UNIVERSITY OF CAPE COAST

RESEARCH COLLABORATION FOR ATTAINMENT OF A KNOWLEDGE–BASED ECONOMY IN GHANA

Thesis submitted to the Institute for Development Studies of the Faculty of Social Sciences, College of Humanities and Legal Studies, University of Cape Coast, in partial fulfilment of the requirements for the award of Doctor of Philosophy degree in Development Studies

DECEMBER 2016

DECLARATION

Candidate's Declaration

I hereby declare that this thesis is the result of my own original research and that no part of it has been presented for another degree in this university or elsewhere.

Candidate's Signature: .... Date: 10/01/2017

Name: Mavis Serwah Benneh Mensah

Supervisors' Declaration

We hereby declare that the preparation and presentation of the thesis were supervised in accordance with the guidelines on supervision of thesis laid down by the University of Cape Coast.

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ABSTRACT

Research collaboration is acknowledged as a critical means of creating comparative advantages for innovation, economic growth and development. In the dire circumstance of limited national innovation and competitiveness, coupled with weak industrial research and development vis à vis a widening knowledge filter, it was imperative to examine research collaboration for attainment of a knowledge-based economy in Ghana. The study followed a sequential mixed methods approach and a descriptive-causal research design. It involved survey of a proportionate stratified sample of 511 academic researchers, with 53 percent response rate, and interview of 11 informants from two public universities in Ghana. Data were analysed with descriptive and inferential statistics such as the mean and standard multiple regression. It was established that involvement of academic researchers in research collaboration was low. Research collaboration made valuable contributions to innovation and had positive impact on the profession and welfare of academic researchers. However, the collaborations were saddled with numerous challenges such as difficulty of collaborating parties to have trust and common values, absence of enforceable intellectual property rights and limited infrastructure and funding. With versatile research orientation and quite high intention to collaborate, explained by a quite high attitude, perceived behavioural control and environmental possibility for research collaboration, academics can effectively fulfill their knowledge production function when the challenges are addressed. It is recommended that academics, through their institutions, create the platform for national discussions on setting up a national research and innovation council and a matching fund in support of research collaboration.

KEY WORDS

Academic

Collaboration

Economy

Innovation

Knowledge

Research

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DEDICATION

To my dear daughters,

Claudia, Caroline, Catherine,

for your forbearance and love.

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AAU	Association of African Universities
ANOVA	Analysis of Variance
CBR	Centre for Business Research
CEFE	Competency-based Economies Formation of Enterprise
CLE	Community Leader's Expectation
CSIR	Council for Scientific and Industrial Research
DRIC	Directorate of Research, Innovation and Consultancy
GDP	Gross Domestic Product
EIPR	Enforceable Intellectual Property Rights
GERD	Gross Expenditure on Research and Development
IBM	International Business Machines
ICT	Information Communications Technology
IP	Intellectual Property
KNUST	Kwame Nkrumah University of Science and Technology
MSMEs	Micro, Small and Medium-sized Enterprises
OGR	Office of Grants and Research
PCA	Principal Component Analysis
PACEC	Public and Corporate Economic Consultants
PNDC	Provisional National Defense Council
QH	Quadruple Helix
R&D	Research and Development
SPSS	Statistical Product and Service Solutions
STEM	Science, Technology, Engineering and Mathematics
STI	Science, Technology and Innovation

STREFund	Science and Technology Research Endowment Fund
TACT	Target, Action, Context and Time
TCC	Technology Consultancy Centre
TFP	Total Factor Productivity
UCC	University of Cape Coast
UK	United Kingdom
UN	United Nations
UNCTAD	United Nations Conference on Trade and Development
US (A)	United States (of America)
UTAG	University Teachers' Association of Ghana
WITS	World Integrated Trade Solution
ZEW	Zentrüm fur Europäische Wirtschaftsforschung (Centre for European Economic Research)

CHAPTER ONE

INTRODUCTION

The study of research collaboration for attainment of a knowledge-based economy in Ghana, was necessitated by a widening knowledge filter and limited innovation in the Ghanaian economy, coupled with the dire need for economic growth and development (Mensah & Nyadu-Addo, 2012; UNCTAD, 2011). From the perspective of the knowledge spillover theory of entrepreneurship (Acs, Braunerhjelm, Audretsch & Carlsson, 2009), persistence of the problem could lead to a Swedish paradox, whereby entrepreneurial opportunities generated through investments in knowledge production, in the form of research, remain under-exploited or are exploited outside the economic system because there are few opportunities to do so within the economy (Ejermo & Kander, 2006).

In order to turn the situation around in favour of economic growth and development, this thesis relies on theories, such as the theory of economic development (Schumpeter, 1934/1983) and the theory of planned behaviour (Ajzen, 1991; 2011b), to illustrate research collaboration as a vital medium for bridging the knowledge filter. The thesis adds to the debate on the importance of all academic disciplines in the knowledge-based economy (Bakhshi, Schneider & Walker 2008; Hughes, Kitson, Probert, Bullock & Milner, 2011).

Background to the Study

Research collaboration refers to interactions, information sharing and co-ordination of activities by persons of diverse interests to undertake research and or disseminate or use the research findings to achieve a particular goal, such as innovation for economic growth and development (Bukvova, 2010; Perkmann & Walsh, 2009). It constitutes a fundamental driver of economic growth and development in the knowledge-based economy, which is an economy in which knowledge drives economic growth and development and, as a result, great investments are made in research, innovation and human and social capital (Leydesdorff, 2012; Rinne & Koivula 2005).

The significance of research collaboration in the knowledge-based economy lies mainly in its capacity to act as a vital medium for the creation and transformation of knowledge, particularly tacit knowledge, into competitive innovations that spur economic growth and development (Johnson, Lorenz & Lundvall, 2002; Mueller, 2005). As a result research, knowledge flow and innovation form an integral part of research collaboration. The linkage among these three facets of research collaboration can be illustrated by the theory of economic development (Schumpeter, 1934/1983), Schumpeterian growth models (Zachariadis, 2003), and the knowledge spillover theory of entrepreneurship (Acs et al., 2009).

The thrust of the theory of economic development is that innovation drives economic development while the Schumpeterian growth models establish research as an invaluable source of knowledge which, according to the knowledge spillover theory of entrepreneurship, must flow from its source to users for innovation (Acs, Audretsch & Lehmann, 2013; Braunerhjelm, 2010; Croitoru, 2012). This phenomenon underlies the knowledge-based economy in which the structure of society, as argued by Leydesdorff (2012a), is continuously upset by transformations that originate from the techno sciences.

Thus, organised research, through its capacity to shape systems of innovation, provides a solid foundation for the knowledge-based economy (Leydesdorff, 2010; Romer, 1994).

In the knowledge-based economy, the pursuit of economic growth and development, as in any other economy type, is highly dependent upon the interplay of some key actors including the university, industry and the state, responsible for knowledge production, innovation and regulation, respectively (Afonso, Monteiro & Thompson, 2012; Leydesdorff, 2012b). The mandate of the university as the main knowledge producer and disseminator is described as the third mission of the university, in addition to the first and second corresponding missions of teaching and research (Dang & Umemoto, 2009; Etzkowitz, 2003; Göransson & Brundenius, 2011).

The third mission is often captured, in entrepreneurship literature, under concepts such as the entrepreneurial university, academic entrepreneurship, capitalisation or commercialisation of knowledge and commodification of academic research (D'Este & Perkmann, 2010; Etzkowitz, 2003; Guerrero & Urbano, 2010; Huggins & Johnston, 2009). It involves activities such as research collaboration, co-authorship, university patenting, licensing, spin-offs and business incubation (Etzkowitz, 2003; Guerrero & Urbano, 2010; Hughes & Kitson, 2012). According to Tuunainen (2013), the three university missions reflect various research-related roles that the university should perform (Huggins & Johnston, 2009).

Economically, the university is expected to provide industry with relevant knowledge for industrial innovation (Leydesdorff & Etzkowitz, 1998; 2005). From an institutional perspective, the university must undertake research into the functioning of institutions for policy action (Dang & Umemoto, 2009; Hughes et al., 2011) while socio-culturally, the university should offer the community or the public insights on alternative livelihoods for socio-cultural advancement (Tuunainen, 2013). Research collaboration provides an effective and efficient platform for the performance of the research-related roles of the university and the roles of the other actors (Mueller, 2005; Robin & Schubert, 2010).

Therefore, the central argument of the thesis is that knowledge, in the form of research findings, contributes to development through recursive interactions, such as research collaboration, that facilitate the flow of the knowledge from universities to knowledge users, and the use of the knowledge for innovation through entrepreneurship (Acs et al., 2009; Etzkowitz & Leydesdorff, 2000; Robin & Schubert, 2010). Nevertheless, the knowledge flow is dependent upon a number of factors explicated by the theory of planned behaviour, the network theory of social capital and the quadrant model of scientific research (Ajzen, 2011b; Lin, 2009; Stokes, 1997).

According to the theory of planned behaviour (Ajzen 1991; 2002), intention is a strong predictor of actual behaviour, hence, analysis of intention and its predictors is essential to the design of appropriate interventions for the promotion of the desired behaviour. The theory predicts that intention to engage in a given behaviour is dependent upon attitude towards the behaviour, perceived behavioural control, subjective norm and environmental possibility (Ajzen, 2011b; Côté, Gagnon, Houme, Abdeljelil & Gagnon, 2012). Particularly important is an environment that offers the necessary structures, systems and incentives in support of research collaboration (D'Este & Perkmann, 2010; Yawson, 2002).

The network theory of social capital (Lin, 1999) also postulates that persons engage in social relations, such as research collaboration, to achieve expressive or instrumental purpose in the form of consolidating or acquiring resources that will facilitate the attainment of returns which could also be instrumental or expressive in nature. As a result structural and positional variations and collective assets, such as trust and common ideology, are important in affecting the degree to which social relations thrive and yield fruitful results (Coleman, 1988; Granovetter, 2005).

Regarding the need to have a common ideology, for example, research type becomes very critical to research collaboration. Stokes (1997), in the quadrant model of scientific research, categorises research into basic, applied, and use-inspired basic research. Through the quadrant model of scientific research alternatively known as the Stokes' quadrant (Stokes, 1997), related studies, such as those by Baba, Shichijo and Sedita (2009) and Hughes and Kitson (2012), have established the existence of common research-related philosophical beliefs and needs between academic researchers and users, who collaborate for the generation of the requisite knowledge for innovation.

Thus, when an enabling environment exists, research collaboration is able to contribute to economic growth and development via the spillover of tacit knowledge from academic researchers to users who transform the knowledge into innovation via entrepreneurship (Baba et al., 2009; Robin & Schubert, 2010). This phenomenon is illustrated by the knowledge spillover theory of entrepreneurship (Acs et al., 2009) which predicts that the more efficiently knowledge flows over from entities such as universities and research institutes to other entities for exploitation, the bigger the effect of new knowledge on entrepreneurship for innovation, competitiveness, growth and development. In this way the stock of economic knowledge that expands the available set of entrepreneurial opportunities, grows to feed the knowledge base of the economy (Arrow, 1962; Audretsch, Hülsbeck & Lehmann, 2010).

Empirical test of the knowledge spillover theory of entrepreneurship by Acs et al. (2009) yielded strikingly robust support for the hypothesis that entrepreneurship tends to be systematically greater in the presence of knowledge spillovers, measured by quality adjusted patents. The implication is that, knowledge-driven entrepreneurial activities, such as the creation of new and improved firms and organisational forms, products, and processes (Ahlstrom, 2010; Schumpeter, 1934/1980), can benefit economic development,

> 'over the long-run by triggering a "take-off" from Malthusian stagnation,...stimulating structural economic transformation from a predominantly traditional/agricultural economy to a modern/industrial economy, and...generate continued productivity increases through innovation-driven growth ...' (Naudé, 2008, p. 34).

For analytical purposes, the link between knowledge and development could be described in a simple linear model. Research generates knowledge and the knowledge is acquired through learning (Arrow, 1969; Lundvall, 2009; Romer, 1986). New knowledge serves as a source of opportunities and is a crucial input factor for innovation that can be exploited commercially (Carlsson, 2009; Mueller, 2005). With such knowledge, entrepreneurs (Kirzner, 1999; Schumpeter, 1939) could enhance their innovative capacity that may yield organisational efficiency and effectiveness, the creation of more jobs, generation of revenue and availability of useful products that enhance the living standard and quality of life of people (Ahlstrom, 2010; Leibenstein, 1968; Powell & Snellman, 2004; Stel, Carree & Thurik, 2005).

