepares legal agreements to reflect the business terms negotiated. When the agreements are signed by either parties, the start-up or licensee has the right— and obligation—to commercialize the invention. Compensation varies and may involve fixed fees, milestone fees, royalties, equity, and other forms of

consideration. Compensation is shared with inventors in accordance with university policy.

Step 8: Commercialization and Revenue

The path to commercial markets will vary, depending on the nature of the invention, the market it is addressing, and the invention's stage of development. Under the terms of the agreement, the commercialization partner provides regular progress reports to the university on its commercialization activities (Office of the Technology Commercialisation, University of Texas, 2015). The inventors may continue to be involved in development activities with the commercialization partner.

CHAPTER THREE

3.0 RESEARCH METHODS

3.1 Research Design

This is the arrangement of conditions for collection and analysis of data in a manner that aims to combine relevance to the research purpose taking cognizance of economy andtime(Kothari & Garg, 2014).In essence it represents the conceptual structure within which the research is conducted; a blueprint for the collection, measurement and analysis of the data.

Thisresearch work is intended to assess the constraints tocollaboration between university and construction industry in Nigeria. To achieve this, mixed method of data collection was adopted;that is the use of interview and questionnaire survey. The two methods are considered suitable for the study because they provide awider range of data on the issue in question for the study than making use of a single method. Both methodswere carried out concurrently. That is to say, while the interview process was ongoing, the questionnaire administration was also being carried out. This is represented inFigure 3.1

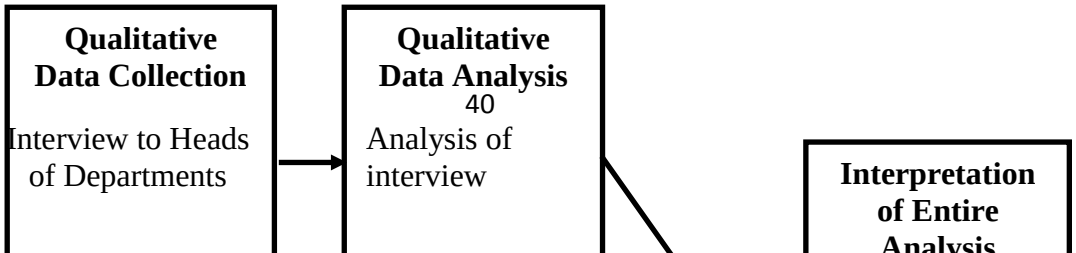


Figure 3.1. Research Design

3.2 Data Collection

Two methods have been used to collect the data in this study. These includes questionnaire survey and interview. Each of the methods were used to achieve a specific objective. Detail of the data collection methods are described in the following sub-sections:

3.2.1 Questionnaire Survey

The study was designed such that questionnaire survey will take care of the second and the third objectives which are to investigate the reasons for UIC identifying the potential preferred areas for the collaboration, and to evaluate the barriers to UIC in Nigeria.

3.2.1.1Sampling and sample size

The populationfor this study consist of two groups of respondents (the Lecturers and practitioners in the construction sector). The respondents in the academia includes lecturers in departments of Building, Architecture, Civil Engineering and Quantity Surveying in University of Lagos, University of Nigeria Nsukka, and Ahmadu Bello University Zaria. While those in construction industry includestop management of the construction firms in Abuja, Lagos, Enugu and Port-Harcourt. Details of the reasons for these selections are shown in the sub-sections bellow. The required sample size depends on two key factors; the degree of accuracy necessary for the sample and the degree to which there is variation in the population with respect to the mainfeatures of the study. The final sample size was therefore a compromise between cost, accuracy and ensuring sufficient numbers for meaningful analysis. Following these facts, random sampling technique was used in determining the sample for the Lecturers and the practitioners. The detail of this is discoursed separately for the academia and the Industry below.

Academia:Three Nigerian Universities (University of Lagos, University of Nigeria Nsukka and Ahmadu Bello University Zaria) were selected for the study. The selection of these universities was influenced by three factors such as; their geographical locations in the six geo-political zones, their rank among the top ten Universities in NUC's 2015 ranking of Universities, and their research capacities as federal universities. According to Glenn (1999). There are several approaches to determining sample sizes for quantitative data. These include using a census for small populations, imitating a sample size of similar studies, using published tables, and applying formulas to calculate a sample size. The sample size for this study was determined by applying Kish formularstated in

Agbodjah(2008) and was validatedusing published table2 by Yamane, (1967)in Glenn, (1999). A sample of this is shown in appendix G.Kish formula states that:

$$n = \frac{M}{1 + \frac{M}{N}} \qquad \text{eq. 1}$$

Where n = Sample Size

N = Total population

$$M = \frac{S^2}{V^2} \qquad \text{eq. 2}$$

Where V is the standard error of the sampling distribution and

S is the maximum standard deviation of the population element

$$S^2 = P \times (1 - P) \qquad \text{eq. 3}$$

P is the proportion of population elements belonging to the defined class.

Using a total error of 0.1 at 95% confidence interval,

V is 0.05 and P is 0.5;

$S^2 = 0.5 \text{ X } (1 - 0.5) = 0.25$

$$M = \frac{0.25}{0.05^2}$$

Hence M = 100

$$n = \frac{M}{1 + \frac{M}{N}}, \quad = \frac{100}{1 + \frac{100}{332}} = \frac{100}{1.30} = 77$$

Adding 10% for non-responsiveness; = 77+7.7 =85

Hence, for the Universities, the sample size (n) = 85. The detail is shown in table 3.1.

Table 3.1 Sample size of respondents for questionnaire across the Universities

UNIVERSITY	**DEPARTMENT**	**LECTURERS**		
		No. of Academic Staff	Sample Size (No. of Questionnaire Distributed)	Percentage (%)
"Abu Zaria"	Building	26	7	7.83
	Architecture	52	13	15.66
	Quantity Surveying	30	8	9.04
	Civil Engineering	32	8	9.64
Sub Total		**140**	**36**	**42.17**
"Unilag"	Building/Quantity Surveying	35	9	10.54
	Architecture	42	11	12.65
	Civil Engineering	34	8	10.24
Sub Total		**111**	**28**	**33.42**
"UNN"	Architecture	48	12	14.46
	Civil Engineering	33	9	9.94
Sub Total		**81**	**21**	**24.40**
TOTAL		**332**	**85**	**100.00**

Industry:Likewise in the samplingof respondent from construction companies, four cities (Abuja, Lagos, Enugu and Port Harcourt) were selected due to the high development

activities in the cities and their proximity to the three universities selected. The population of the registered construction companies in the four cities according to CAC in 2012 is six thousand four hundred and sixty-five(6465). Three thousand four hundred and nine(3409) of the companies are in Lagos, one thousand nine hundred and eleven (1911) are in Abuja, seven hundred and ninety-one (791) are in Port Harcourt while three hundred and fifty four (354) are in Enugu.The sample size was obtained fromthepublished table by Yamane (1967) in Glenn (1999)shown in appendix G (Industry).The sample size corresponding to the population is 98. Adding ten percent for non-responsiveness gives 98 + 9.8 = 108. The respondents includes top managementof the companies selected in the four cities. Random sampling technique was adopted. The detail of this is shown in Table 3.3.

Table 3.2Sample size of respondents for questionnaire in the Industry

Location (Cities)	Number of Firms	Sample Size	Add 10% for non-responsiveness
Lagos	3409	52	57
Abuja	1911	29	32
Port-Harcourt	791	12	13
Enugu	354	5	6
Total	**6465**	**98**	**108**

The sample size of ninety-eight was distributed proportionately as shown in the table. The total sample size of questionnaire for both the Academia and Industry is one hundred and ninety three(193)in whichthe questionnaires were distributed to both Lecturers in the Universities and Managers of the Construction Companies.

3.2.1.2Data collection instrument.

A structured questionnaire consisting of closed ended questions was developed for the study.Five point Likert Scale was used for ranking of the items in which 1 stands for strongly disagree (or not a factor), 2 stands for disagree (of low effect), 3 stands for indifferent (of moderate effect), 4 stands for agree (of high effect), 5 stands for strongly agree (of extreme effect). They were administered to Lecturers in the Universities and Managers of the construction companies.

3.2.1.3 Reliability and validity of data:

The reliability analysis of the data was carried out using SPSS. For a research data to be considered reliable, the Cronbach's Alpha value should be greater or equal to 0.7. According to Mohsen and Reg (2011), there are different reports about the acceptable values of alpha, ranging from 0.70 to 0.95. A low value of alpha could be due to a low number of questions, poor interrelatedness between items or heterogeneous constructs. However, giving a Cronbach's Alfa value is 0.827 and 0.887 for the Industry and University respectively, the data for this study can be said to be reliable. The result of the reliability analysis is shown in Appendix F.

In order to ensure the validity of the data, the questionnaire was subjected to series of criticism and correction by the supervisory committee and some senior lecturers from the department of Building and Quantity Surveying, Ahmadu Bello University, Zaria.

3.2.1.4 Administration of questionnaire:

The form of administration of the questionnaire to the respondents by the researcher was majorly by hand and face to face with the respondents during which the researcher took time to explain to the respondents what was required of them and how they were to respond to the questions and collected the questionnaires back by hand. The researcher also administered some of the questionnaires via email and received them back via the same medium.

3.2.2 Interview

The study was designed such that semi structured interview method was adopted in collecting qualitative data to take care of the second objective which is to establish the current status of UIC in Nigerian Construction Industry. The detail on this choice of approach is given in the succeeding subsections.

3.2.2.1 Sampling and sample size

Purposive sampling technique was adopted and the population for the interview includes the HODs of the departments of Building, Architecture, Quantity Surveying and Civil Engineering in University of Lagos, University of Nigeria Nsukka and Ahmadu Bello University Zaria. The choice of the HODs is owing to the fact that they should be aware of any past or existing linkages at least at the level of the departments.The sample size for the interview isnine because the total number of these departments in the three universities are nine. The detail of this is shown in Table 3.2.

Table 3.3 Sample size of respondents for interview across the Universities

University	Departments	No of Interviewee
Ahmadu Bello University Zaria	Architecture	1
	Quantity Surveying	1
	Civil Engineering	1
	Building	1
Sub Total		4
University of Nigeria Nsukka	Civil Engineering	1
	Architecture	1
Sub Total		2
University of Lagos	Building/Quantity Surveying	1
	Architecture	1
	Civil Engineering	1
Sub Total		3
Total		**9**

3.2.2.2 Data collection instrument.

A Semi-structured Interviewguide was developed and used for the quantitative data collection. The characteristics of semi-structured interviews are: The interviewer and respondents engage in a formal interview, secondly, the interviewer develops and uses an interview guide being a list of questions and topics that needs to be covered during the conversation, in a particular order.A sound recorder was used for recoding the conversation with the interviewee's consent.

3.2.2.3Administration of interview

The researcher conducted the interview face to face with the respondents with the aid of an assistant helping to write down the response. A recorder was also used to capture the response. However, this was done with the permission of the respondents.

3.3 Data Analysis

The data generated in the studyare presented using tables and charts showing frequencies and percentages where necessary to enable the result to be properly understood and evaluated. The data analysis was carried out using descriptive analysis with the aid of relevant computer packages.

3.3.1 Data measurement approach

Data Measurement is defined as a process of associating numbers or symbols to observations obtained in the study. The study adopted both qualitative and quantitative data approaches. The quantitative data approach considered the mean, standard deviation, etc. Which will be computed for quantitative characteristics, while on the other hand, Qualitative data was collected and onlycounted and analysed but not computed. Qualitative data approach was used to establish the status of UIC. While quantitative approach was adopted in evaluating the reasons for which the two parties would want to collaborate as well as the factors affecting the collaboration.

3.3.2 Relative importance index (RII)

Relative importance index was used in the analysis to rank the constraint of the collaboration and the reasons for the collaboration.

Relative Importance Index (RII)$= \frac{\sum fx}{\sum f} \times \frac{1}{k}$

Where,

∑fx = is the total weight given to each attributes by the respondents.

∑f = is the total number or respondents in the sample.

K = is the highest weight on the likert scale.

Ranking of the items under consideration will be based on their RII values. The item with the highest RII value will be ranked first (1) the next (2) and so on.

The rating of all the factors for degree of significance will be based on the value of their respective relative importance index (RII). The guide for the rating is given in Table 3.1:

Table 3.4 Guide to degree of significance

Degree of significance	**Rating**
Very significant	0.76 above
Significant	0.67-0.75
Fairly significant	0.45-0.66
Not significant	0.44 below

Source: (Vanduhe, 2012)

CHAPTER FOUR

4.0 DATA PRESENTATION, ANALYSIS AND DISCUSSION OF RESULTS

This chapter deals with presentation and making sense out of the data derived from study. The data is presented using tables and charts, showing their frequencies, percentages, mean, standard deviations, relative importance index and their rank and are subsequently analysed and discoursed.Table 4.1 shows a summary of the questionnaires distributed and returned.

T

able 4.1 Breakdown of Questionnaire

UNIVERSITIES		**RESPONDENTS**	
	Departments	Number of Questionnaire Distributed	Total Number of Questionnaires Properly Filled and Returned
"Abu Zaria"	Building	7	
	Architecture	13	
	Quantity Surveying	8	
	Civil Engineering	8	
Sub Total		**36**	**29**
"Unilag" Lagos	Building/Quantity Surveying	9	
	Architecture	11	
	Civil Engineering	8	
Sub Total		**28**	**20**
"UNN" Nsukka	Architecture	12	
	Civil Engineering	9	
Sub Total		**21**	**13**
Total for University		**85**	**62**
INDUSTRY (Construction Firms) A	Locations (Cities)	Number of Questionnaire Distributed	Total Number of Questionnaires Properly Filled and Returned
s	Lagos	57	27
	Abuja	32	17
	Port-Harcourt	13	9
s	Enugu	6	6
Total for Industry h		108	**59**
GRAND TOTAL o		**193**	**121**

wn in the table, One hundred and ninety three (193) questionnaires were administered, one hundred and twenty one (121) were returned properly filled and valid making up to sixty three percent of the number distributed. Based on the assertion of Moser &Kalton (1971), the result of a survey could be considered significant if the response rate is not

lower than 30-40%. Therefore, the percentage of the returned questionnaire is considered adequate for analysis.

4.1 Background Information

This sub-section shows the general information and detail about the respondents that provided the data for this study. The first part shows the section where they work while the second part shows their professions.

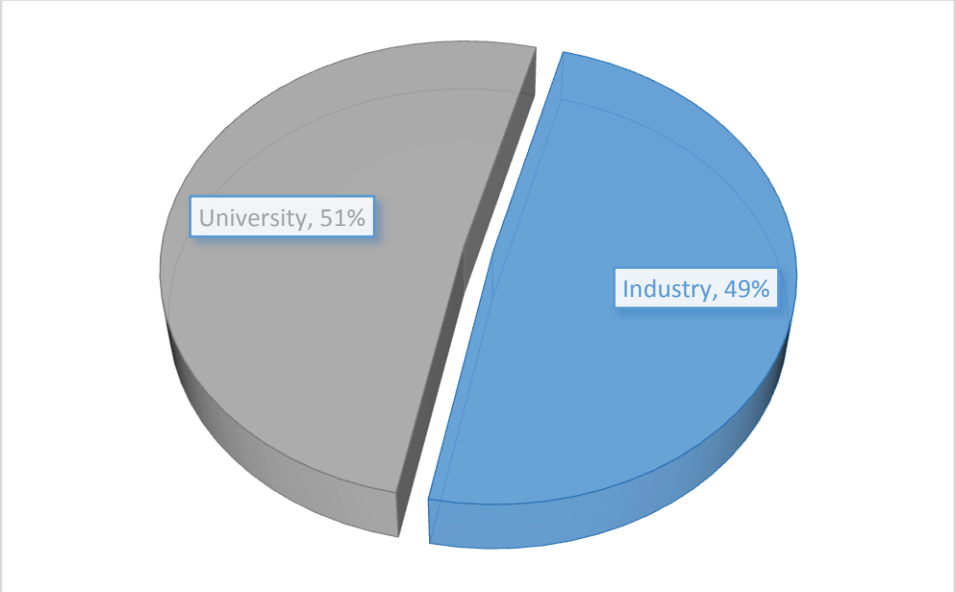


Figure 4.1 Part of the Construction Sector where the Respondents work

Figure 4.1 shows the section of the construction sector where the respondents work, fourty nine percent of the respondents are in Industry while fifty two percent are in Academia.

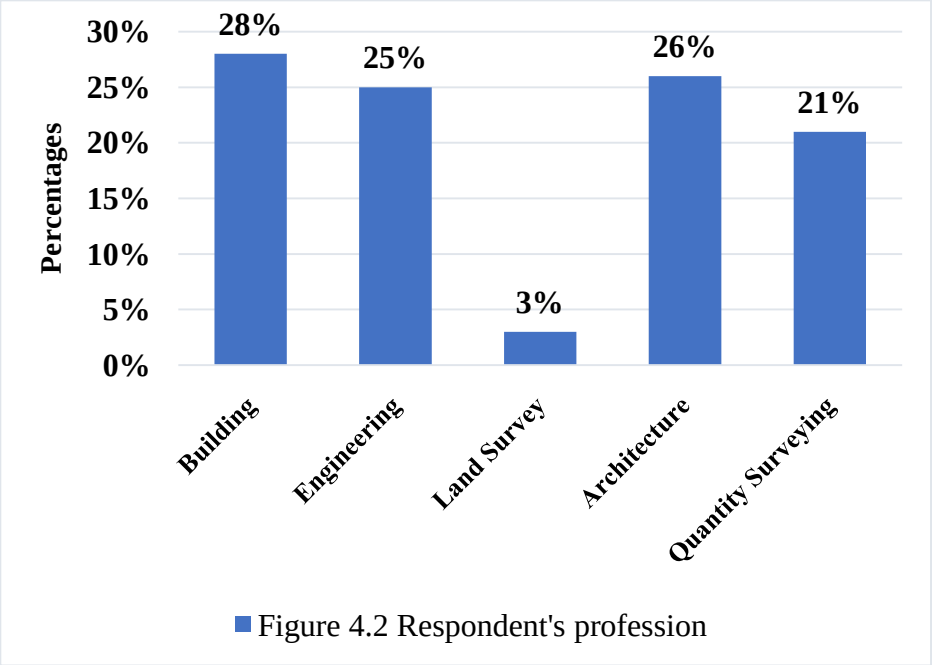


Figure 4.2 Respondent's profession

Figure 4.2 shows the various profession of the respondents. As shown in the figure, twenty eight percent of the respondents were Builders, twenty five percent were Engineers, three percent were Land Surveyors, twenty six percent were Architects, and twenty one percent were Quantity Surveyors.

4.2 Adoption and awareness of Universities - Industry Collaboration in Nigerian Construction Sector

The data collected from the interviewees based on their perspectives on the adoption of UIC is analysed in this section to establish the current adoption of University-Industry Collaboration (UIC) in Nigeria's Construction Sector. The detail of the interviewees is shown in table 3.2. Table 4.5 shows a summary of the result of the interview.

(i) Existence of Collaboration

This theme is on the existence of collaborative experience. Majority of the participants; seventy five percent (75%) emphasized the fact that they have had no experience of such

kind of collaboration. Twenty-five percent (25%) of the participants claimed that they have had/having collaborations with their counterparts in the industry. However, a further probe revealed that not all were research collaborations but other kinds of collaboration also.

(ii) Objective of the Collaborations

Out of the twenty-five percent (25%) that claimed to have had collaboration experience, only twelve and a half (12.5%) have had research collaboration in the past. However, it was an international research partnership.

(iii) Impetus for the collaboration

The twenty-five percent (25%) of the respondents that have had collaboration experience in the past were further asked about what the stimulus for the collaboration was. For the first half it was the department that initiated the collaboration while for the second half, it was an external body (a practitioner).

(iv) Current Practice of University-Industry Collaboration in Nigeria

This theme is on the general practice of UIC nationwide. Majority of the participants, seventy five percent (75%) opined that research collaboration is not a household concept. A lot of people are not acquainted with the operation of the concept.