Moreover, when the innovations possess sustainable competitive advantages and are traded internationally, they earn the national economy foreign exchange (Lucas, 1988; UNCTAD, 2011) which may be used for development projects such as infrastructure upgrading and provision of support for more productive research and development (Rodrik, 2001). In this way, all other things being equal, the stock of a country's knowledge capital contributes to national development, making the knowledge production function an essential structural component of the modern economy (Braunerhjelm, Acs, Audretsch & Carlsson, 2010). Baumol, Litan, Schramm and Strom (2011, p. 4) also argue that innovative and knowledge-driven entrepreneurship has become 'an important means by which technical change – the unexplained residual in standard growth equations – gets translated into economic growth'.

According to Etzkowitz and Leydesdorff (1995), in the 1990s, multinational institutions such as the European Union, the World Bank and the UN began to embrace concepts of knowledge-based economic development that bring the knowledge, productive and regulatory spheres of society into new configurations. Over the years, the vital role that knowledge plays in economic development has culminated into the call for nations to pursue knowledge-based development as against highly factor-driven development or the operation of a low-income agrarian economy (Lin, 2011).

As a result, several countries have instituted measures for the promotion of knowledge-based development through research collaboration. A key measure is the enactment of policies and legislation, such as the Bayh-Dole Act (1948) of the United States of America (USA), aimed at enhancing incentives and rewards of collaboration (Grimaldi, Kenney, Siegel & Wright, 2011; Guerrero & Urbano, 2010). In addition is the establishment of research foundations that offer funding, by aligning academic research with the demands of industry (Guerrero & Urbano, 2010; Stokes, 1997).

The various measures have, largely, focused on the academic disciplines of the Sciences, Technology, Engineering and Mathematics (STEM) due to the perception that these disciplines have the higher potential to commercialise their research results for the advancement of the knowledge-based economy (Bakhshi et al., 2008; Chang, Yang, Tsai-Lin & Chi, 2011). However, studies by Hughes et al. (2011) and Moore, Hughes and Ulrichsen (2010) indicate that research by all academic disciplines, including the Arts and the Social Sciences or the Humanities, can make substantial contributions to innovation.

Furthermore, in a comparative study of Sweden and the USA, Henrekson and Rosenberg (2001) identified incentives for academic entrepreneurship, including research collaboration, as comprising the formalisation of collaboration between universities and society in general, enactment of laws on intellectual property rights and the creation of research foundations and chairs that facilitated competitive funding of research towards advancement of industrial and national innovation (Bramwell & Wolf, 2008; Leydesdorff & Meyer, 2010). According to Henrekson and Rosenberg (2001), the USA had more returns on its investments than Sweden due to the promotion of an entrepreneurial culture, improvements in government and university regulations supporting academic entrepreneurship, and development of the venture capital industry in facilitating access to risk capital (Mansfield, 1995).

In Africa, the challenge to pursue knowledge-based development has also been accepted in diverse ways. The science, technology and innovation (STI) policy of the New Partnership for Africa's Development aims at harnessing and applying STI in order to eradicate poverty and achieve sustainable development as well as to ensure that Africa contributes to global scientific knowledge and technological innovations (Etzkowitz & Dzisah, 2007; Mouton, Gaillard & Lill, 2015). Some initiatives include the establishment of research and innovation councils that provide advice to governments without customarily engaging in policy development (Brundenius & Göransson, 2011; Mouton et al., 2015). The Association of African Universities (AAU) has also been promoting university-industry collaboration, for example through workshops.

There is also an increasing adoption of the mission of extension and outreach, and the establishment of technology transfer offices by universities to oversee licensing activities between the university and industry (Etzkowitz & Dzisah, 2007; Göransson & Brundenius, 2011). However, Schalkwyk (2015) notes in a review of a report on eight flagship African universities that universities engaged more in activities, such as consulting and service-oriented work, that were fueled by the need to secure external research funding. Furthermore, analysis of various national innovation systems (NIS) across the African continent by Mouton et al. (2015) revealed weak or fragmented NIS and relatively low investment in research and development (R&D) with many countries investing below 0.5 percent of their GDP in R&D.

In Ghana, the first national science and technology policy was launched in 2000 (Amankwah-Amoah, 2015). Available statistics show that Ghana's gross expenditure on research and development (GERD) as a percentage of GDP were 0.23 percent, 0.47 percent and 0.38 in 2007, 2008 and 2010, respectively (Bartels, Koria & Vitali, 2016; Mouton et al., 2015). The Council for Scientific and Industrial Research (CSIR), established in 1968 by the government of Ghana, is mandated among other functions to implement government policies on scientific research and development in agriculture, health, medicine, environment, technology and other service sectors. Another key function of the CSIR, per the CSIR Act, 1996 (Act 152), is to promote the commercialisation of research results through its thirteen research institutes (Asare & Essegbey, 2016; Appiah, Agyapong & Asamoah, 2012).

The CSIR also coordinates and administers the operations of the Science and Technology Research Endowment Fund (STREFund) which is governed by a board of trustees with representation from the CSIR, the Association of Ghana Industries, the Ministry of Finance and Economic Planning, universities, the National Council for Tertiary Education, the Ghana Academy of Arts and Sciences, and the Ghana Atomic Energy Commission (Ministry of Environment, Science and Technology, 2010; Mouton et al., 2015). Mouton et al. (2015) argue that the board is a mechanism by which the STREFund, as a second layer of agent, satisfies the interests of the CSIR as its immediate principal.

A study by Bartels and Koria (2014) on Ghana's national system of innovation established that the system faces several challenges including extensive co-ordination failures, ineffective framework of incentives and lack of connectivity between actors (Bartels & Koria, 2014). Jowi and Obamba (n.d.) in a research report identified other major and persistent challenges of Ghana's knowledge-based economy. Some of the challenges are lack of national and institutional policies and programmes that stimulate collaboration and knowledge exchange between research sub-systems and industry, inadequate and undiversified funding regimes, and dwindling public subsidies for research by public universities and research institutes.

Ghana's public universities are mandated, by the laws that established them, to conduct research that will advance the knowledge-base of the Ghanaian economy. For example, Section 2 of the Kwame Nkrumah University of Science and Technology Act, Kumasi Act – 1961 (Act 80) enjoins the university to provide higher education, undertake research, disseminate knowledge and foster relationships with outside persons and bodies. Similar mandates can be found in the University of Ghana Act, 2010 (Act 806) and the University of Cape Coast Law 1992 (PNDC Law 278). Section 2 of the University of Cape Coast Law stipulates that the university should execute its knowledge production function with particular reference to the needs and aspirations of the people of Ghana and other countries in Africa (Crabbe, 2005; Government of Ghana, 1961; Government of Ghana, 1992; University of Ghana, 2012).

Research in universities is expected to take precedence on national and university research agenda because other sources of knowledge such as public research institutes and firms are relatively under-resourced to conduct adequate research for technological innovation and catch-up (Robson & Obeng, 2008; Sawyerr, 2004). Moreover the Ghanaian economy, which is mainly driven by the private sector, thrives on the operation of micro, small and medium-sized enterprises (MSMEs) which constitute about 92 percent of businesses in the country (Abor & Quartey, 2010; Mensah & Nyadu-Addo, 2012). These enterprises hardly perform scientific research necessary for competitive innovations (Robson & Obeng, 2008). The research interests of the few capable firms may not also be driven by national research priorities due to conflicting interests like profit maximisation versus public goods (Fuller, 2005).

Consequently, there have been mounting calls on higher education institutions to align their research agenda with regional and national development priorities and with much expectation on academic researchers to collaborate with users of research findings (Government of Ghana, 2010; UNCTAD, 2011). The priorities include development of education, agriculture and agro-processing sectors, ICT, science, technology and mathematics, and oil and gas (Government of Ghana, 2010; UNCTAD, 2011). There are ongoing consultations, spearheaded by the government of Ghana, to establish a research foundation that will call for competitive grant applications from academic researchers, with the aim of ensuring that society benefits from state-funded research (Vice Chancellors Ghana, July 17, 2013).

Moreover the third university mission, of contributing towards development through outreach and extension, is already part of the mission statements of several universities notably, those of the University of Cape Coast (UCC) and the Kwame Nkrumah University of Science and Technology (KNUST). Both universities have the strategic mandate to provide higher education, undertake research, disseminate knowledge and foster relationships with stakeholders (Kwame Nkrumah University of Science and Technology 2005; University of Cape Coast, 2012a).

The corporate strategic plans of both universities highlight the commitment of the institutions towards entrepreneurship and regional development (Kwame Nkrumah University of Science and Technology, 2005; University of Cape Coast, 2012a). The University of Cape Coast communicates this entrepreneurial mandate, for instance, in its quest to produce entrepreneurial or enterprising graduates, nurture proactive administrative and academic staff to respond to development needs of the regional and national economy, and promote scholarship in teaching, research and extension services (University of Cape Coast, 2012a). The vision statement of KNUST succinctly points to the advancement of knowledge in science and technology for sustainable development in Africa (Kwame Nkrumah University of Science and Technology, 2005; Sawyerr, 2004).

Consequently, UCC and KNUST have over the years established a number of research centres and institutes in line with the strategic focus of Ghana's Medium-Term National Development Policy Framework (Government of Ghana, 2010; Kwame Nkrumah University of Science and Technology 2005; University of Cape Coast, 2012b). The universities have also introduced similar structures and incentives, such as funding, in support of research and extension. Put together, UCC and KNUST provide a comprehensive population of the STEM, the Arts and the Social Sciences. Such a population is ideal for comparative analysis by academic discipline in contributing towards the debate as to whether the STEM should continue to take precedence over other academic disciplines in the promotion of research for development (Bakhshi et al., 2008; Chang et al., 2011).

Statement of the Problem

In the knowledge-based economy universities, and for that matter academic researchers, have the mandate to undertake research, disseminate the research findings and assist in the use of the findings in innovation for national competitiveness, growth and development (Etzkowitz, 2003; Johnson et al., 2002; Leydesdorff, 2012a). This entrepreneurial role of universities is highly crucial in the Ghanaian economy due to high incidence of poverty and unsteady economic growth. About 24 percent of Ghana's population live below the poverty line while the country's GDP has not been growing steadily. Ghana's GDP has been in the range of 7 percent per annum since the 2000s. It reduced to 4 percent, 3.4 percent and rose to 4.9 percent in 2014, 2015 and the first quarter of 2016, respectively (Amankwah-Amoah, Ifere & Nyuur, 2016; Boachie & Ramu, 2015; Ghana Statistical Service, 2016).

However in Ghana, there appears to be under-utilisation of academic research results for innovation (Bloom et al., 2006; Etzkowitz & Dzisah, 2007; UNCTAD, 2011). Since the 1960s when the first three public universities were established in the country, academics have been conducting research (Sawyerr, 2004). Thus several volumes of research are produced, each year, in Ghanaian universities in fulfillment of promotion requirements which obligate academic researchers to undertake research and disseminate the findings. In addition, hundreds of student research projects and theses are produced each year under the supervision of academics. Ordinarily, the results of such research should enhance the innovation capacity of the country for growth and development.

Nevertheless, Ghana has not made major strides in this regard as evidenced by the country's rising innovation deficit (UNCTAD, 2011). Available rankings on global innovation indicated that Ghana ranked 115 out of 133 countries in 2009 (UNCTAD, 2011) and dropped from 96 out of 141 countries in 2014 to 108 out of 143 countries in 2015 (Bartels et al. 2016). Similarly Ghana's competitiveness ranking on technological readiness stood at 112 out of 133 countries in 2009 (UNCTAD, 2011).