S/N	Themes	Responses								f	Percentage of Response	
		A_1	A_2	A_3	A_4	N_5	N_6	L_7	L_8		Positive	Negative
1	Existence of Collaboration Experience	×	✓	×	×	×	✓	×	×	8	25	75
2	Objective of the Collaboration	–	OC	–	–	–	RC	–	–	2	12.5	12.5
3	Impetus for the Collaboration	–	DP	–	–	–	IND	–	–	2	12.5	12.5
4	Current adoption of UIC in Nigeria	×	✓	×	×	×	×	×	×	8	12.5	87.5

Table 4.2 Summary of Interview survey on the adoption of UIC in Nigeria

NB: × = Negative response, ✓= Positive response, - = Nil, f = Frequency of Response, OC = other kind of collaboration, RC = Research Collaboration, DP = The Department, IND = other individual, A1, A2, A3, A4, N5, N6, L7 and L8 are the departments the interview were conducted.

Therefore, from the response of the respondents interviewed; on the "existence of collaborations" in Nigeria (currently or in the past); twenty-five percent (25%) of the interviewee gave a positive response, while seventy-five percent (75%) opined that it does not exist. On the "objective of the Collaborations"; fifty percent (50%) of the twelve point five percent that claimed that it was a mutual research partnership also asserted that it was to develop a kind of roofing material and the other twelve and a half that said yes also said it was not really focused on research venture. On the Impetus for the collaboration, a practitioner who was formerly a lecturer initiated the collaboration. On the Current Practice of University-Industry Collaboration in Nigeria, seventy-five percent

of the interviewee claimed that it is very poor in the country generally and twenty-five percent claimed that it is completely lacking. This is in line with the claim of Matawal, (2011) that "the link between Academia and Industry in Nigeria is relatively low and policies are rearly made based on research findings from the Academia". Only few Universities have had one kind of linkage or the other with other external bodies or Firms both International and Local. The collaboration that has existed on research projects is negligible. The common type of partnership that has existed are partnerships such as Student Co-ops and Intenships, Personal Consulting Arrangements and Linkage between external professional bodies such as NIQS, NIA, NIOB and COREN with the coresponding departments in the universities.

4.3 Needs for UIC forthe Industry and University.

The study identified eightneedsfor which industry would collaborate with university and eight needs for which university would collaborate with industryfrom literature and subjected them to the opinion of the respondents who filled the questionnaires to indicate the level of their agreement with each of the items. The frequency of their choices has been presented in Table 4.3 and Table 4.4. The first table (Table 4.3) is for data from industry, while the second one (Table 4.4) is for data from the University.Detail of the analyses and discussion of the result is shown in this sub-section.

S/N	Industry's Needs for UIC	Frequency of response						∑fx	Mean	SD	RII	Rank
		1	2	3	4	5	∑f					
1	To solve specific technical or design problems	1	2	7	23	26	59	229	4.02	3.37	0.80	1th
2	To develop new material and machine (innovation)	4	8	4	27	16	59	208	3.65	2.98	0.73	5th
3	To conduct research leading to new patents	3	6	14	19	17	59	209	3.67	2.89	0.73	4th
4	To improve product quality and production process	2	4	7	22	23	59	216	3.79	3.07	0.76	2nd
5	To reorient Research and Development (R&D) agenda	4	7	15	20	13	59	204	3.58	2.99	0.72	6th
6	To have access to new research via seminars and workshops.	4	5	12	19	19	59	208	3.65	2.78	0.73	3th
7	To maintain an ongoing relationship and network with the university	6	7	17	18	11	59	196	3.44	2.86	0.69	7th
8	To recruit university graduates	9	10	12	20	8	59	186	3.26	2.62	0.65	8th

Table 4.3: Ranking of Needs for which Industry Seek for Collaboration with University

1 = strongly disagree, 2 = disagree, 3 = neutral, 4 = agree, 5 = strongly agree, SD = Standard deviation, RII = Relative Important Index. Source: Field Survey, (2015)

Table 4.3shows the ranking of theneeds for which construction companies seek to collaborate with universities. "To solve specific technical or design problems ranked first with RII value of 0.80. Based onthe guide to degree of significance (table 3.4), the item is very significant and in fact, the most significant collaboration need of the industry. "To improve product quality and production process" ranked second with RII of 0.76 which is also very significant. "To develop new material and machine (innovation)", "To conduct research leading to new patents", and "To have access to new research via seminars and workshops" had the same RII of 0.73 which are significant, however, "To have access to new research via seminars and workshops" was ranked third because it had the lowest standard deviation of 2.78. "To conduct research leading to new patents" was ranked fourth with a higher standard deviation of 2.89 and "To develop new material and

machine (innovation)" was ranked fifth having standard deviation of 2.98. "To reorient Research and Development (R&D) agenda" ranked sixth with RII of 0.72. It is significant. "The seventh in the ranking is "To maintain an ongoing relationship and network with the university" with RII of 0.69. It is significant. "To recruit university graduates" ranked eight with RII of 0.65. It is fairly significant.

Hence, the ranking implies that the most pressing need of construction companies for collaboration is "To solve specific technical or design problems", while on the other hand, they claim that conductingfundamental research with no specific applications in mind is of least important/significance to them as far as collaborating with University is concerned.

S/N	University's Needs for UIC	Frequency of response					∑f	∑fx	Mean	SD	RII	Rank
		1	**2**	**3**	**4**	**5**						
1	To supplement funds for one's own academic research	6	9	6	21	20	62	226	3.65	3.13	0.73	6th
2	To test the practical application of one's own research and theory	5	5	10	18	24	62	237	3.82	3.24	0.76	2st
3	To gain insights in the area of one's own research	3	6	16	25	12	62	223	3.60	3.33	0.72	7th
4	To further the university's outreach mission	3	7	12	25	16	63	233	3.76	3.29	0.75	5th
5	To look for business opportunity	6	10	22	18	6	62	194	3.13	3.22	0.63	8th

6	To gain knowledge about practical problems useful for teaching	3	5	8	24	22	62	243	3.92	3.48	0.78	1nd
7	To create student internships and job placement opportunity	2	6	15	22	17	62	232	3.74	3.22	0.75	4th
8	To secure funding for research assistants and lab equipment	3	8	11	20	20	62	232	3.74	3.11	0.75	3rd

Table 4.4 Ranking of Needs for which Universities seek for Collaboration with Firms

1 = strongly disagree, 2 = disagree, 3 = neutral, 4 = agree, 5 = strongly agree, SD = Standard deviation, RII = Relative Important Index. Source: Field Survey, (2015)

Table 4.4 shows the ranking of the needs for which Universities seek to collaborate with firms in the Construction Industry based on the relative importance index. They are in other words the benefits which the Universities seek to derive from collaborating with construction companies. The sixth and the second items in the table which are"To gain knowledge about practical problems useful for teaching" and "To test the practical application of one's own research and theory"were ranked first and second, having RII of 0.78 and 0.76 respectively and are both very significantbased on the guide to degree of significance."To secure funding for research assistants and lab equipment", "To create student internships and job placement opportunity", and "To further the university's outreach mission" are having the same RII of 0.75 but different standard deviation of 3.11, 3.22 and 3.29 respectively and at such were ranked third, fourth and fifth in that order. They are significant. "To supplement funds for one's own academic research" had RII of 0.73which is significant and was ranked sixth. "To gain insights in the area of one's own research" is having RII of 0.72 which is significant and was ranked seventh. "To look for business opportunity" was ranked eighth having RII of 0.63 which is fairly significant.

Therefore, this implies that “To gain knowledge about practical problems useful for teaching”, “To test the practical application of one’s own research and theory” and “To secure funding for research assistants and lab equipment” constitutes the top three needs for which universities would collaborate with the Construction Industry. On the other hand, they claim that “To look for business opportunity” is of least importance to them.