The country is also saddled with huge imports which put a strain on its GDP. Statistics from the World Integrated Trade Solution (WITS) of the World Bank indicate that Ghana's import of goods and services as a percentage of GDP stood at 46.31 in 2013 and rose to 48.51 in 2014 while export of goods and services as a percentage of GDP was 33.36 in 2013 and 38.87 in 2014. The WITS further shows that Ghana's exports of goods and services as a percentage of GDP did not experience steady growth from 2010 to 2014 with respective percentages of 29.48, 36.89, 40.09, 33.36 and 38.87, respectively.

The WITS database, 2013 fact sheet, also shows that export of consumer goods accounted for 6.8 percent of total exports against 35.53 percent of total imports among four product categories, namely, raw materials, intermediate goods, consumer goods and capital goods. Additionally, exports of raw materials constituted 41.37 percent of total exports while import of capital goods stood at 30.82 percent share of total imports. The huge import of consumer and capital goods, in the face of a higher concentration of export on raw materials, makes research collaboration imperative to the transformation of raw materials into higher order goods and the provision of value-added services for national consumption and export-driven growth. The importance of academic or science-based research to economic growth and development has been well-established.

Academic research, for example, has been a valuable source of knowledge and or entrepreneurial opportunities for innovations that have placed economies such as that of the US and Germany, especially in biotechnology, on the forefront of global trade and economic development (Etzkowitz, 2003; Etzkowitz, Webster, Gebhardt, Regina & Terra, 2000). Recursive interactions between academia and industry were key to the success stories of these economies (Leydesdorff, 2012a; Robin & Shubert, 2010). The apparent limited research collaboration and under-utilisation of academic research results for innovation in Ghana, could be attributed to a number of factors explicated, in this thesis, with the theory of planned behaviour (Ajzen, 1991; 2011b), the network theory of social capital (Lin, 1999; 2008), and the Stokes' quadrant (Stokes, 1997).

Firstly, on the basis of the theory of planned behaviour (Ajzen, 1991; 2011b) the parties to research collaboration, for example academic researchers, may not have high intention to collaborate, leading to low engagement in research collaboration and limited use of academic research findings for innovation. Alternatively high intention to collaborate may not translate into actual engagement in research collaboration as desired, for example, due to the fact that academic researchers perceive certain critical factors, such as availability of requisite resources, to be limited or non-existing (Ajzen, 1991; Hughes et al., 2011). As postulated by the theory of planned behaviour, persons will actually act as expected if, for example, they have the right attitude towards the behaviour and believe they have control over the behaviour (Ajzen, 1991; 2011b; Cheung & Vogel, 2013).

Thus, for instance, public support in the form of environmental possibilities for research collaboration may be biased towards the STEM thereby depriving researchers in the Arts and the Social Sciences of active involvement in research collaboration (Bakhshi et al., 2008; Hughes et al., 2011). For example, Oduro-Marfo (2015) criticises the 2010 Ghana National Science, Technology and Innovation Policy for treating innovation as an offshoot of only Science and Technology. However, the emerging literature indicate the valuable contributions that research from the Arts and the Social Sciences could make towards the advancement of the knowledge-based economy, thus making the disciplines equally relevant for promotion (Hughes et al., 2011; Moore et al., 2010).

Secondly, there may be limited opportunities for collaboration that meets the aspirations of academic researchers (Hughes & Kitson, 2012). Empirical studies, such as that by D'Este and Perkmann (2010) and Hughes et al. (2011), indicate that academic researchers engage with users, primarily, to learn and have access to in-kind resources that advance their research work. The research-related goal is in line with the network theory of social capital which describes such goal as instrumental purpose (Lin, 2008). In addition, on the basis of the network theory of social capital (Lin, 2008), fulfilment of the purpose of research collaboration may be reflected in the positive impact of the collaboration on the profession and welfare of academic researchers (Hughes & Kitson, 2012). In the absence of such opportunities, research collaboration is likely to be limited in the economy, that is, academic researchers may engage less often in it or, for some, not at all.

Thirdly the seeming under-utilisation of research results for innovation, may be attributable to academic researchers engaging more in research collaborations that aim at problem solving and knowledge generation instead of innovation (Abdi & Ali, 2013; Mouton et al., 2015) which, according to the theory of economic development, is a critical stimulus to economic growth and development (Schumpeter 1934/1983). Academic researchers may also be engaging in fewer collaborations with the private sector, which constitutes the engine of growth in the Ghanaian economy, possibly, due to limited opportunities for collaboration, such as limited funding and the existence of an ivory tower between the two sides (Mensah & Nyadu-Addo, 2012; Robson & Obeng, 2008; Shapin, 2012).

Fourthly, per empirical studies such as that by Hughes and Kitson (2012) situated within the quadrant model of scientific research (Stokes, 1997), there should be compatibility between academic research and the demands of users of research findings. As a result limited collaboration may take place between academia and the user community, for instance, if there is a mismatch between the research orientations of the two sides (Hughes et al., 2011; Stokes, 1997). Moreover, literature increasingly suggests the need for research in developing countries to focus on learning-by doing instead of re-inventing the wheel (Lucas, 1988; Mathews & Hu, 2007; Romer, 1986). Therefore, if most academics pursue research agenda that are different from the demands of the economy, the probability of limited research collaboration and the resultant under-utilisation of research results for innovation, is likely to be high.

Furthermore, the challenges of research collaboration may be enormous deterring most academic researchers from collaborations that will transform their research findings into useful innovations for national development (Robin & Schubert, 2010; Schumpeter, 1934/1983). For instance, clash of values between academic researchers and knowledge users and lack of time for research collaboration may prevent academics from initiating or engaging in useful research collaborations (Hughes & Kitson, 2012; Moore et al., 2010).

Furtherance to the preceding discussions and the outcome of the review of related literature, two key inferences can be drawn on research collaboration for attainment of a knowledge-based economy in Ghana. Firstly, although there appears to be limited research collaboration between academics and users of research findings in Ghana, the outcome of extensive review of literature suggests that there has not been any systematic research on the subject matter. Hence one is not very sure, for instance, of the extent of involvement of academic researchers in research collaboration which, within the framework of the network theory of social capital (Lin 199; 2008), is essential to capitalisation in the form of using resources embedded in social relations to achieve specific purposes such as knowledge production and innovation (Granovetter, 1985; 2005).

Secondly, not much is known about the willingness or intention of academic researchers to engage in research collaboration, considering systems in support of research collaboration. Furthermore, existing literature on the subject matter appears to be highly informed by developed country experiences thereby necessitating the conduct of research in a developing country setting to augment the evolving literature and, particularly, to contribute to the debate on the relevance of different academic disciplines to innovation in the knowledge-based economy (Bakhshi et al., 2008; Moore et al., 2010). Therefore, the study sought to analyse the intention of academic researchers to collaborate and examine various dynamics of the involvement of academics in research collaboration.

Purpose of the Study

The purpose of the study was to examine research collaboration for attainment of a knowledge-based economy in Ghana.

Research Objectives

The specific objectives of the study were to:

1. analyse the determinants of the intention of academic researchers to collaborate across the STEM, the Social Sciences and the Arts.
2. examine the involvement of academic researchers in research collaboration. This objective also seeks to analyse the number of times academics from the STEM, the Social Sciences and the Arts engage in research collaboration as well as the factors that are considered important to the research collaboration.
3. explore the use of collaborative research findings, from the STEM, the Social Sciences and the Arts, in innovation.
4. examine the research orientation of academic researchers across the STEM, the Social Sciences and the Arts.
5. assess the welfare and profession-related impact of research collaboration.

6. analyse the challenges of research collaboration.
7. make recommendations for policy action.

Research Questions

The study sought to address the research objectives by finding answers to the following questions.

1. What are the determinants of the intention of academic researchers to collaborate across the STEM, the Social Sciences and the Arts?
2. What constitutes the involvement of academic researchers in research collaboration?
3. To what extent are collaborative research findings from the STEM, the Social Sciences and the Arts used in innovation?
4. What is the research orientation of academic researchers across the STEM, the Social Sciences and the Arts?
5. What are the welfare and profession-related impact of research collaboration?
6. What are the challenges of research collaboration?

Research Hypotheses

In relation to the first four objectives of the thesis, the following hypotheses were tested. A number of the hypotheses were composite in nature. That is they constituted individual but related variables which were separately tested in the analysis and presentation of results. The hypotheses were Hypothesis 1(b), Hypothesis 1(c), Hypothesis 3 and Hypothesis 4.

Hypothesis 1(a)

H_0: There is no significant difference among academic researchers in the Sciences, Technology, Engineering and Mathematics (STEM), the Social Sciences, and the Arts, in their intentions to collaborate.

H_1: There is a significant difference among academic researchers in the Sciences, Technology, Engineering and Mathematics (STEM), the Social Sciences, and the Arts, in their intentions to collaborate.

Hypothesis 1(b)

H_0: Attitude towards research collaboration, perceived behavioural control over research collaboration, subjective norm on research collaboration and perceived environmental possibility for research collaboration, do not significantly influence intention to collaborate.

H_1: Attitude towards research collaboration, perceived behavioural control over research collaboration, subjective norm on research collaboration and perceived environmental possibility for research collaboration, significantly influence intention to collaborate.

Hypothesis 1(c)

H_0: There is no significant difference among academic researchers from the STEM, Social Sciences and the Arts in their attitude towards research collaboration, perceived behavioural control over research collaboration, subjective norm on research collaboration and perceived environmental possibility for research collaboration.

H_1: There is a significant difference among academic researchers from the STEM, Social Sciences and the Arts in their attitude towards research collaboration, perceived behavioural control over research collaboration, subjective norm on research collaboration and perceived environmental possibility for research collaboration.

Hypothesis 2

H_0: There is no significant difference in the number of research collaboration by academic researchers from the Sciences, Technology, Engineering and Mathematics (STEM), the Social Sciences, and the Arts.

H_1: There is a significant difference in the number of research collaboration by academic researchers from the Sciences, Technology, Engineering and Mathematics (STEM), the Social Sciences, and the Arts.

Hypothesis 3

H_0: There are no significant differences among academic researchers in the Sciences, Technology, Engineering and Mathematics (STEM), the Social Sciences, and the Arts, in the extent to which their collaborative research findings contributed to product innovation, service innovation, technological innovation, process innovation, administrative innovation and opportunity-related innovation.

H_1: There are significant differences among academic researchers in the Sciences, Technology, Engineering and Mathematics (STEM), the Social Sciences, and the Arts, in the extent to which their collaborative research findings contributed to product innovation, service innovation, technological innovation, process innovation, administrative innovation and opportunity-related innovation.

Hypothesis 4

H_0: There are no significant differences among academic researchers in the Sciences, Technology, Engineering and Mathematics (STEM), the Social Sciences, and the Arts, in their research orientation as basic researchers, applied researchers and use-inspired basic researchers.

H_1: There are significant differences among academic researchers in the Sciences, Technology, Engineering and Mathematics (STEM), the Social Sciences, and the Arts, in their research orientation as basic researchers, applied researchers and use-inspired basic researchers.

Significance of the Study

This study may serve to augment the existing literature on research collaboration in two main ways. Firstly, it could be useful in providing a developing country perspective on the evolving literature on interactions between the university and knowledge users, in the knowledge-based economy. Secondly, it is anticipated that the findings of this study will contribute to the debate on the role and relevance of the Arts and Social Sciences in the knowledge-based economy, and will also offer justification for improvement in the promotion of the two disciplines (Bakhshi et al., 2008; Hughes et al., 2011).

Moreover, the study may provide a foundation for further related studies, such as one from the perspective of users of research output in Ghana.

The findings of the study may also be useful in the identification of issues that should be addressed through policy for the promotion of research collaboration between academics and knowledge users, in building the knowledge base of the Ghanaian economy. Furthermore, the findings may be practically relevant in identifying training and development needs of academics for effective and efficient collaboration with users of their research results.

Delimitations

The study focused on academic researchers in the University of Cape Coast (UCC) and the Kwame Nkrumah University of Science and Technology (KNUST). Research collaboration involves at least two groups of key actors in the knowledge-based economy. The actors are academic researchers and knowledge users. However, the study concentrated on academic researchers only, purposely, to make room for a more focused, and extensive, study of research collaboration from their perspective. Specifically, the intention of academic researchers and predictors of the intention were analysed. In addition, the dynamics of research collaboration were studied. The dynamics of research collaboration studied, included analysis of the involvement of academic researchers in research collaboration, use of collaborative research findings in innovation, as well as the essentials, impact and challenges of research collaboration.

Definition of Key Terms

A number of variables and terms were employed in the study. Below are some key variables and terms and their definitions, as used within the context of the study.

1. *Research collaboration* was operationalised as interaction(s) between academic researchers and knowledge users for the production of research output that is useful for innovation and or problem solving.
2. *Intention to collaborate* was defined as the willingness to engage in research collaboration.
3. *Attitude towards research collaboration* comprised the conviction and the relevance attached to the conviction that research collaboration will advance an individual's profession and personal welfare.
4. *Perceived behavioural control over research collaboration* was operationalised as the belief and the importance attached to the belief that one is capable of carrying out various types of research and relate well with collaborating partners.
5. *Subjective norm on research collaboration* was defined as the extent to which the university, immediate superiors and colleagues expected respondents to collaborate, and the willingness of respondents to comply with the expectations.
6. *Perceived environmental possibility for research collaboration* referred to the importance and availability of rewards, funding and administrative support for collaboration.

7. *Innovation* consisted of using research findings in developing and or improving upon a good, service, process, tools and or equipment, alternative source(s) of livelihood, laws, policies and or organisational systems and procedures, and market.
8. *Basic research* was defined as research aimed at creating understanding.
9. *Applied research* was operationalised as research that is conducted in order to obtain findings that can be used for innovation or problem solving.
10. *Use-inspired basic research* was defined as research that is conducted with the purpose of creating understanding and applying the findings in innovation and or problem solving.
11. *Knowledge-based economy* referred to an economy in which knowledge drives economic growth and development and, as a result, great investments are made in research, innovation and human and social capital.
12. *Knowledge filter* was defined as the gap that exists when investment in knowledge creation yields new knowledge that is yet to be exploited and put to commercial use.
13. *Swedish paradox* was defined as a situation whereby entrepreneurial opportunities, generated through investments in knowledge production, remain under-exploited or are exploited outside the economic system because there are only a few entrepreneurs, in the economy, to innovate and or the knowledge does not flow to entrepreneurs for innovation.

Organisation of the Study

The thesis is organised into nine Chapters, including this Chapter which is an introduction to the thesis. Chapter two consists of review of related theories and concepts whereas Chapter three comprises empirical literature review, lessons learnt from the entire literature review and presentation of the conceptual framework of the study. Rubrics of the research methodology are presented in Chapter four within the framework of a descriptive and analytical survey design. Chapter five consists of presentation and discussion of research findings on the determinants of intention to collaborate, as informed by the theory of planned behaviour (Ajzen, 1991; 2011b). Findings and discussions on the dynamics of research collaboration are presented in Chapters six to eight.

Specifically, based on the network theory of social capital (Lin, 1999; 2008), involvement of academics in research collaboration is analysed and discussed in Chapter six. Informed by the theory of economic development (Croitoru, 2012; Schumpeter, 1934/1983) and the quadrant model of scientific research (Stokes, 1997; Hughes & Kitson, 2012), the contributions of research collaboration to innovation, and the research orientation of academics and its implications on the knowledge-based economy, are presented in Chapter seven. Chapter eight comprises findings and discussions on the impact and challenges of research collaboration, while Chapter nine consists of summary and conclusions of the study, contributions to knowledge, limitations of the study and suggestions for further research.

CHAPTER TWO

THEORETICAL AND CONCEPTUAL REVIEW

Introduction

Literature review, according to Zikmund, Babin, Carr and Griffin (2013), is a directed search of published works that discusses theory and presents empirical results, relevant to the topic at hand. Additionally, Leedy and Ormrod (2010) indicate that literature review helps in the formulation of the research problem and it offers relevant information on methodological and design issues, as well as insights into how to analyse, interpret and report data and research findings. Moreover, Webster and Watson (2002) argue that effective literature review creates a firm foundation for advancing knowledge, for example, by uncovering areas where research is needed.

Accordingly, this Chapter of the thesis consists of thematic review of related theories and concepts. The theoretical review includes presentation and discussion of four theories that underpin the study while the conceptual review takes a look at key concepts of each of the theories and how these relate to guide the achievement of the research objectives.

Theoretical Review

The theoretical review begins with the theory of economic development (Schumpeter, 1934/1983) and ensuing Schumpeterian growth models (Zachariadis, 2003), which elucidate innovation as the main driver of economic development, and research as an important source of innovation, respectively. The next theory is the knowledge spillover theory of entrepreneurship (Acs et al., 2009) which illustrates how knowledge, generated through research, contributes to economic development. In addition, the network theory of social capital (Lin, 1999; 2008) is presented as an explanation of the dynamics of social interactions, such as research collaboration. Furthermore, a key thrust of this research was the quest to analyse the intention of academics to collaborate and the determinants of intention to collaborate. As a result, the study drew upon the theory of planned behaviour (Ajzen, 1991; 2011b) in the identification of essential constructs and concepts.

The Theory of Economic Development

The theory of economic development was propounded by Schumpeter (1934/1983) as an explanation of the process of economic development. The theory postulates that an economic system goes through a cyclical process of alternating booms and depressions with occasional crises. According to the theory (Schumpeter, 1934/1983) innovation, defined as the carrying out of new and untried combinations, forms the characteristic feature of a period of boom. The theory further states that there must always be a depression, that is a process of absorption, between two booms (Andersen, 2012; Croitoru, 2012).

The development of the theory was informed by a number of gaps in earlier theoretical works. Notable among them was the prime attribution of economic development to capital accumulation as, for example, presented by neoclassical theorists like Marx (1847/1999) and the postulate that development takes a uniform unilineal nature as put forward, for example, by Roscher (as cited in Schumpeter, 1934/1983) and in later years by Rostow (1959). Contrary to these views Schumpeter (1934/1983; Korotayev, Zinkina & Bogevolnov,

2010) demonstrates, through the theory of economic development, that innovation is the main driver of economic development and it is as a result of innovation that economic development proceeds cyclically.

According to Schumpeter (1934/1983), the relationship between innovation and the business cycle contrasts the doctrine, for example by Keynes (1924; von Hayek, 1931) and Fisher (1933), which sees in the business cycle essentially a monetary phenomenon or one which has its root in bank credit. Moreover, contrary to the usual emphasis on the downsides of depression (Ellis, 1911; Mitchell & King, 1923), Schumpeter (1934/1983; Wood, 2005) demonstrates that depression acts as an instrumental process of absorption which moves the economic system towards a position of equilibrium necessary for development in the subsequent boom. The predictions of the theory of economic development are based on several assumptions, principles and conditions, some which are of relevance to the thesis.

Firstly, in order to show the nature and the source of economic development, the theory assumes constant conditions in a circular flow of economic life. This implies that economic development arises out of equilibrium, that is, a position without economic development and that there is a commercially organised state characterised by private property, division of labour and free competition (Schumpeter, 1934/1983). The assumption is guided by the Wieser's principle of continuity which Schumpeter (1934/1983, p. 9; Ebner, 2006) describes to consist of several facets summed up as follows: "the economic system will not change capriciously on its own initiative but will at all times be connected with the preceding state of affairs". In relation to competition, Archibugi, Filippetti and Frenz (2013) note that competition is fierce and entrepreneurial spirit plays a crucial role.

Comparatively, the assumption of constant conditions in the circular flow of economic life is consistent with neoclassical theory which also assumes an equilibrium state whose alteration is mainly driven by the firm and production in a competitive industry (Nelson & Winter, 1974). However, the assumption contrasts Kirzner (1999; Wood, 2005) whose complementary theoretical works illustrate that entrepreneurial opportunities arise through market disequilibrium largely created by information asymmetry. Nonetheless, the Schumpeterian and Kirznerian schools of thought share a similarity in terms of the need for entrepreneurial alertness, for instance, to face fierce competition or to recognise the gap created by the disequilibrium (Chiles, Bluedorn & Gupta, 2007; Roininen & Ylinenpää, 2009).

Secondly Schumpeter (1934/1983) demonstrates, in the theory of economic development, that capital investment and the carrying out of new combinations are the sources of cyclical disturbances in a boom. By this assumption, the theory identifies the causal nexus of development to begin with the means of production which are bought with capital (Schumpeter, 1934/1983). This prediction agrees, in part, with neoclassical theory (Fisher, 1933; Solow, 1956) and evolutionary theory of development (Nelson & Winter, 1974; Nelson & Pack, 1999) which acknowledge the importance of capital accumulation to economic development.

Thus the theory of economic development illustrates that entrepreneurs, supported by capital in the form of bank credit, produce innovations such as the introduction of new or improved products and the opening of a new market

(Schumpeter 1934/1983). If the innovations are successful, imitators follow, first in the industry of origin and subsequently in other parts of the economy, a phenomenon which according to Schumpeter (1934/1983), results in the appearance of innovations in the economy in swarms or groups. These inferences reflect endogenous growth (Arrow, 1969; Romer, 1986), which Romer (1994) defines as growth that is propelled by forces within an economic system and not a result of forces from outside the system.

Furthermore Schumpeter (1934/1983) argues that the new enterprises, that innovate, either completely eliminate the old businesses or force them to restrict their operations, a process described by Schumpeter (1950; Kirzner, 1999) as creative destruction. However, Bergek, Berggren, Magnusson and Hobday (2013) argue that when technological discontinuities seldom lead to creative destruction, creative accumulation prevails. According to Bergek et al. (2013), in creative accumulation incumbents perceive the potential of new technologies and integrate them with existing capabilities.

In other words, the new entrants fail to creatively destroy the old due to their inability to match the incumbent's accumulated knowledge, experience, and capacity on the market (Bergek et al., 2013; Shiu, Wong & Hu, 2014). Leydesdorff and Rafols (in press) indicate that the concept of creative accumulation arose from the latter works of Schumpeter, dubbed Schumpeter Mark II, in which large corporations accumulate non-transferrable knowledge for innovation. In the theory of economic development, a number of conditions must be met for economic development to be ushered into the circular flow.

One key condition is that credit is primarily necessary to new combinations and that it is as a result that it forces its way into the circular flow

(Schumpeter, 1934/1983). According to Schumpeter (1934/1983), in principle, only the entrepreneur needs credit and only for industrial development does it play a fundamental role. Secondly, the theory is based on the condition that economic change, in the form of the new combinations, is initiated by new entrepreneurs and consumers are educated by them if necessary (Schumpeter 1934/1983). The first condition indicates the importance of fiscal discipline and investing in productive activities (Mueller, 2005; OECD, 2009) while the second condition points to the relevance of marketing of new innovations (Roininen & Ylinenpää, 2009).

In spite of the diverse contributions to economic development literature, the theory of economic development has been criticised in several ways. Particularly, Schumpeter's (1934/1983) description of the business cycle as consisting of a single wave-like movement has been faulted in literature since, in reality, there are several waves (Andersen, 2012; Korotayev & Tsirel, 2010). In addition, the theory appears not to have given much prominence to the source of entrepreneurial opportunities which has prompted several discussions, including that by Kirzner (1999). Kirzner (1999) and Chiles et al. (2007) illustrate, through comparative analysis, that in "Kirznerian entrepreneurship" entrepreneurial opportunities arise through market disequilibrium while in a Schumpeterian growth framework, opportunities emanate from market equilibrium and vision, which spark off innovation (Blundell & Locket, 2010).

As a result subsequent development of the theory, through modelling within the framework of endogenous growth, took care of the source of entrepreneurial opportunity gap by demonstrating the correlation between research on one hand, and innovation or development on the other. The models are categorised into first generation endogenous growth models and second-generation models. The second-generation models are further categorised into semi-endogenous growth models and Schumpeterian growth models (Dinopoulos & Şener, 2007; Ha & Howitt, 2005). The second generation models emerged in the wake of the first on the premise that the first generation models had invalid scale effect implications. Jones (1995), for example, criticised the models on the rising R&D expenditures in relation to constancy of total factor productivity (TFP) growth.