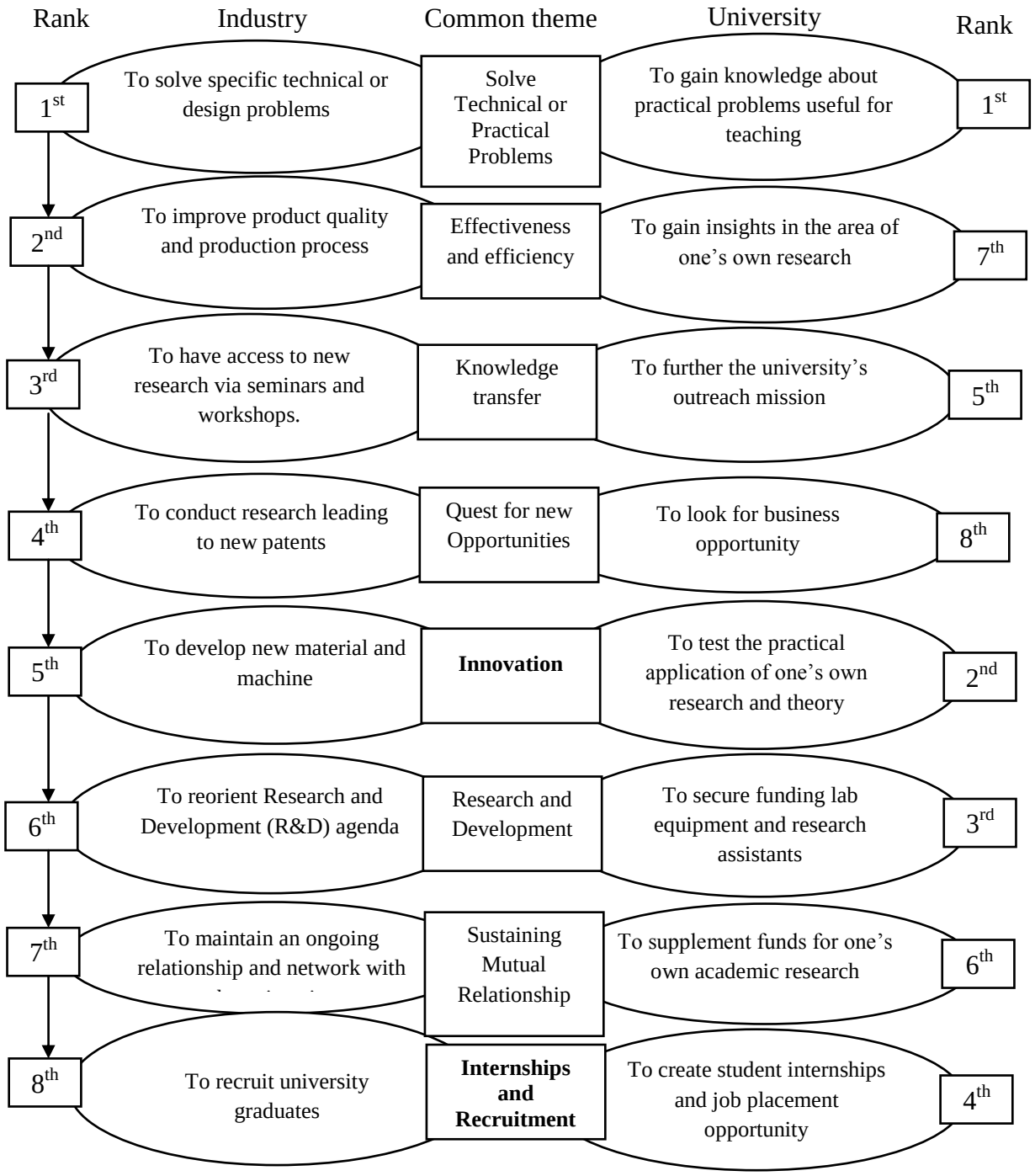


Figure 4.3 Correlation between the reasons for UIC for Industry and for Universities

As depicted by figure 4.3,there are common themes between the needs for collaboration for the university and the industry, however, they are of different priorities to the parties. The common themes among themincludes; Technical or Practical Problems, Effectiveness and Efficiency, Knowledge Transfer, Maximizing Profit, Relevance,Research and Development, Mutual Relationship, as well asInternship and Recruitment. However, Technical or Practical issues constitute the topmost priority to both the Industry and the Universities. Internship and Recruitment reasons which is of low significance to the industry but fourth in rank of significance to the academia.

4.4 Barriers to UIC in Nigerian Construction Industry

The common barriers to University-Industry Collaborationidentified from literatures weresubjected to the opinion of the respondents in the Industry and in the University via the questionnaire to indicate their level of agreement or disagreement. Based on their opinion, the ranking of the items identified is shown in table 4.5. The entire table is split into three parts the first part is the ranking based on the opinion ofthe top management of firms (industry), the second part is the ranking based on the opinion of the academics, while the third part is the overall ranking based on the combined opinion of the professionals and the academics.The split frequencies of the response by the academics and the professionals is shown in the appendix C.

Table 4.5 Ranking of Barriers to University - Construction Industry Collaboration

S/N	Barriers to Collaboration	Industry						University						Overall										
														Frequency										
		∑f	∑fx	Mean	SD	RII	Rank	∑f	∑fx	Mean	SD	RII	Rank	1	2	3	4	5	∑f	∑fx	Mean	SD	RII	Rank
1	Inadequate resources (funding, human and facilities)	59	234	4.03	3.62	0.81	1st	62	229	3.69	3.03	0.74	2nd	8	11	16	41	45	121	467	3.86	5.21	0.77	2nd
2	Poor Incentive structures for university researchers	59	223	3.84	3.81	0.77	3rd	62	225	3.63	3.44	0.73	4th	5	14	17	59	26	121	450	3.72	5.63	0.74	3rd
3	The issue of recruitment and training for technology transfer staff	59	207	3.57	3.22	0.71	11th	62	220	3.55	3.32	0.71	8th	4	16	32	48	21	121	429	3.55	5.18	0.71	11th
4	Capacity constraints of Small & Medium Enterprises (SMEs)	59	213	3.67	3.54	0.73	7th	62	223	3.60	3.40	0.72	6th	4	7	41	47	22	121	439	3.63	5.47	0.73	4th
5	Inflexible university policies including intellectual property rights (IPR), patents, and licenses and contractual mechanisms	59	210	3.62	3.52	0.72	10th	62	207	3.34	3.06	0.67	17th	7	14	34	46	20	121	421	3.48	5.09	0.70	12th
6	Treatment of confidential and privately owned information, moral responsibility versus legal restrictions	59	196	3.38	3.48	0.68	23rd	62	213	3.44	3.23	0.69	13th	9	10	40	46	16	121	413	3.41	5.29	0.68	17th
7	Conflict over intellectual property	59	196	3.38	3.32	0.68	21st	62	205	3.31	3.59	0.66	21st	4	17	51	30	19	121	406	3.36	5.31	0.67	22nd
8	Poor Leadership/Top management commitment and support	59	230	3.97	3.46	0.79	2nd	62	247	3.98	3.44	0.80	1st	2	12	18	43	46	121	482	3.98	5.42	0.80	1st
9	Lack of Collaboration champion	59	209	3.60	3.20	0.72	9th	62	224	3.61	3.55	0.72	7th	5	13	29	52	22	121	436	3.60	5.31	0.72	7th
10	Lack of Teamwork and flexibility to adapt	59	204	3.52	3.15	0.70	13th	62	227	3.66	3.30	0.73	3rd	4	18	27	48	24	121	433	3.58	5.10	0.72	5th
11	Poor Communication Skills	59	203	3.50	3.19	0.70	14th	62	208	3.35	2.99	0.67	16th	10	16	30	43	22	121	414	3.42	4.83	0.68	16th
12	Lack of mutual trust, commitment and personal relationships	59	212	3.66	3.53	0.73	6th	62	215	3.47	2.89	0.69	10th	8	23	15	46	29	121	428	3.54	4.96	0.71	10th
13	Lack of Project Management Skills	59	191	3.29	3.05	0.66	25th	62	195	3.15	3.04	0.63	25th	10	23	32	42	14	121	390	3.22	4.88	0.64	26th
14	Organization culture differences	59	198	3.41	3.20	0.68	19th	62	205	3.31	2.88	0.66	19th	10	18	32	41	20	121	406	3.36	4.79	0.67	20th
15	Organization structure (university administrative structure and firm structure)	59	211	3.64	3.85	0.73	8th	62	209	3.37	2.84	0.67	15th	7	16	28	50	20	121	423	3.50	5.15	0.70	13th

16	Firm size (size of organization)	59	203	3.50	3.24	0.70	15th	62	201	3.24	2.89	0.65	22nd	9	19	34	37	22	121	407	3.36	4.72	0.67	19th
17	Poor absorptive capacity	59	201	3.47	3.24	0.69	18th	62	214	3.45	3.13	0.69	12th	3	21	34	44	19	121	418	3.45	5.08	0.69	15th
18	Lack of Skill and the role of both university and industry boundary spanners	59	201	3.47	2.92	0.69	17th	62	199	3.21	3.28	0.64	24th	8	19	35	42	17	121	404	3.34	4.94	0.67	21st
19	Human capital movement/personnel exchange	59	196	3.38	3.75	0.68	24th	62	205	3.31	3.34	0.66	20th	2	22	42	43	12	121	404	3.34	5.37	0.67	23rd
20	Nature of the technology/knowledge to be transferred	59	217	3.74	3.42	0.75	4th	62	216	3.48	3.32	0.70	9th	7	12	26	53	23	121	436	3.60	5.30	0.72	6th
21	Policy/legislation/regulations on UIC	59	211	3.64	3.09	0.73	5th	62	213	3.44	3.06	0.69	11th	8	14	30	44	25	121	427	3.53	4.92	0.71	9th
22	Ability of the collaboration to enhance reputation/prestige	59	196	3.38	3.40	0.68	22nd	62	214	3.45	3.55	0.69	14th	6	21	27	53	14	121	411	3.40	5.34	0.68	18th
23	Low level of awareness of university research capabilities	59	201	3.47	2.72	0.69	16th	62	223	3.60	3.29	0.72	5th	11	18	18	42	32	121	429	3.55	4.78	0.71	8th
24	Use of intermediary (third party)	59	187	3.22	3.05	0.64	26th	62	201	3.24	3.62	0.65	23rd	6	21	46	35	13	121	391	3.23	5.19	0.65	25th
25	Risk of research	59	196	3.38	3.25	0.68	20th	62	192	3.10	3.08	0.62	26th	9	25	31	41	15	121	391	3.23	4.85	0.65	24th
26	Geographic proximity	59	203	3.50	3.12	0.70	12th	62	209	3.37	3.19	0.67	18th	5	23	28	45	20	121	415	3.43	4.97	0.69	14th

1 = not a factor, 2 = low factor, 3 = moderate effect, 4 = high effect, 5 = extreme effect, SD = Standard deviation, RII = Relative Important Index. Source: Field Survey, (2015)

As shown by Table 4.5the practitioners ranked "Inadequate resources (funding, human and facilities)" as the first barrier to UIC (With RII =0.81) which is very significant. To the academics, it is not but the second with RII = 0.74 which is only significant. Based on the overall (combined) ranking, it was ranked second with RII = 0.77 which is very significant. The academics ranked "Poor Leadership/Top management commitment and support" with RII = 0.80 which is very significant, but to the practitioners, it is ranked second with RII = 0.79 which is also very significant. To the practitioners in the industry "Use of intermediary (third party)" is the least item on the ranking with RII = 0.64 which is only fairly significant but to the academics, it was ranked 23rd with RII = 0.65, it is only fairly significant. The least ranked item according to the academics is "risk of research" having RII = 0.62(fairly significant), however, it was ranked as the twentieth with RII = 0.68 which is significant.