According to Ang and Madsen (2009), the first generation endogenous growth models, such as Romer (1990) and Howitt (1999), illustrate that total factor productivity (TFP) growth is positively related to the levels of R&D leading to an assumption of scale effects in ideas production. However, the semi-endogenous models, for example by Jones (1995) and Segerstrom (1997) predict a continuous increase in R&D to sustain a positive TFP growth on the assumption of diminishing returns to the stock of R&D knowledge. Nonetheless, Schumpeterian growth models, such as those developed by Dinopoulos and Thompson (1998) and Howitt (1999), illustrate that "...growth can still be sustained at a constant level if R&D is kept to a fixed proportion of the number of product lines, which is in turn proportional to the size of the population along the balanced growth path" (Ang & Madsen, 2009. pp. 3-4).

However, later studies including that by Zachariadis (2003) reconfirm, to a greater extent, the authenticity of the first generation models through a fully-endogenous Schumpeterian growth theory without scale effect. The models, as noted by Braunerhjelm (2010), demonstrate the relevance of investments in knowledge and human capital, as embodied in research and development, which generate economic growth through the spillover of knowledge. As a result, Braunerhjelm et al. (2010, p. 105) argue that the intellectual breakthrough of endogenous growth theory 'was the recognition that investments in knowledge and human capital endogenously generate economic growth through the spillover of knowledge'.

The Knowledge Spillover Theory of Entrepreneurship

The knowledge spillover theory of entrepreneurship was propounded by Acs et al. (2009) to demonstrate how knowledge contributes to development via entrepreneurship. Firstly, the theory postulates that an increase in the stock of knowledge has a positive effect on the level of entrepreneurship. Secondly, the theory predicts that the more efficiently incumbents exploit knowledge flows, the smaller the effect of new knowledge on entrepreneurship. Thirdly, according to the theory, entrepreneurial activities decrease under greater regulation, administrative burden and market intervention by government (Acs et al., 2013). Thus, ceteris paribus, the theory predicts that

> 'entrepreneurial activity will be greater where investments in new knowledge are relatively high, since start-ups will exploit spillovers from the source of knowledge production (the incumbents). In an environment with relatively low investments in new knowledge, there will be fewer entrepreneurial opportunities based on potential spillovers' (Acs et al., 2009, p. 17).

The predictions of the knowledge spillover theory of entrepreneurship (Acs et al., 2009) are based on three main assumptions. Firstly, the theory assumes that all knowledge is economic knowledge contrary to endogenous growth frameworks (Arrow 1962; Romer, 1990) which distinguished between knowledge and economic knowledge. Secondly, the theory assumes intra-temporal knowledge spillovers from incumbents to start-ups, as opposed to inter-temporal spillover of knowledge in the endogenous growth frameworks. Thirdly, the theory assumes that radical innovation comes from new firm start-ups. The assumptions reflect the essence of the knowledge-based economy characterised by structural and institutional arrangements that spur knowledge production and knowledge usage in the form of research and innovation, respectively (Leydesdorff, 2010; 2012b).

Comparatively, in agreement with the theory of economic development (Schumpeter 1934/1983), the knowledge spillover theory of entrepreneurship (Acs et al., 2009) recognises entrepreneurship as key to economic development and emphasises entrepreneurial start-ups as important users of knowledge for the development of competitive innovations. Moreover, both the knowledge spillover theory of entrepreneurship (Acs et al., 2009) and Schumpeterian growth frameworks (Aghion, Akcigit & Howitt, 2013) establish the importance of knowledge, particularly research output, and investments in knowledge production to economic growth and development.

Furthermore, the theory of economic development (Schumpeter 1934/1983), Schumpeterian growth frameworks (Dinopoulos & Thompson, (1998; Howitt, 1999) and the knowledge spillover theory of entrepreneurship (Acs et al., 2009) recognise the need for government support in the economic system. The theory of economic development advocates for government support, such as subsidies, in periods of economic crises for industries that are critical to a nation's economic development while the knowledge spillover theory of entrepreneurship emphasise the importance of lesser administrative and regulatory burden to the intra-temporal spillover of tacit knowledge. In addition, the knowledge spillover theory of entrepreneurship and Schumpeterian growth frameworks illustrate the need for an economy to invest in research and development.

The knowledge spillover theory of entrepreneurship establishes the transmission of knowledge spillovers as critical to the exploitation of knowledge for economic growth (Acs et al., 2009). Specifically, the theory illustrates that for knowledge, such as research output, to contribute to innovation and hence economic growth, it must move from universities and other knowledge producers to knowledge users, particularly start-ups, otherwise the economy will not make significant gains from knowledge production. This is because knowledge spillovers serve as possible sources of entrepreneurial opportunities that drive innovation. The theory further shows that knowledge spillovers are greater when entrepreneurs are located in close proximity to knowledge producers (Acs et al., 2009; Acs et al., 2013).

In contrast to endogenous growth frameworks which do not explicitly link entrepreneurship to investment in new knowledge and knowledge spillover, Acs et al. (2009) and Braunerhjelm et al. (2010) agree that the knowledge spillover theory of entrepreneurship illustrates entrepreneurship as a key mechanism that may enhance the effect of knowledge investments through the transformation of the knowledge into competitive innovations that drive economic growth and development. This particular role of entrepreneurship is deemed critical in bridging the knowledge filter which Acs et al. (2013) describe as the gap that exists when investment in knowledge creation yields new knowledge that is yet to be exploited and put to commercial use. In addition, entrepreneurship serves as a means to overcome what is termed the Swedish paradox.

The Swedish paradox, according to Ejermo and Kander (2006) and Braunerhjelm et al. (2010) consists of a situation whereby entrepreneurial opportunities, generated through investments in knowledge production, remain under-exploited or are exploited outside the economic system because there are only a few entrepreneurs, in the economy, to innovate. Braunerhjelm et al. (2010) and Block, Thurik and Zhou (2013) explain that mere investment in knowledge creation does not automatically yield competitive innovations for economic growth and development. Instead, they argue that it is through entrepreneurship that knowledge is transformed into competitive innovations that drive economic growth and development.

Entrepreneurship, as explained by Barringer and Ireland (2008) and Shane, Locke and Collins (2012), consists of creativity and innovation. Creativity comprises the mental process of idea generation whereas innovation involves the application of the creative ideas to solving problems or the exploitation of entrepreneurial opportunities (Mumford, Hunter & Byrne, 2009; Zimmerer & Scarborough, 2009). By these definitions it could be inferred that at the macro-economic level, as informed by the knowledge spillover argument, knowledge producers are primarily involved in creativity while knowledge users mainly engage in innovation.

Closer and recursive interactions must occur between knowledge producers and users to ensure that the right knowledge is produced and used for innovation (Huggins & Johnson, 2009; Leydesdorff, 2010). For example, Robin and Schubert (2010) acknowledge that interaction between industry and science is one of the most prominent institutional interfaces for knowledge diffusion and innovation. Nonetheless, the knowledge spillover theory of entrepreneurship (Acs et al., 2009) does not explicitly illustrate the dynamics of interactions, such as research collaboration, for the spillover of knowledge from incumbents to users. As a result, the network theory of social capital (Lin, 1999; 2008) is employed to provide a framework for understanding the dynamics of research collaboration.

Network Theory of Social Capital

The network theory of social capital (Lin, 1999) illustrates the nature of networks and the use of social capital in networks, such as research collaboration, to achieve purposive actions. Lin (1999) propounded the theory upon the premise that network-based literature on social capital was perceived to be shrouded in less-reconciling views which, largely, belonged to two main schools of thought, namely, structural hole and network closure (Portes, 1998). According to Burt (1997), the structural hole argument dwells on weaker social ties which offer the broker of the ties an advantage of control over information and projects in the network while network closure, as argued by Coleman (1988), focuses on group norms, shared goals and similar behaviour that turn a network of actors, with strong ties to one another, into a collective entity.

Moreover, contrary to network closure which is based on the principle of homophily, structural hole is grounded on heterophily. The principle of homophily proposes that there is a strong correspondence between intensity of interactions, shared sentiments and shared resources (McPherson, Smith-Levin

& Cook, 2001; Rutashobya, Allan & Jaensson, 2001). Consequently, for the inner layer among ties that bind, there is also a tendency for similarity of resources or capital. On the other hand, in line with the principle of heterophily (Fu, Nowak, Christakis & Fowler, 2012; Rivera, Soderstrom & Uzzi, 2010), the theory proposes that as one reaches out of one's inner circle, one is more likely to encounter ties with more diverse and, possibly, better characteristics and resources.

The implication for social relations, such as research collaboration is that, although a network of persons from similar social circles may enjoy solidarity in attaining collective goals, it may however be limited in diversity and richness of resources, needed for the pursuit of collective and individual goals. Therefore, on the basis of the principles of homophily and heterophily and the assumption that a relationship exists between purposes of action and the form of social relation (Borgatti & Halgin, 2011; Kreiser, 2011), the network theory of social capital (Lin, 2008) connects the structural hole and network closure arguments.

Specifically, the theory conceptualises social relations to be either binding or belonging consisting of stronger and weaker ties respectively, or bonding relations, comprising both stronger and weaker ties. To an extent, the propositions are consistent with arguments by Kossinets and Watts (2006) and Burt (2004) which suggest possible interplay between the two schools of thought. Kossinets and Watts (2006) and Burt (2004) argue that structural holes dwell on weaker social ties and are a source of value added, while network closure focuses mainly on stronger social ties which can be essential to realising the value added in structural holes.

Therefore, the network theory of social capital hypothesises that collective assets and structural and positional variations affect the richness or poorness of various social ingredients (Figure 1). The general expectation is that the better the accessible embedded resources, the better embedded resources can and will be mobilised in purposive actions by an individual. Also, through the capitalisation process, one or more of the elements of social capital directly or indirectly impact an individual's economic, political and social capital or resources or his or her physical, mental and life-well-being (Lin, 1999; Wasko & Faraj, 2005). By these propositions, the network theory of social capital is consistent with the network closure (Kalish & Robins, 2006) and structural hole arguments (Long, Cunningham & Braithwaite, 2013).

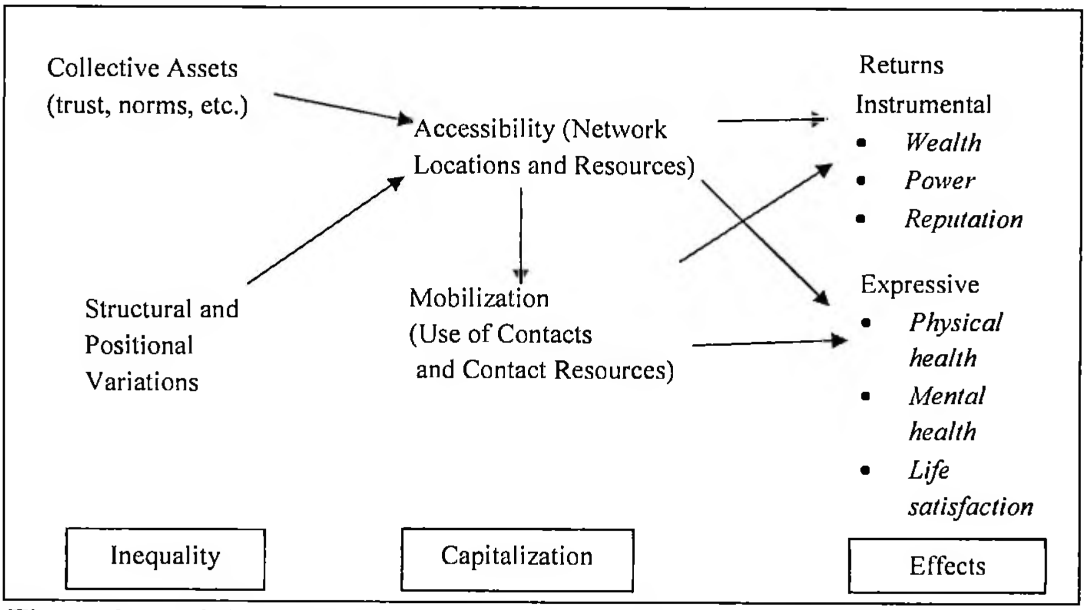

Figure 1: **Modeling a theory of social capital**
Source: Lin (1999)

However, in contrast to Coleman (1988) who considers factors such as trust and obligations as social capital, Lin (1999; 2008) presents these factors as exogenous variables that have the capacity to account for differences in accessibility and mobilisation of social capital in purposive action. The implication is that the extent to which persons derive the most from social interactions, such as research collaboration, depends on their access to and use of collective assets such as trust and values as well as structural characteristics such as access to requisite resources and support mechanisms. According to Kwon and Adler (2014), norms and values constitute the content of social relations and act as a motivational force for achieving collective goals by persons from different sectors of an economy.

Additionally, Yang, Zheng and Zhao (2014), on the basis of findings of an empirical study, argue that trust and shared norms could be beneficial to exploration alliances because these collective assets are critical to uncertain projects involving intensive exchange of tacit knowledge and a higher level of collaboration as well as when rights and obligations are not well outlined. This argument conforms to that by Granovetter (2005) who notes that threat of sanctions increases the likelihood of trust and meeting of obligations by close peers. Coleman (1988) also reiterates that trustworthiness of the social environment means that obligations will be repaid and this is truer when trust goes with sanctions, thereby acting as a form of insurance, for example, in the form of a substitute to enforceable intellectual property rights when the rights are not available or are inadequate, as is the case of Ghana (Yawson, 2002).

In spite of the consensus in literature on the role of collective assets in social relations, it is often claimed that the norms and values of academia are different from those of the knowledge user community, thereby, leading to the much talked about clash of values (Calvert, 2002; Rinne & Koivula, 2005). However, an empirical study by Hughes and Kitson (2012) proved otherwise with 'clash of values' emerging as one of the least constraints to collaboration between academia and external entities. In addition to collective assets, the network theory of social capital posits the importance of structural and positional variations to social interactions.

By this proposition, the network theory of social capital is consistent with the theory of economic development (Schumpeter, 1934/1983) and the knowledge spillover theory of entrepreneurship (Acs et al., 2009) which demonstrate the importance of resource availability, including credit and budget, and intellectual property rights, in support of research and innovation. Moreover, various related studies have established that network activity thrives when certain vital environmental factors are available and accessible, for example, funding, information (Hughes et al., 2011; Hughes & Kitson, 2012) and availability of capable collaborating parties (Kwon & Adler, 2014). These factors could create an enabling environment for the attainment of the purpose of engaging in social relations, categorised into instrumental and expressive returns, while their absence could thwart the collaboration process.

According to the network theory of social capital (Lin, 1999) instrumental action is pursued to obtain additional or new resources while expressive action is taken to maintain and preserve existing resources. However, in contrast to the immediate concern of attaining individualistic goals under the structural hole argument, or collective goals of network closure (Portes, 1998; Burt, 2000), the network theory of social capital demonstrates the relevance and possibility of pursuing both personal and collective goals in a given social interaction. For example, empirical studies by D'Este and Perkmann (2010) and Moore et al. (2010) revealed that academics engaged in collaborations to advance their research work as well as to contribute to the advancement of society, in general.

Furthermore, the network theory of social capital (Lin, 2008) illustrates the impact or returns to social capital in the form of instrumental and expressive outcomes. According to the theory, instrumental returns consist of gains in wealth, power and reputation while expressive returns comprise betterment of physical and mental health, and life satisfaction in general. These views are supported in literature, for instance, by Wasko and Faraj (2005) in a study of why nodes contribute knowledge in electronic networks and by D'Este and Perkmann (2010) on why academics engage with industry.

Nonetheless, Portes (1998), and Portes and Landolt (2000) caution that although literature tends to be highly skewed towards positive returns to social capital and network activity, social capital can produce negative returns. For instance, Levien (2014) established social capital as an obstacle to development in the brokering of land in rural India and concluded that social capital was seen as an aspect of class inequality that hindered inclusive development. In relation to trust, a key unresolved issue encountered in network theories in general, is the place and treatment of trust.

Although trust has been employed as an indicator of social capital (Coleman, 1988; Lin, 2008), its "social" nature, according to Lin (2008), is uncertain and, conceptually, it might be more appropriate to consider it as an antecedent or effect rather than a component of social capital. In addition, the network theory of social capital appears to focus highly on social factors that are essential to social interactions to the neglect of psychological determinants of intention to engage in the interactions. As a result, the theory of planned behaviour (Ajzen, 2011b) was employed to understand the determinants of intention to engage in research collaboration and to serve as a broader framework for the integration of relevant concepts from all the reviewed theories that informed the thesis.

The Theory of Planned Behaviour

The theory of planned behaviour posits that 'intentions to perform behaviors of different kinds can be predicted with high accuracy from attitudes towards the behavior, subjective norms, and perceived behavioral control; and these intentions, together with perceptions of behavioral control, account for considerable variance in actual behavior' (Ajzen, 1991, p. 179). Specifically, the theory hypothesises intention as a function of salient information or beliefs categorised into behavioural beliefs, normative beliefs and control beliefs which capture attitude towards behaviour, subjective norms and perceived behavioural control, respectively (Figure 2). A general rule of the theory is that the stronger the intention to engage in a behaviour, the more likely should be its performance (Ajzen, 2011a; Ingram, Cope, Harju & Wuensch, 2002). The predictions of the theory rely on several assumptions.

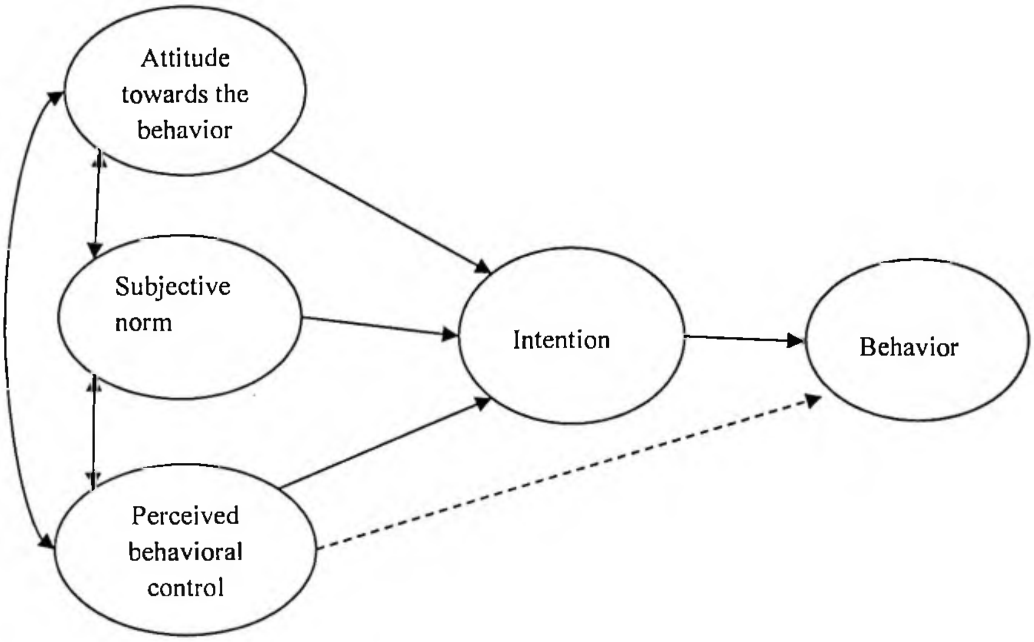

Figure 2: **Theory of planned behaviour**
Source: (Ajzen, 1991).

Firstly, it is assumed that individual processing of available information mediates the effects of biological and environmental factors on behaviour. The implication is that cognitive self-regulation is an important aspect of human behaviour (Ajzen, 2011b). This assumption agrees with a fundamental feature of extrinsic motivation which is said to reflect external control or true self-regulation of a given behaviour (Ryan & Deci, 2000). Secondly, it is assumed that the relative importance of the main antecedents of behaviour, in the prediction of intention, is expected to vary across behaviours and situations. Thirdly, behavioural beliefs comprise attitudes toward the behaviour, normative beliefs constitute the underlying determinants of subjective norms, and control beliefs provide the basis for perceptions of behavioural control (Ajzen, 2011b; Côté et al., 2012).

Accordingly, a fundamental requirement for the measurement of variables is that each belief-based variable should be assessed with double items to allow for better evaluation of the variable (Armitage & Conner, 2001). Ajzen (2002, p. 9), explains that 'belief strength and outcome evaluations for the different accessible beliefs provide substantive information about the attitudinal considerations that guide people's decisions to engage or not to engage in the behaviour under consideration'. Hence, in measuring behavioural beliefs, both belief strength and outcome evaluation should be captured. Similarly, normative beliefs should be measured by assessing normative belief strength and motivation to comply while control beliefs should be measured by assessing control belief strength and control belief power (Ajzen & Klobas, 2013; Pearson & Hamilton, 2014).

In addition, the theory stresses the need to measure each construct or factor with, at least, five to six items defined by target, action, context and time (TACT), following the principle of compatibility which states that no matter how the TACT elements of the behaviour are defined, the three constructs of the theory should be defined in terms of exactly the same elements. Furthermore, the theory recommends the measurement of variables using the semantic differential scale due to its relative ease of use and the fact that the scale allows for parametric analysis (French & Cook, 2012; Espetvedt et al., 2013; Ajzen, 2014).

The theory of planned behaviour (Ajzen, 1991) agrees with the theory of economic development (Schumpeter, 1934/1983), the knowledge spillover theory of entrepreneurship (Acs et al., 2009) and the network theory of social capital (Lin, 1999) in the postulate that the right conditions must be created to arouse the performance of the desired behaviour among people. The theory of economic development and the knowledge spillover theory of entrepreneurship point to systemic factors such as investment in research and development and lesser administrative and regulatory burden on economic actors (Acs et al., 2009; 2013). However, the network theory of social capital and the theory of planned behaviour argue for individual and social factors such as trust and societal approval, and systemic factors in the form of environmental possibilities (Espetvedt et al., 2013; Lin, 2008).

In contrast to the theory of economic development (Schumpeter, 1934/1983) and the knowledge spillover theory of entrepreneurship (Acs et al., 2009), the theory of planned behaviour (Ajzen, 2014) offers possibilities for the explanation of a wider range of human social behaviour. Thus, whereas the theory of economic development and the knowledge spillover theory of entrepreneurship are behaviour-specific in terms of their focus on research, innovation, and entrepreneurship, the theory of planned behaviour and the network theory of social capital make room for learning about all possible forms of human social behaviour both in the past and in the future (Ajzen, 2014; Kautonen, van Gelderen & Fink, 2015).

In spite of the relevance of the theory of planned behaviour as an explanation of various forms of human social behaviour, it has sometimes been criticised, for example by Miniard and Cohen (1981), for unnecessarily differentiating among the three types of beliefs and between the related constructs. However, Ajzen (2011b) argues that the justification for such a distinction lies in the need to separately measure the beliefs for theoretical and practical purposes, such as to direct policy towards specific issues to address. A further justification is the usefulness of the distinctions in predicting intentions and behaviour. Moreover, Ajzen (2011b) explains that the distinction makes room for the inclusion of additional predictors so long as the new variables meet the theory's criteria for inclusion (Cheung & Vogel, 2013).

The theory has also been criticised for not distinguishing between affective and evaluative responses to behaviour (Ajzen, 1991). However, a test of this proposal by Ajzen and Driver (1992) revealed that using two separate measures of attitude did not significantly improve prediction of intention. Another concern has been the non-inclusion of personal feelings of moral obligation or responsibility to perform, or refusal to perform, a certain behaviour as, for example, put forward by Conner and Armitage (1998). According to Ajzen (2011a), multiple experiments on the proposed constructs revealed that, although addition of perceived moral obligation made significant contribution in the prediction of intention, experiments without it also showed enough sufficiency for the theory. The implication is that, as a flexible theory, perceived moral obligation could be added to the predictors of intention, when necessary (Ajzen, 2011a; Côté et al., 2012).

Thus, the theory of planned behaviour remains an influential model for the prediction of human social behaviour due to its wide application across various disciplines and activities, and its strong predictive power (Ajzen, 2014; Kautonen et al., 2015). For example, Ajzen (2011b) notes that the theory has been applied across such disciplines and activities as health sciences and education. The theory's flexibility is also manifested in making room for additional predictors leading to the use of synonymous terms such as decomposed or extended theory of planned behaviour (Kautonen, van Gelderen & Tornikoski, 2011; Xiao, Tang, Serido & Shim, 2011). Therefore, as a relatively advanced theory in its development (Ajzen, 2011a; Cheung & Vogel, 2012), the theory provides a rigorous framework for the study of human social interactions such as research collaboration.