However, based on the overall ranking, "Poor Leadership/Top management commitment and support" was ranked as first with RII of 0.80, (very significant). "Inadequate resources (funding, human and facilities)" was ranked second with RII of 0.77 which is also very significant. The third item in rank is "Poor Incentive structures for university researchers"having RII of 0.74. Therefore, it is a significant item. "Capacity constraints of Small & Medium Enterprises (SMEs)" was ranked fourth with RII of 0.73 (significant). "Lack of Teamwork and flexibility to adapt", "Nature of the technology/knowledge to be transferred", and "Lack of Collaboration champion" had the same RII of 0.72 (significant) but different standard deviation and so, were ranked fifth, sixth and seventh respectively based on their standard deviation. "Low level of awareness

of university research capabilities", "Policy/legislation/regulations on UIC", "Lack of mutual trust, commitment and personal relationships" and "The issue of recruitment and training for technology transfer staff" all had the same RII of 0.71 (significant) but were ranked eighth, ninth, tenth and eleventh respectively using their standard deviation. "Inflexible university policies including intellectual property rights (IPR), patents, and licenses and contractual mechanisms" and "Organization structure (university administrative structure and firm structure)" both had RII of 0.70 (significant) and were ranked twelfth and thirteenth respectively. "Poor absorptive capacity" and "Geographic proximity" had a common RII of 0.69 (significant) and are ranked fourteenth and fifteenth respectively. "Poor Communication Skills", "Treatment of confidential and privately owned information, moral responsibility versus legal restrictions" and "Policy/legislation/regulations on UIC" had a common RII of 0.68 (significant) and are ranked sixteenth, seventeenth and eighteenth respectively using their standard deviation. "Firm size (size of organization)", "Organization culture differences", "Lack of Skill and the role of both university and industry boundary spanners", "Conflict over intellectual property" and "Human capital movement/personnel exchange" had a common RII of 0.67 (significant) and are ranked nineteenth, twentieth, twenty first, twenty second, and twenty third respectively. "Risk of research", "Use of intermediary (third party)" and "Lack of Project Management Skills" had a common RII of 0.64 (fairly significant) and were ranked twenty fourth, twenty fifth and twenty sixth respectively This implies that the most striking barrier to University-Industry Collaboration (UIC) is Poor Leadership/Top management commitment and support, while on the other hand, "Lack of Project

Management Skills" is a factor/or barrier to University Industry Collaboration (UIC) of least relevance.

CHAPTER FIVE

5.0 SUMMARY, CONCLUSION AND RECOMMENDATION

5.1 Summary of Major Findings

Below is a list of the major findings from the research;

1. The concept of University – Industry Research Collaboration is yet unfamiliar to and relegated by many construction practitioners and academics in Nigeria as 75% of the respondents claimed they have never had any research collaboration with any construction company before and that "it is completely lacking".
2. To solve specific technical or design problems is the most important reason why the industry want to collaborate with the Academia with RII of 0.80 which is very significant based on its rank. This is followed by a need to improve product quality and production process which is significant.
3. The major reason why the University want to collaborate with the Industry on the other hand is "To gain knowledge about practical problems useful for teaching" followed by the need "To test the practical application of one's own research and theory", having RII of 0.78 and 0.76 respectively and are very significant.
4. Most of the multi-national construction companies in Nigeria usually engage their home country's universities in research collaborations and innovative ventures rather than Nigerian Universities.

5. Poor Leadership/Top management commitment and support is the major barrier to partnership between the University and the construction industry having the highest RII of 0.80. Which is very significant.

5.2 Conclusion

The following are the conclusions drawn from the study based on the objectives of the research as stated in chapter one.

1. Research Partnership between Construction industry and University is relatively inactive in Nigeria as the level of the enlightenment and adoption is low.
2. Technically, Construction practitioners and academics seeks collaboration for different unique reasons which not only mutually beneficial to them but to the nation's economy and they can be harmonised for maximum benefits.
3. The potential preferential areas of collaboration for both the university and industry includes areas concerning 'dealing with technical and practical problems, Knowledge transfer, and innovations'.
4. Management systems and policies do not offer significant support to UIC as poor management and leadership issues constitute the highest barrier to UIC. Other barriers include issues relating to, policies, capacity and technology, availability of equipment as well as enlightenment issues.

5.3 Recommendations

The following recommendations were made based on the objectives of the research.

1. Construction companies should make Research and Development (R&D) an imperative unit within the organisations and as a requirement, establish link(s) with any university within the country.
2. Both the industry and academics should lay emphasis on proper management of existing link and establishing new mutually beneficial partnership keeping abreast the individual's needs for collaboration.
3. Government should promote globalization and participation in international projects by the construction industry to boost capacities.
4. The major barriers to the partnership should be resolved via joint effort.
5. Further study should identify barriers to UIC and the needs from the opinion of the various respondents and compare the results.

5.4 Contributions to Knowledge

The following are the contributions to knowledge

1. The research has identified the high impact factors affecting collaboration between University and Construction Industry in the country being poor leadership/top management commitment and support towards such partnership.
2. The study has also identified themajor collaboration needs of the University based on the guide to degree of significance in table 3.2, which is to gain knowledge about practical problems useful for teaching.
3. The study showed the major reasons why construction practitioners would rather collaborate with the University which is to solve specific technical or design problems.

4. The study has established the fact that the concept of University – Industry Collaboration is not widely practiced in Nigeria. There is a need to make policies that will promote it.

REFFERENCE

Abeda, M. I. (2010). University-Industry Collaboration In Malaysia. *M.Sc. Research Thesis In Malasia*, 1-79.

Ahmad, I., and Azhar, S. (2004). Implimenting Data Warehousing in Construction Industry: Opportunities and Challenges. *International Conference on Construction in The 21st Century* (863-871). Athens, Greece: (CITC-III).

Akindoyeni, A. (2004). *The Builder, a Catalyst in National Development.* Abuja: National Institute of Building (NIOB).

Albert, B, J Mireia and M. Cornelia. *The Impact of Industry Collaboration on Research*. UK: Engineering Academics, 2010.

Anumba, C.J., Egbu, C.O., and Carrillo, P.M. (2005). Knowledge management in construction. United Kingdom: *Blackwell publishing limited*.

Bako, S. (2005). Universities, Research and Development in Nigeria: Time for a Paradigmatic Shift, *Paper prepared for 11th General Assembly of CODESRIA, on Rethinking African Development: Beyond Impasse: Towards Alternatives, Maputo, Mozambique*, 6th– 8th December, 2005

Banal-Estañol, A., and Macho-Stadler. (2010). Scientific and Commercial Incentives in RandD: Research vs. Development. *Journal of Economics and Management Strategy*, 1: 1-26.

Barnes, T., Pashby, I., and Gibbons, A. (2002). Effective university—industry interaction: A multi-case evaluation of collaborative RandD projects. *European Management Journal*, 20: 272—285.

Barrett, D, J. E Austin and S. Mccarthy (2000). *Cross sector collaboration: Lessons from the international trachoma initiative in In M. Reich (Ed.)*. Massachusetts: Public—private partnerships for public health. Harvard University Press.

Bercovitz, J., Feldman, M., (2008). Academic entrepreneurs: Organizational change at the individual level. Organization Science 19(1), 69-89.

Bero, L., Grilli, R., Grimshaw, J., Harvey, E., Oxman, A., and Thomson, M. (1998). Closing the gap between research and practice: an overview of systematic reviews of

interventions to promote the implementation of research findings. *British Medical Journal*, 312; 465-468.

Blackman, C., and Seagal, N. (1991). Access to skills and knowledge: Managing the relationships with higher education institutions. *Technology Analysis and Strategic Management*, (3), 297-303.

Bower, D. J. (1993). Successful joint ventures in science parks. *Long Range Planning*, 6.

Brown, J. S., and P. Duguid. (2000). *The Social Life of Information.* Boston, Massachusetts: Harvard Business School Press.

Cohen, W. M., and Walsh, J. P. (2002). Links and Impacts: The Influence of Public Research on Industrial RandD. *Management Science*, 48: 1-23.

Cricelli, L., and Grimaldi, M. (2010). Knowledge-based interorganizational collaboration. *Journal of Knowledge Management*, 14: 348-358.

D'Este, P., & Perkmann, M. (2010). *Why do academics engage with industry? The entrepreneurial university and individual motivations.* London: Imperial College London.

Darrel, L., and Sellbom, M. (2015, 05 02). *Barriers to Adoping Technology*. Retrieved from cmapspublic: http://cmapspublic3.ihmc.us/rid=1KC10V38V-C21PMV-GG/Barriers To Technology.pdf

Dasgupta, P., and David, P. (1994). Towards a New Economics of Science. *Research Policy*, (23) 487-522.

David. (2006). *Labour-Intensive Industrialisation in Hong Kong, 1950-1970: A note on sources and Method.* Asia Pacific Business Review.

Dodgson, M. (1991). Management of technological collaboration. *Engineering Management Journal*, 187-192.

Dorota, M. (2009) *Commercialisation of research results – step by step.* Cracow University of Technology

Dulaimi, M. F. (2002). Enhancing Integration and Innovation in Construction. *Building Research and Information*, 47-237.

eLearning Industry, (2015). Six Big Benefits of Leadership Training. Available from https://elearningindustry.com/6-big-benefits-of-leadership-training. (Accessed October 2016)

Florida, R., and Cohen, W. M. (1999). *Engine or Infrastructure? The University Role in Economic Development" In: Branscomb, L.M., Kodama, F., Florida, R. (Eds.),.* London: MIT Press,.

Gertner, D., Roberts, J., and Charles, D. (2011). University-industry Collaboration: A CoPs approach to KTPs. *Journal of Knowledge Management*, 05: 625-647.

Geuna, A., Steinmeuller, W., and Salter, A. J. (2003). *Science and Innovation: Changing Rationales for the Public Funding of Research.* Cheltenham, UK: Edward Elgar.

Glenn, D. I. (1999). *Determining Sample Size.* Tallahassee: University of Florida IFAS Extension.

Hagedoorn, J., Link, A. N., and Vonortas, N. S. (2000). Research Partnerships. *Research Policy*, (29) 567–86.

Hall, B. H., Link, B. H., and Scott, J. (2003). University as Research Partners. *Review of Economics an Statistics*, (85) 485-491.

Harman, G., and Sherwell, V. (2002). Risks in university—industry research links and the implications for university management. *Journal of Higher Education Policy and Management*, 24; 37-51.