Review of Related Concepts

The theoretical review produced a number of key concepts which are relevant to the study of research collaboration for attainment of a knowledge-based economy. The concepts included economic growth and economic development, knowledge economy and knowledge-based economy, research, innovation, social network and social capital, and planned behaviour.

Economic Growth and Economic Development

The theory of economic development (Schumpeter, 1934/1983) and the knowledge spillover theory of entrepreneurship (Acs et al., 2009) explain economic growth while the theory of economic development (Schumpeter, 1934/1983) further explains economic development. Specifically, the theory of economic development explains economic development and its fundamental cause while the knowledge spillover theory of entrepreneurship builds upon the former by demonstrating entrepreneurship as an important link between knowledge and economic growth. Notably, in the theory of economic development, Schumpeter (1934/1983) defined and differentiated between economic growth and economic development.

Economic growth, according to Schumpeter (1934/1983), is a mere incremental change in economic data such as upward adjustment in national income, saving, and population. Schumpeter (1934/1983) further argues that economic growth calls forth no qualitatively new phenomena, but only processes of adaptation of the same kind as the changes in the natural data. As a result, although economic growth forms part of the process of economic development, economic growth does not constitute economic development (Schumpeter, 1934/1983). Schumpeter's explanation of economic growth appears consistent with that of Acs et al. (2009) who, in the knowledge spillover theory of entrepreneurship, defined economic growth to consist of upward adjustments in gross domestic product (Ahlstrom, 2010; Lin, 2011).

On the other hand, economic development is described by Schumpeter (1934/1983) as revolutionary changes in economic life as are not forced upon it from without but arise by its own initiative, from within. In other words, economic development consists of spontaneous and discontinuous change in the channels of the circular flow of economic life, disturbance of equilibrium, which forever alters and displaces the equilibrium state previously existing (Schumpeter, 1934/1983). However, Robbins (1968, p. 3) acknowledges that economic development 'is capable of a variety of meanings' and defines it to consist of increases in real income per head or increases in capacity to produce that income over a long period with a lot of positive qualitative changes in, for example, standard of living, institutions, culture, and politics (Brundenius & Göransson, 2011; Chiles et al., 2007; Mwenda, 2006).

The above distinction notwithstanding, there is agreement in development literature on the benefits of economic development propelled by innovation or development (Ahlstrom, 2010; Ang & Madsen, 2009). For instance, according to Schumpeter (1934/1983) it is innovation that creates new economic functions, makes idle money useful by creating employment for unused purchasing power and giving bank credit the opportunity to enter the economic system for productive economic activity. Schumpeter (1934/1983) further notes that although innovation creatively destroys old businesses, it makes room for better advancement of the economy in terms of re-organisation of the economic system and elevation of the carriers of development, together with their families, to the upper strata of society. This phenomenon, according to Croitoru (2012), is an essential means of poverty reduction.

Lewis (1954) and Ayal (1965) uphold that economic growth and economic development are indispensable. This fact is evidenced by the immense benefits that accrue to nations that pursue and attain them and the void that non-pursuers or unsuccessful pursuing nations experience (Maddison, 2001). Specifically, economic development accords individuals and society benefits such as availability of more well-paid jobs, access to more quality products and dramatic increase in life expectancy (Collier, 2007; Ahlstrom, 2010). As a result, several approaches to development have emerged, over the years, to guide nations in their pursuit of the goals of economic development. One of such approaches is knowledge-based development or the pursuit of a knowledge-based economy as advanced by Acs et al. (2009; 2013) in the knowledge spillover theory of entrepreneurship.

Knowledge, Knowledge Economy and Knowledge-based Economy

Knowledge is a concept that has been defined in several ways. For example, Nelson (1959) defines knowledge as facts or data observed in reproducible experiments as well as theories or relationships between facts, while Braunerhjelm (2010) describes knowledge to consist of scientific discoveries. Braunerhjelm (2010) further notes that knowledge is also associated with novel ways of doing things such as producing and distributing in business. However, the recognition of knowledge as facts and the use of knowledge for a given purpose is common to the various definitions of the concept. Therefore, knowledge can be defined as a meaning which makes a difference (Leydesdorff, 2010).

As with its definition, there are also several classifications and types of knowledge two of which are central to the pursuit of knowledge-based development. These are codified and tacit dimensions of knowledge, and knowledge as asset, relation and capability. According to Polanyi (1966), Gibbons et al. (1994) and Leydesdorff (2010), codified knowledge is that which can be represented in writing or symbols, often, openly available to potential users while tacit knowledge is not readily available but resides in individuals, for example skills and experience which could be technical or cognitive (Karnani, 2013).

On the other hand, knowledge as asset, capability and relation corresponds to investment in, for instance, human resource, organisational processes, and social capital that thrives on networks (Dang & Umemoto, 2009). The tremendous pay-offs of investing in the various forms of knowledge gave birth to the concept of "knowledge economy" as well as a rise in its pursuit for economic development (Dang & Umemoto, 2009; Powell & Snellman, 2004). The term knowledge economy is said to have evolved in the 1960s while the term "knowledge-based economy" emerged in the 1990s (Cooke & Leydesdorff, 2006; Dang & Umemoto, 2009).

According to Cooke and Leydesdorff (2006), the foremost operationalisation of the knowledge economy, was by Machlup (1962, as cited associated with novel ways of doing things such as producing and distributing in business. However, the recognition of knowledge as facts and the use of knowledge for a given purpose is common to the various definitions of the concept. Therefore, knowledge can be defined as a meaning which makes a difference (Leydesdorff, 2010).

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According to Cooke and Leydesdorff (2006), the foremost operationalisation of the knowledge economy, was by Machlup (1962, as cited in Cook & Leydesdorff, 2006), who contributed to the development of the concept in two main ways. Firstly, Machlup (1962 as cited in Cook & Leydesdorff, 2006) identified sectors with heavy concentration of knowledge production and classified them into six, namely, education, research and development, artistic creation, communications media, information services and information technology. Secondly, Machlup (1962 as cited in Cook & Leydesdorff, 2006) showed that the sectors accounted for the largest share of sectorial GDP and employment in the US and predicted growth of the share.

In a similar way, Powell and Snellman (2004) define the knowledge economy as production and services based on knowledge-intensive activities that contribute to an accelerated pace of technical and scientific advance, as well as rapid obsolescence. Powell and Snellman's (2004) definition conforms to an earlier exposition on the economic fundamentals of the knowledge economy by David and Foray (2003) who characterise the knowledge economy as involving an accelerated creation, accumulation and depreciation of knowledge in terms of economic relevance and value. David and Foray (2003) further consent to the increasing relative share of the gross domestic product that is attributable to intangible capital, or the Solow residual, in the form of investment in knowledge creation.

On the other hand, the concept knowledge-based economy is relatively newer. Leydesdorff (2010) indicates that Foray and Lundvall first introduced the concept of a knowledge-based economy at a workshop of the Organisation of Economic Co-operation and Development (OECD) in 1994. According to Leydesdorff (2012a), in a knowledge-based economy as against a political economy the structure of society is continuously upset by transformations which originate from the techno sciences. The transformations, Leydesdorff (2010) argues, thrive on a systems perspective such as the national and regional innovation systems corresponding to structural and institutional arrangements that spur research and innovations at both the national and regional levels within a given territorial sovereignty (Veugelers et al., 2012).

In spite of the above-mentioned peculiarities, the concepts "knowledge economy" and "knowledge-based economy" are often used interchangeably (Cooke & Leydesdorff, 2006). For instance, Rinne and Koivula (2005) treat both terms as synonyms and acknowledge that in a knowledge economy or knowledge-based economy, knowledge is seen as the primary motor of economic growth and as a result, education is considered an increasingly important economic resource while great investments are made both in research and development and in information technology. However, the synonymous use of the two concepts has received criticisms on several grounds.

First and foremost, Leydesdorff (2010) argues that a knowledge-based economy is analytically different from a knowledge economy in that in the former, codified knowledge is regarded as key to economic growth and development, while in the latter, emphasis is placed on knowledge workers and hence tacit or embodied knowledge. However, Johnson et al. (2002) had earlier indicated that "tacit" and "codified" describe two dimensions of knowledge, implying that any particular knowledge type could possess these two dimensions hence, there is no need for such distinction. Secondly, Cooke and Leydesdorff (2006) indicate that the knowledge economy focuses on the composition of the labour force while the knowledge-based economy thrives on workplace and industry, in general, become more salient as the need for life-long learning increases (Audretsch et al., 2010; Boulton & Lucas, 2011).

In conclusion, the preceding discussions suggest that the concept knowledge-based economy is a higher-order concept compared to the term knowledge economy in that the knowledge-based economy functions on recursive interactions among key economic actors, such as the university and industry, in creating constructed advantages that drive economic growth and development. Therefore, in agreement with the theory of economic development (Schumpeter, 1943/1983), the network theory of social capital (Lin, 1999; 2008) and the knowledge spillover theory of entrepreneurship (Acs et al., 2009; 2013), in a knowledge-based economy, knowledge produced through collaborative research contributes to economic growth and development, via entrepreneurship.

Research

Research is a purposive and curiosity-driven inquiry aimed at producing knowledge (Adria & Boechler 2004; Sarantakos, 2005). In the knowledge-based economy, scientific research constitutes the primary means of knowledge production (Guererro & Urbano, 2010; Leydesdorff, 2010). Leedy and Ormrod (2010) define scientific research as the systematic process of collecting, analysing and interpreting data for a given purpose. The definition by Leedy and Ormrod (2010) conforms to that by Nelson (1959) who defines scientific research as '...the human activity directed towards the advancement of knowledge... and is most fruitful when it leads to ability to predict facts about phenomena without, or prior to, experimentation and observation' (p. 299).

Scientific research has been severally categorised. A leading classification comprises basic and applied research while an emerging taxonomy includes use-inspired basic research (Chang et al., 2011; Hughes et al., 2011). Universally, there appears to be consensus on the meaning of the three types of research. Basic research, according to Mansfield (1980), is defined by the American National Science Foundation as an original investigation for the advancement of scientific knowledge which does not have immediate commercial objectives.

Applied research, on the other hand, is mainly driven by consideration for its use with relatively little quest for advancing science, while use-inspired basic research aims at producing knowledge to advance science as well as for application (Stokes, 1997; Gibbons et al., 1994). Definitions by other scholars including Sarantakos (2005), Bakhshi et al. (2008) and Chang et al. (2011) conform to the distinguishing features of generating knowledge for understanding, application, and both understanding and application as the primary focus of basic, applied and use-inspired basic research, respectively.

The classification of research into basic and applied research began to take the centre stage in discussions on scientific research with the creation of a report titled "Science, the Endless Frontier" presented by Vannever Bush to the US government, in 1945 (Brooks, 1994; Rosenberg & Nelson, 1994). According to Stokes (1997) the Bush classification was largely informed by the need for more basic research to produce technological innovations in support of the US military agenda, in World War II. The pursuit of the Bush agenda yielded dramatic returns to investments, by the US government, in basic research (Grimaldi, 2011; Pielke Jr., 2012) which sent strong signals across the globe on the importance of funding basic research as well as the rapid adoption of the categorisation of scientific research into basic and applied research (Pielke Jr., 2012; Zewail & Zewail, 2013).

Nevertheless, literature shows that Bush's paradigm came under intense pressure in the aftermath of World War II since the main justification for funding basic research was no longer adequate, particularly, the enactment of policy for science instead of policy for innovation, as argued by Gibbons et al. (1994). The waning validity for funding basic research resulted in the growing demand on researchers to justify investment in basic research while at the same time, there was a higher expectation for the conduct of more applied research, in line with the rising demands of industry for applied research (Calvert, 2002; Stephan, 2013).

In the face of the rising expectations of the university to produce knowledge for application in addition to knowledge for the advancement of science, scholars have dedicated much attention to the goal-oriented distinction between basic research and applied research, especially, whether basic research can, eventually, be applied or used for innovation. For instance while Nelson (1959) held the view that basic research was less oriented towards innovation, Rosenberg and Nelson (1994) thought otherwise on the basis of growing evidence that successful pure basic research often yields relatively more, advanced and diversified benefits to society (Hughes & Kitson, 2012; Moore et al., 2010).