Ibidapo-Obe, O. (2014). *Enhancing Research Collaboration Between the Academia, Government and Industry.* Ife: Computer Science/Information Technology Research and Development Workshop.

Ifeanyi, O. A. (2010). Innovation Process and Practices In Costruction Industry In Anambra State of Nigeria. *Construction Management journal*, 1-89.

Isa, R. B, R. A Jimoh and E Achuenu. (2013) "An overview of the contribution of construction sector to sustainable development in Nigeria." *Net Journal of Business Management*: Vol. 1(1), 1-6.

Isabel, M. B., Rosane, A. M., and Evando, M. (2013). University–industry collaboration and innovation in emergent and mature industries in new industrialized countries. *Research Policy*, (42) 443-453.

Izaidin, A. M., and Ismail, K. (2009). *Entrepreneurial Management and Technology-based Firms.* Koln. Germany.: Lambert Academic Publisher.

Jan, S., Blazej, S., and Ewa, M. (2010). Collaboration between Universities and Industry Based on Experience of the Silesian University of Technology. *International Conference on Engineering Education* (1-10). Gliwice, Poland: Science and Industrial Cooperation.

Jeffrey, P. (2011, January 31). *Innovation on Purpose*. Retrieved from OVO Innovation's Blog Site: http://innovateonpurpose.blogspot.com/

John Walley, M. K. (2007). How to Get Research into Practice: First Get Practice into Research. *Bulletin of the World Hear*, 85(6): 424.

Jose, G. (2013). Promoting University-Industry Collaboration In Developing Countries. *The Innovation Policy Platform*, 1: 1-9.

Julio, A., Edward, S., Edward, M., and William, A. (2010). On Best Practices for Industry-University Collaboration. *MITSloan Management Review.*, 51(4): 83-90.

Koschatzky, K., and Stahlecker, T. (2010). New Forms oStrategic Research Collaboration between Firms and Universities in the German Research System. *International Journal of Technology Transfer and Commercialization*, (9) 94-110.

Kothari, C. R., and Garg, G. (2014). *Research Methodology; Methods and Techniques, Third Edition.* Rajasthan (India): New Age International (P) Limited, Publishers.

Kyrgidou, L. P., and Spyropoulou, S. (2013). Drivers and performance outcomes of innovativeness: An empirical study. *British Journal of Management*, 24: 281-298.

Lee, J., and Win, H. N. (2004). Technology transfer between university Research Centers and Industry in Singapore. *Technovation*, 24: 433-442.

Lee, Y. S. (2000). The sustainability of university-industry research collaboration: An empirical assessment. *The Journal of Technology Transfer*, 25(2), 111-133.

Matawal, D. S. (2011). *Linking Academia To Industry: A Case Study of The Building and Construction Industry.* Abuja: Nigerian Building and Road Research Institute.

Mbamali, I. and Okotie, A. J. (2012). An assessment of the threats and opportunities of globalization on building practices in Nigeria. *American International Journal of contemporary research* 2(4).

Mieczyslaw, B., and Przemyslaw, K. (. (2009). *" Institute for Private Enterprise and Democracy* . Warsaw: Entrepreneurial University.

Mitsuhashi, H. (2005). University—industry collaborations in Japan: The role of new technology-based firms in transforming the national innovation system. *Research Policy*, 34: 583-594.

Mohsen, T., and Reg, D. (2011). Making sense of Cronbach's alpha. *International Journal of Medical Education*, 2:53-55.

NPC (2011). The Nigerian Economy: Annual Performance Report. The Presidency, National Planning Commission Report. Abuja.

Nelson, R. R. (2004). The market economy, and the scientific commons. *Research Policy*, (33) 455-471.

Office of the Technology Commercialisation, The University of Texas. (2015, January 15). The 8 steps of technology commercialization. 25.

Ogunoh, P. E. (2005). Building Maintenance Culture of Public Housing Estate In Awka. *Unpublished M.Sc. Thesis, Department of Building, Nnamdi Azikiwe University, Awka*.

Oliver, A. L. (2004). On the duality of competition and collaboration: Network-based knowledge relations in the biotechnology industry. *Scandinavian Journal of Management*, 20: 151-171.

Olowo-Okere, E. O. (1985). Construction Industry in Nigeria. *Journal for Building and Civil Engineering Contractors in Nigeria*, 2 (2), 6-10.

Osofisan, A. O. (2007). Innovation as an Agent of Change in the Nigerian Building Industry. *Journal of the Nigerian Institute of Building*, 17-22.

Powers, J. B. (2003). Com mercialising academic research: Resource effects on performance of university technology transfer. *Journal of Higher Education, Columbus*, 74: 26-47.

Rajasekar, S., Philominathan, S., and Chinnathambi, V. (2013, November 06). *Research Methology*. Retrieved from arxi.org/pdf/physics/0601009.

Robert, T. (2013). *Top 15 Barriers to Adopting New Technology*. Retrieved from eSCRIBE BLOG: http://www.escribecorporate.com/blog

Rohana, M. (2008). *An investigation into the barriers to the implementation of automation and robotics technologies in the construction industry.* (Doctorate dissertation, Queensland University of Technology).

Salter, A., Bruneel, J. and D'Este, P. (2009, June 17-19). Investigating The Factors That Diminish The Barriers To University-Industry Collaboration. *Druid*, 02-42.

Samuel, A., and Omar, A.-T. (2015). University-Industry collaboration: A systemic review. *Scandavian Journal of Management*, 928-950.

Siddiqi, K., and Robinson, M. (2006). Getting evidence into practice in developing countries. *Evid Based Cardiovasc Med*, 10: 5-7.

Siegel, D., Waldman, D., and Link, A. (2003). Assessing the impact of organizational practices on the relative productivity of university technology transfer offices: An exploratory study. *Research Policy*, 32: 27—48.

Sitthi-Amorn, C., and Somrongthong, R. (2000). Strengthening health research capacity in developing countries: a critical element for achieving health equity. *British Medical Journal*, 321: 813-817.

Thorpe, David and Neal Ryan. (2006) "Facilitating Technology Transfer in the Construction Industry Industry." *Clients Driving Innovation: Moving Ideas into Practice: Cooperative Research Centre (CRC) for Construction Innovation*.

Thursby, J., and Thursby, M. (2007). Are there Real Effects of Licensing on Academic Research? A Life Cycle View. *Journal of Economic Behavior and Organization*, 63(4), 577-598.

Tina Barnes, L. P. (2002). Effective University - Industry Interaction: A Multi-case Evaluation of Collaborative RandD Projects. *European Management Journal*, 20(3) 272-285.

Tuten, T. L., and Urban, D. J. (2001). An expanded model of business-to-business

Universities	Industry

partnership formation and success. *Industrial Marketing Marnagement*, 30: 149-164.

Ukaegbu, C. (1991). The Structure of the Nigerian Industries and the Utilization of Scientific and Technological Manpower. *The Journal of Economic and Social Studies*.

University-Industry Liaison Office (UILO). (2015, May 08). *Types of Partnerships*. Retrieved from A place of Mind, The University Of British Columbia (UBC): http://www.ubc.ca/

Vanduhe, B. A. (2012). *An Investigation of Factors affecting Residential Building Maintenance.* Zaria, Nigeria: An Unpublished Thesis in Department of Building, Ahmadu Bello University Zaria.

Winer, M., and Ray, K. (1994). *Collaboration Handbook: Creating, Sustaining and Enjoying the Journey.* Gliwice, Poland: International Conference On Engineering Education.

Woolgar, L. (2007). New institutional policies for university—industry Link in Japan. *Research Policy*, 36: 1261-1274.

Yong, S. L. (2000). The Sustainability of University - Industry Research Collaboration: *Journal*

Economic-related	Source of revenue (both public and private) Patents/IPRs/licensing income Additional income or financial benefit to researchers Create business opportunities Contribution to local/regional economic development	New products and/or processes Improved products and/or processes Patents, prototypes, generate IPRs, etc More cost-effective than similar research in-house Improved competitiveness Access public grants Promote economic growth/enhancement of wealth creation
Institutional-related	Exposure of students and faculty to practical problems/new ideas and/or to state-of-the-art technology, with positive effects on the curriculum Provide a ‘‘test bed’’ for feedback on research ideas, results/interpretations for the refinement of academic ideas/theories Stimulate technological advancement and/or research activities in certain key areas Acquisition of or access to up-to-date equipment Training and employment opportunities for students Build credibility and trust for the academic researcher among practitioners Stimulate the development of spin-offs (or spin-off companies) Provide opportunity for companies to influence and encourage the development of particular lines of university research Joint publications with industry Publication of papers by academics	Improved innovative ability and capacity/ Keep up to date with major technological developments Advance new technologies Accelerates commercialization of technologies/Increases speed of innovation to market No inter-firm conflicts of interest Provide much needed legitimacy for industry products (e.g. software programme) Access to new knowledge and leading edge technologies and/or a wide variety of multidisciplinary research expertise and research infrastructure Influence university research directions and new programs for industry good Access to specialized consultancy/Identify relevant problems/Solve specific technical problems Product testing with independent credibility in testing Training/continued professional development Opportunity to access a wider international network of

		expertise Act as a catalyst that leads to other collaborative ventures Joint publications Hiring of talent graduates
Social-related	Service to the community Enhancement of university's reputation	Enhance reputation by becoming more social responsible business
	Drawbacks	
Deviation from Mission or Objective (Core Ethic)	Threats to research autonomy or integrity for commercial advantage that may have a negative impact on culture of open science and affect university mission Confidentiality agreements may block the dissemination of knowledge Could result in the abandonment of long-term basic research in favour of results-oriented, short term, applied research and technology transfer. Concern that the end result of collaboration could be short-term contracts in which industry would require 'quick and dirty' solutions to problems, with university departments acting as extensions to the research activities of firms.	Slow academic bureaucracies may stifle technology commercialization, depress the firm's performance and delay the fulfilment of the firm's objectives Diversion away from the 'bottom-line' issues of industry like return on capital investment Collaboration may be costly due to increase in administrative overheads, as industry may have to develop specific managerial and administrative competencies, which may be a time-consuming process
Quality Issues	Potential diversion of energy and commitment of individual staff who are involved in interaction with industry, away from core educational activities Could affect types of research questions addressed and reduce the quantity and quality of basic research	Low intellectual level of some contract work Results in theoretical and impracticable solutions since university staff are too theoretical and not very practical whereas industry's focus is much more problem centred on critical situations requiring immediate attention
Conflicts	Conflicts between researchers and company over the release of adverse results/damage in professional relationships among the researchers	Disharmony and discord during R&D development Intellectual property disputes and patenting disagreement

	Biased reporting by researchers sponsored by companies in favour of positive experimental results relating to company products	
Risks	Dilemma of either publishing results for short term revenue and academic recognition or withholding until they are patented, with the risk of the technology becoming obsolete Risks that academic-industry relationships pose to human subjects of research and to the integrity of academic investigation	Diminished control or leakage of proprietary information High failure rate of collaborations Financial risk to industry Risk of incomplete transfer or non-performance of technology Market risk where there is uncertainty of the success of the product launched in the market

APPENDIX

APPENDICES A

Benefits and Drawbacks of University-Industry Collaboration UIC

Source: Samuel and Omar, (2015)

APPENDIX B

	Universities	Industry
Necessity	Responsiveness to government policy Strategic institutional policy	Responsiveness to government initiatives/policy Strategic Institutional policy
Reciprocity	Access complementary expertise, state-of-the-art equipment and facilities Employment opportunities for university graduates	Access to students for summer internship or hiring Hiring of faculty members
Efficiency	Access funding for research (Government grant for research & Industrial funding for research assistance, lab equipment, etc. Business opportunity, e.g. exploitation of research capabilities and results or deployment of IPR to obtain patents Personal financial gain for academics	Commercialize university-based technologies for financial gain Benefit financially from serendipitous research results Cost savings (easier and cheaper than to obtain a license to exploit foreign technology) National incentives for developing such relations such as tax exemptions and grants Enhance the technological capacity and economic competitiveness of firms Shortening product life cycle Human capital development

Motivations of University-Industry Collaboration UIC	Stability	Shift in knowledge based economy (growth in new knowledge) Discover new knowledge/test application of theory Obtain better insights into curricula development Expose students and faculty to practical problems/ applied technologies Publication of papers	Shift in knowledge based economy (growth in new knowledge) Business growth Access new knowledge, cutting-edge technology, state-of-the art expertise/research facilities and complementary know-how Multidisciplinary character of leading edge technologies Access to research networks or pre-cursor to other collaborations Solutions to specific problems Subcontract R&D (for example due to lack of in-house R&D) Risk reduction or sharing
	Legitimacy	Societal pressure Service to the industrial community/society Promote innovation (through technology exchange) Contribute to regional or national economy Academics' quest for recognition or achieve eminence	Enhancement of corporate image
	Asymmetry	NA	Maintain control over proprietary technology

APPENDIX C

Barriers to University-Industry Collaboration

S/N	Barriers to Collaboration	Industry											University									
		Frequency											Frequency									
		1	2	3	4	5	∑f	∑fx	Mean	SD	RII	Rank	1	2	3	4	5	∑f	∑fx	Mean	SD	RII	Rank
1	Inadequate resources (funding, human and facilities)	3	4	4	25	23	59	238	4.03	3.68	0.81	1st	5	7	12	16	22	62	229	3.69	3.03	0.74	2nd
2	Poor Incentive structures for university researchers	1	7	7	31	13	59	225	3.81	3.80	0.76	3rd	4	7	10	28	13	62	225	3.63	3.44	0.73	4th
3	The issue of recruitment and training for technology transfer staff	1	9	16	23	10	59	209	3.54	3.22	0.71	11th	3	7	16	25	11	62	220	3.55	3.32	0.71	8th
4	Capacity constraints of Small & Medium Enterprises (SMEs)	1	3	21	24	10	59	216	3.66	3.59	0.73	7th	3	4	20	23	12	62	223	3.60	3.40	0.72	6th
5	Inflexible university policies including intellectual property rights (IPR), patents, and licenses and contractual mechanisms	2	6	13	29	9	59	214	3.63	3.61	0.73	10th	5	8	21	17	11	62	207	3.34	3.06	0.67	17th
6	Treatment of confidential and privately owned information, moral responsibility versus legal restrictions	4	4	22	23	6	59	200	3.39	3.54	0.68	23rd	5	6	18	23	10	62	213	3.44	3.23	0.69	13th
7	Conflict over intellectual property	1	9	22	19	8	59	201	3.41	3.31	0.68	21st	3	8	29	11	11	62	205	3.31	3.59	0.66	21st
8	Poor Leadership/Top management commitment and support	1	5	8	25	20	59	235	3.98	3.50	0.80	2nd	1	7	10	18	26	62	247	3.98	3.44	0.80	1st
9	Lack of Collaboration champion	2	6	17	23	11	59	212	3.59	3.24	0.72	9th	3	7	12	29	11	62	224	3.61	3.55	0.72	7th
10	Lack of Teamwork and flexibility to adapt	1	12	13	23	10	59	206	3.49	3.17	0.70	13th	3	6	14	25	14	62	227	3.66	3.30	0.73	3rd
11	Poor Communication Skills	3	10	11	25	10	59	206	3.49	3.20	0.70	14th	7	6	19	18	12	62	208	3.35	2.99	0.67	16th

12	Lack of mutual trust, commitment and personal relationships	**4**	**10**	**4**	**28**	**13**	**59**	**213**	**3.61**	**3.50**	**0.72**	**6th**	**4**	**13**	**11**	**18**	**16**	**62**	**215**	**3.47**	**2.89**	**0.69**	**10th**
13	Lack of Project Management Skills	**4**	**11**	**14**	**23**	**7**	**59**	**195**	**3.31**	**3.12**	**0.66**	**25th**	**6**	**12**	**18**	**19**	**7**	**62**	**195**	**3.15**	**3.04**	**0.63**	**25th**
14	Organization culture differences	**5**	**7**	**14**	**25**	**8**	**59**	**201**	**3.41**	**3.23**	**0.68**	**19th**	**5**	**11**	**18**	**16**	**12**	**62**	**205**	**3.31**	**2.88**	**0.66**	**19th**
15	Organization structure (university administrative structure and firm structure)	**1**	**6**	**14**	**31**	**7**	**59**	**214**	**3.63**	**3.86**	**0.73**	**8th**	**6**	**10**	**14**	**19**	**13**	**62**	**209**	**3.37**	**2.84**	**0.67**	**15th**
16	Firm size (size of organization)	**4**	**6**	**15**	**25**	**9**	**59**	**206**	**3.49**	**3.27**	**0.70**	**15th**	**5**	**13**	**19**	**12**	**13**	**62**	**201**	**3.24**	**2.89**	**0.65**	**22nd**
17	Poor absorptive capacity	**1**	**10**	**17**	**23**	**8**	**59**	**204**	**3.46**	**3.28**	**0.69**	**18th**	**2**	**11**	**17**	**21**	**11**	**62**	**214**	**3.45**	**3.13**	**0.69**	**12th**
18	Lack of Skill and the role of both university and industry boundary spanners	**4**	**8**	**14**	**22**	**11**	**59**	**205**	**3.47**	**3.00**	**0.69**	**17th**	**2**	**11**	**17**	**21**	**11**	**62**	**214**	**3.45**	**3.13**	**0.69**	**24th**
19	Human capital movement/personnel exchange	**2**	**7**	**20**	**27**	**3**	**59**	**199**	**3.37**	**3.80**	**0.67**	**24th**	**4**	**11**	**21**	**20**	**6**	**62**	**199**	**3.21**	**3.28**	**0.64**	**20th**
20	Nature of the technology/knowledge to be transferred	**1**	**5**	**15**	**26**	**12**	**59**	**220**	**3.73**	**3.45**	**0.75**	**4th**	**0**	**15**	**22**	**16**	**9**	**62**	**205**	**3.31**	**3.34**	**0.66**	**9th**
21	Policy/legislation/regulations on UIC	**2**	**8**	**13**	**23**	**13**	**59**	**214**	**3.63**	**3.12**	**0.73**	**5th**	**6**	**7**	**11**	**27**	**11**	**62**	**216**	**3.48**	**3.32**	**0.70**	**11th**
22	Ability of the collaboration to enhance reputation/prestige	**1**	**14**	**14**	**24**	**6**	**59**	**197**	**3.34**	**3.36**	**0.67**	**22nd**	**6**	**6**	**17**	**21**	**12**	**62**	**213**	**3.44**	**3.06**	**0.69**	**14th**
23	Low level of awareness of university research capabilities	**4**	**10**	**13**	**17**	**15**	**59**	**206**	**3.49**	**2.76**	**0.70**	**16th**	**5**	**7**	**13**	**29**	**8**	**62**	**214**	**3.45**	**3.55**	**0.69**	**5th**
24	Use of intermediary (third party)	**4**	**11**	**18**	**20**	**6**	**59**	**190**	**3.22**	**3.11**	**0.64**	**26th**	**7**	**8**	**5**	**25**	**17**	**62**	**223**	**3.60**	**3.29**	**0.72**	**23rd**
25	Risk of research	**3**	**7**	**21**	**21**	**7**	**59**	**199**	**3.37**	**3.31**	**0.67**	**20th**	**2**	**10**	**28**	**15**	**7**	**62**	**201**	**3.24**	**3.62**	**0.65**	**26th**
26	Geographic proximity	**3**	**11**	**10**	**24**	**11**	**59**	**206**	**3.49**	**3.12**	**0.70**	**12th**	**6**	**18**	**10**	**20**	**8**	**62**	**192**	**3.10**	**3.08**	**0.62**	**18th**

APPENDIX D

GUIDE TO HOD'S INTERVIEW

1. Demographic profile.
    i. Name
    ii. Institution
    iii. Work experience
    iv. Membership of professional body
2. Past or Current University-Industry Collaboration Experience.
3. General information on the relationship(s) in terms of the objectives, forms of research management, facilitators (Impetus) and barriers, and the organizational efforts to support collaboration with industry.
4. General Comment about the status of University-Industry Collaboration in Nigeria Construction Industry currently.
5. Any other comment (suggestions or complain) about the research.

APPENDIX E

Sample of Questionnaire

TOPIC: An Investigation into University-Industry Collaboration in the Nigerian Construction Industry

Dear Respondent, Please respond to the following questions honestly by ticking ☑ the relevant boxes or by filling in the gap where necessary. Thank you.

SECTION A: (General Information)

1. Which part of the construction sector do you work?
   (a) Academia ☐ (b) Industry ☐

2. Which of the following is your profession?
   (a) Building ☐ (b) Engineering ☐ (c) Architecture ☐
   (d) Quantity surveying ☐ (e) Land surveying ☐ (f) Estate surveying ☐
   (g) Town planning ☐ (g) others(specify) _____

SECTION B: (The reasons Companies and Academia Seek Collaboration with each other)

3. Please indicate the level of your agreement with the following reasons firms and academia wants to collaborate with each other. **The First part (A) is for Industry only while the Second part (B) is for University only**

1 = Strongly Disagree, 2 = Disagree, 3 = Indifferent, 4 = Agree, 5 = Strongly Agree.

A	REASONS (OR NEEDS) FOR COLLABORATION **(FOR PEOPLE IN THE INDUSTRY ONLY)**	**1**	**2**	**3**	**4**	**5**
1	To solve specific technical or design problems					
2	To develop new material and machine (innovation)					
3	To conduct research leading to new patents					
4	To improve product quality and production process					
5	To reorient Research and Development (R&D) agenda					
6	To have access to new research via seminars and workshops.					
7	To maintain an ongoing relationship and network with the university					
8	To conduct creative or impractical research in search of new technology					
9	To conduct fundamental research with no specific applications in mind					
10	To recruit university graduates					

B	REASONS (OR NEEDS) FOR COLLABORATION**(FOR PEOPLE IN THE UNIVERSITY ONLY)**	**1**	**2**	**3**	**4**	**5**
1	To supplement funds for one's own academic research					
2	To test the practical application of one's own research and theory					
3	To gain insights in the area of one's own research					
4	To further the university's outreach mission					
5	To look for business opportunity					
6	To gain knowledge about practical problems useful for teaching					
7	To create student internships and job placement opportunity					
8	To secure funding for research assistants and lab equipment					

SECTION C: (Barriers to Successful Industries – University Collaboration UIC).

7. Please indicate your level of agreement or disagreement with the followingFactors affecting Construction Industries – University Collaboration.

1 = Strongly Disagree, 2 = Disagree, 3 = Indifferent, 4 = Agree, 5 = Strongly Agree.

FACTORS AFFECTING CONSTRUCTION INDUSTRIES – UNIVERSITY COLLABORATION						
	Capacity and Resources Issues	**1**	**2**	**3**	**4**	**5**
1	Inadequate resources (funding, human and facilities)					
2	Poor Incentive structures for university researchers					
3	The issue of recruitment and training for technology transfer staff					
4	Capacity constraints of Small & Medium Enterprises (SMEs)					
	Legal issues, and Contractual Mechanisms	**1**	**2**	**3**	**4**	**5**
5	Inflexible university policies including intellectual property rights (IPR), patents, and licenses and contractual mechanisms					
6	Treatment of confidential and privately owned information, moral responsibility versus legal restrictions					
7	Conflict over intellectual property					
	Management and Organization Issues	**1**	**2**	**3**	**4**	**5**
8	Poor Leadership/Top management commitment and support					
9	Lack of Collaboration champion					
10	Lack of Teamwork and flexibility to adapt					
11	Poor Communication skills					
12	Lack of mutual trust, commitment and personal relationships					
13	Lack of Project Management Skills					
14	Organization culture differences					
15	Organization structure (university administrative structure and firm structure)					
16	Firm size (size of organization)					
17	Poor absorptive capacity					
18	Lack of Skill and the role of both university and industry boundary spanners					
19	Human capital movement/personnel exchange					
	Issues Relating to the Technology	**1**	**2**	**3**	**4**	**5**
20	Nature of the technology/knowledge to be transferred (academic rigor or industrial relevance)					
	Political Issues	**1**	**2**	**3**	**4**	**5**
21	Policy/legislation/regulations on University-Industry Collaboration (UIC)					
	Social Issues	**1**	**2**	**3**	**4**	**5**
22	Ability of the collaboration to enhance reputation/prestige					
	Other Issues	**1**	**2**	**3**	**4**	**5**
23	Low level of awareness of university research capabilities					
24	Use of intermediary (third party)					
25	Risk of research					
26	Geographical proximity					

APPENDIX F

Result of Reliability Analysis

Reliability Analysis for Data from Industry

Scale: ALL VARIABLES

Case Processing Summary

		N	%
Cases	Valid	58	47.9
	Excluded[a]	63	52.1
	Total	121	100.0

a. Listwise deletion based on all variables in the procedure.

Reliability Statistics

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.827	.819	39

Item Statistics

	Mean	Std. Deviation	N
Part of the Construction sector where the respondents work	1.98	.131	58
Respondent's profession	2.38	1.211	58
Has your Institution been in any UIC before?	1.69	.467	58
To solve specific technical or design problems	4.22	.899	58
To develop new products and processes (innovation)	3.72	1.211	58

Reliability Analysis for Data from Universities

Scale: ALL VARIABLES

Case Processing Summary

		N	%
Cases	Valid	62	51.2
	Excluded[a]	59	48.8
	Total	121	100.0

a. Listwise deletion based on all variables in the procedure.

Reliability Statistics

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.887	.880	37

Item Statistics

	Mean	Std. Deviation	N
Part of the Construction sector where the respondents work	1.02	.127	62
Respondent's profession	2.42	1.095	62
Has your Institution been in any UIC before?	1.42	.497	62
Inadequate resources (funding, human and facilities)	3.68	1.277	62
Lack or Poor Incentive structures for university	3.65	1.147	62

APPENDIX G

Published Table for Sample Size

Industry

Table 1. Sample Size for ±3%, ±5%, ±7%, and ±10% Precision Levels where Confidence Level Is 95% and P=.5.

Size of Population	Sample Size (n) for Precision (e) of:			
	±3%	±5%	±7%	±10%
500	a	222	145	83
600	a	240	152	86
700	a	255	158	88
800	a	267	163	89
900	a	277	166	90
1,000	a	286	169	91
2,000	714	333	185	95
3,000	811	353	191	97
4,000	870	364	194	98
5,000	909	370	196	98
6,000	938	375	197	98
7,000	959	378	198	99
8,000	976	381	199	99
9,000	989	383	200	99
10,000	1,000	385	200	99
15,000	1,034	390	201	99
20,000	1,053	392	204	100
25,000	1,064	394	204	100
50,000	1,087	397	204	100
100,000	1,099	398	204	100
>100,000	1,111	400	204	100

a = Assumption of normal population is poor (Yamane, 1967). The entire population should be sampled.

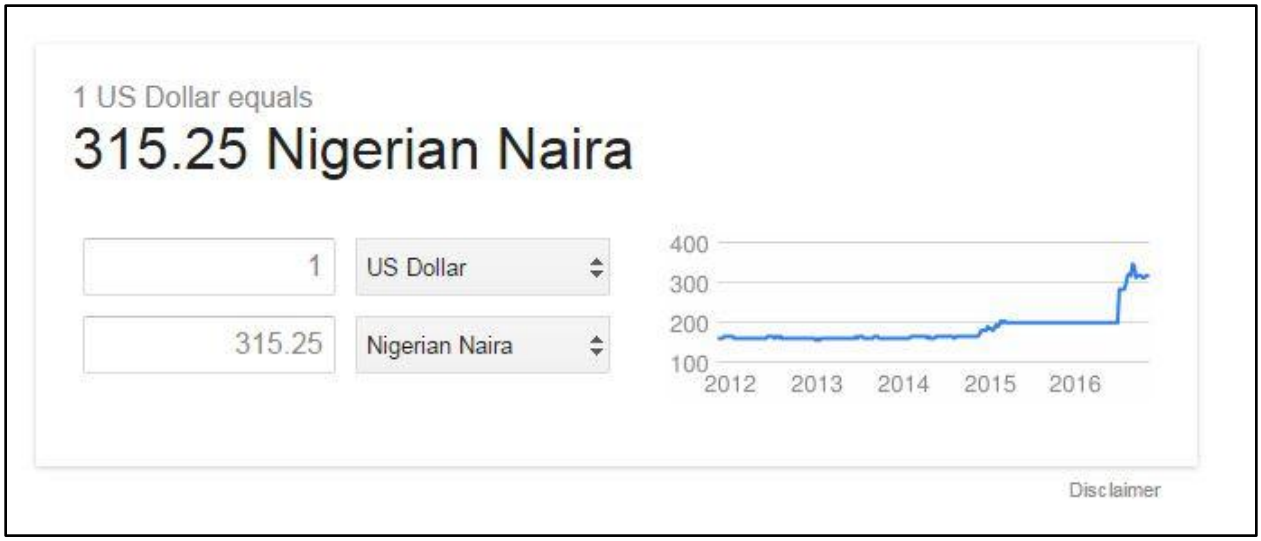
University

Table 2. Sample Size for ±5%, ±7% and ±10% Precision Levels where Confidence Level Is 95% and P=.5.

Size of Population	Sample Size (n) for Precision (e) of:		
	±5%	±7%	±10%
100	81	67	51
125	96	78	56
150	110	86	61
175	122	94	64
200	134	101	67
225	144	107	70
250	154	112	72
275	163	117	74
300	172	121	76
325	180	125	77
350	187	129	78
375	194	132	80
400	201	135	81
425	207	138	82
450	212	140	82

APPENDIX H

Dollar-Naira Exchange Rate



Source;
https://www.google.com.ng/?gfe_rd=cr&ei=d4YcWPHjIoX38AfuqKvABg&gws_rd=ssl#q=exchange+rate+of+dollar+to+nairahttps://www.google.com.ng/?gfe_rd=cr&ei=d4YcWPHjIoX38AfuqKvABg&gws_rd=ssl#q=exchange+rate+of+dollar+to+naira, retrieved on 4/11/2016