The usefulness of basic research to innovation (Mansfield, 1980; Salter & Martin, 2001) has been well established in literature. For example Griliches (1985), in a study of R&D, basic research and productivity growth at the firm level, found that basic research continued to contribute to productivity growth in US manufacturing in the 1970s, much fueled by private R&D expenditure as against public expenditure. In the face of the rising evidence in support of the contribution of basic research to innovation, scholars, including Nelson (2006), who hitherto believed otherwise, concede to the argument that basic research can eventually lead to innovation. Nelson (2006) argues that in many scientific disciplines, such as engineering and molecular biology, a number of basic research commences with questions about how technology works or an inquiry into more general practical problems that are still begging for solutions.

Stokes (1997) was among the early scholars who believed in the usefulness of basic science to innovation. On the basis of the outcome of a technical and historical analysis of scientific inquiry beginning with the ancient Greeks who are believed to have invented scientific inquiry, Stokes (1997) identified three goals and three types of research and researchers, respectively. The goals include the quest for understanding, consideration of use and the pursuit of the combined goal of understanding and consideration of use, as elaborated in Figure 3. The three goals, according to Stokes (1997), give rise to three types of research, namely, pure basic, pure applied and use-inspired basic research and their corresponding group of scientists, namely, Bohr scientists, Edison scientists and Pasteur scientists (Baba et al., 2009; Grimpe & Fier, 2010).

Research is inspired by:		Considerations of use? No	Considerations of use? Yes
Quest for fundamental understanding?	Yes	Pure basic research (Bohr)	Use-inspired basic research (Pasteur)
	No		Pure applied research (Edison)

Figure 3: **Quadrant model of scientific research**
Source: Stokes (1997)

Apart from the classification of research into basic, applied and use-inspired basic research, there are various types of collaborative research which are emerging as a result of interactions between academia and knowledge users, especially, industry. Notable among them are classifications by Perkmann and Walsh (2009) and an adaptation by D'Este and Perkmann (2010). Perkmann and Walsh (2009) categorise collaborative research into problem solving, technology development, idea testing and knowledge generation research projects.

According to Perkmann and Walsh (2009) problem solving research projects aim at seeking solutions to specific problems encountered in firms' research and development, engineering or manufacturing activities. However, technology development projects focus more directly on improving or developing specific technologies relevant to commercial users and mainly deal with concepts, products or processes that are a step away from market readiness but are characterised by higher degrees of uncertainty (Perkmann & Walsh 2009). The nature of problem solving and technology development research projects is consistent with applied research which Stokes (1997) defined as research with the primary purpose of consideration of use or application of the research output.

On the other hand idea testing projects, according to Perkmann and Walsh (2009), are research projects that are inspired by the desire to explore potentially and commercially interesting ideas that often emerge within firms' research and development or manufacturing units. Knowledge generation projects, as explained by Perkmann and Walsh (2009), consist, essentially, of academic research projects with industry participation but are informed by challenges at the frontier of academic research and of broad interest to industry. The definitions of idea testing projects and knowledge generation projects suggest a blend of basic research and applied research (Chang et al., 2011; Hughes & Kitson, 2012) although knowledge generation projects appear to be highly basic research-oriented.

Alternatively, collaborative research can be joint research, contract research, consulting and commercialisation. According to D'Este and Perkmann (2010) joint research, alternatively known as research joint ventures (Hall, Link & Scott, 2001), is a formal collaborative arrangement aimed at co-operation on research and development projects often subsidised by public funding while contract research refers to research that is explicitly commissioned by firms, directly and commercially relevant to firms and, hence, is usually ineligible for public support. However consulting, as explained by D'Este and Perkmann (2010), constitutes research-related advisory services provided by individual academics to their industry clients, usually, for a fee whilst commercialisation comprises taking out a patent, licensing research output, and forming a spin-out firm or business (Hughes & Kitson, 2012).

In sum, the relevance of research to economic activity, and eventually to economic development, has made the definition of research a subject of discussion over time. The various classifications notwithstanding, it appears a consensus is being built upon the classification of research into basic, applied and use-inspired basic research as advanced by Stokes (1997) and employed in various studies, for example, by Baba et al. (2009), Moore et al. (2010) and Hughes et al. (2011). Furthermore, the tacit dimension of knowledge necessitates research collaboration for effective knowledge transfer whilst there is a growing appreciation of the importance of academic research to economic development via innovation (Al-Saleh & Vidican, 2011; Boulton & Lucas, 2011; Ye, Yu & Leydesdorff, 2013).

Innovation

Innovation is a multi-faceted concept whose evolution is largely informed by Schumpeter's (1934/1983) exposition in the theory of economic development. Firstly Schumpeter, in the theory of economic development, (1934/1983) describes innovation as development to connote a process or activity. Thus development or innovation, according to Schumpeter (1934/1983), is the carrying out of new combinations or employing existing resources in a different way, in doing new things with them, irrespective of whether those resources increase or not. This definition is consistent with Barringer and Ireland (2008) and Abdi and Ali (2013) who define innovation as the process of applying creative solutions to solve problems or exploit opportunities.

Secondly, Schumpeter (1934/1983) identifies five forms of innovation comprising the introduction of a new good or of a new quality of a good, the introduction of a new or improved method of production, the opening of a new market, the conquest of a new source of supply of raw materials and the carrying out of the new or improved organisation of any industry. Accordingly Fagerberg, Srholec and Verspagen (2009), in a review of literature on innovation and economic development, define innovation to include new products and processes. Similarly, Gunday et al. (2011) and Mirzadeh, Mahmoudian and Asghari (2013) define innovation to include product, process, marketing and organisational innovation. These definitions of innovation buttress Quintane, Casselman, Reiche and Nylund's (2011) view that innovation can be defined as an outcome or outcome of the process.

Thirdly, several innovation concepts have emerged in relation to the concept of creative destruction by Schumpeter (1934/1983; 1950). Notable among them are the works of Anderson and Tushman (1990) on technological discontinuities and Christensen (1997) on disruptive and sustaining innovation. As a result, Thomond and Lettice (2002), in an exploration of disruptive innovation, summarise the various concepts on the premise that innovation could be defined on a continuum of evolutionary or sustaining to revolutionary or disruptive. Therefore, following an explanation by Christensen (1997; 2006), Thomond and Lettice (2002) indicate that evolutionary or sustaining innovation improves the performance of established products, for example, along dimensions of performance that mainstream customers in major markets have historically valued.

Thomond and Lettice (2002) define revolutionary or disruptive innovation as a successfully exploited product or business model that significantly transforms the demands and needs of a mainstream market and disrupts its former key players. Eventually, Thomond and Lettice (2002) identify sustaining innovation and incremental innovation as synonymous to evolutionary innovation while radical, non-linear, discontinuous, breakthrough, paradigm shifting and disruptive innovation are synonymous to revolutionary innovation. Tödtling, Lehner and Kaufmann (2008) follow similar classification, in a study of innovation types and knowledge interaction, by classifying innovation into radical innovation and incremental innovation.

Innovation is also classified, on the basis of novelty, into new-to-the-world innovations and new-to-the-country innovations. According to Mathews and Hu (2007), new-to-the-world innovations consist of commercialisation of inventions usually by lead countries while new-to-the-country innovations involve the management of accelerated diffusion of technologies from advanced countries, for example, to the developing world. It can therefore be deduced that, in pursuit of economic development, creative accumulation offers developing countries or countries in need of catch-up a complementary alternative to creative destruction in its capacity to build upon what already exist for the derivation of competitive advantage through export (Mathews & Hu, 2007; Romer, 1986).

The feasibility of innovations to originate from developing countries and the relevance of the innovations to economic advancement of the countries are widely acknowledged, for instance by Lundvall (2009) and UNCTAD (2011). In this regard development economists, such as Rodrik (2001), advocated for countries in need of catch-up to pursue outward-oriented industrialisation. Similarly, Lucas (1988), in a study of the mechanics of economic development, noted that the 'miraculous' growth stories of the Asian tigers could well be explained by learning-by doing linked to the export of products not formerly produced in these countries, conforming to the ideas of indigenous innovation and reverse innovation. Indigenous innovation has been described both as a process and outcome of the process.

Lazonick and Mass (1995), for example, define indigenous innovation as new products and processes that originate within a nation. Lazonick and Mass (1995) further stress the critical role of indigenous innovation to economic development by arguing that indigenous innovation was a key determinant of Japan's phenomenal economic development during the twentieth-century. On the other hand, Lazonick (2004, p. 3) defines indigenous innovation as the "...process of making use of technologies transferred from the advanced economies to develop superior technologies at home". Lazonick's (2004) definition of indigenous innovation conforms to that of reverse innovation by Zedtwitz, Corsi, Søberg and Frega (2015) and Govindarajan and Ramamurti (2011) who indicate that reverse innovation originates from developing countries and end up in developed country markets.

In spite of the fuzzy distinction between reverse and indigenous innovation, one can infer from the preceding definitions that indigenous innovation may become reverse innovation when marketed or used in developed countries with the consequent benefit of the exporting country accruing foreign exchange that could be dedicated to modernise its economy. In this way, indigenous innovation becomes a critical aspect of endogenous growth and development, that is, growth propelled from within an economy as opposed to from outside the economy, as advanced by Schumpeter (1934/1983) in the theory of economic development and Romer (1986; 1994) in his theoretical works on new growth theory.

In spite of the several categorisation of innovation, there appears to be a growing consensus in literature on the carriers of innovation who have been identified to include all individuals and entities in the private, public and third sectors of an economy (David & Foray, 2003; Mueller, 2005). The private sector comprises individuals and entities, such as entrepreneurs and businesses that pursue privately-owned economic activities whereas the public sector consists of state-owned institutions as well as public sector organisations and employees. Charities, voluntary organisations and social enterprises including the local community and non-governmental organisations (NGOs) constitute the third sector (Alcock & Kendall, 2011; Hughes & Kitson, 2012).

The sectorial classification of the carriers of innovation is coupled with a distinction between private sector innovation and public sector innovation to connote innovation within or by the private and public sectors, of an economy, respectively (Arundel & Huber, 2013; Bloch & Bugge, 2013). Bloch and Bugge (2013) note, in a study on public sector innovation, that literature on public sector innovation has been scarce and that the innovation literature is highly informed by private sector innovation in spite of the tremendous contributions that public sector innovation could make towards the advancement of an economy.

Costa and Teixeira (2005) also consent that both private sector innovation and public sector innovation are critical to economic growth and development. From the perspective of private sector innovations, literature suggests that leading industry players (Christensen, 1997) and entrepreneurial start-ups (Acs et al., 2009; Braunerhjelm, 2010) are key carriers of innovation with the former usually best at the pursuit of sustaining innovations while the latter are, ideally, best at disruptive innovation. On the other hand, Sørensen and Torfing (2012) argue, among other things, that public sector innovation is regarded as critical to tackling difficult and universal issues such as climate change and rural growth stimulation.

Innovation, whether within the public or private sector, is largely a concerted effort and often involves parties from various sectors and institutions of an economy (Leydesdorff, 2012a; Robin & Schubert, 2010). As a result, the concepts of collaborative innovation and open innovation are employed in the innovation literature to reflect the collaborative nature of innovation. Collaborative innovation, according to Ketchen, Ireland and Snow (2007, p. 371), is the pursuit of innovations across firm boundaries through the sharing of ideas, knowledge, expertise, and opportunities". Open innovation, on the other hand, is defined by Chesbrough (2003) as an innovation process in which firms interact extensively with their environment, leading to a significant amount of external knowledge exploration and exploitation.

Both collaborative innovation and open innovation relate to the growing expectation of interaction between knowledge producers and knowledge users, in the performance of their duties towards the advancement of the knowledge-based economy (Leydesdorff, 2012b; Huggins & Johnston, 2009). For instance, empirical work by Tödtling et al. (2008) and Costa and Teixeira (2005) indicate that collaborations, among firms and research-based institutions such as universities, produce valuable innovations particularly radical innovations, some of which become technological breakthroughs. Moreover, collaborative and open innovation enable organisations to overcome challenges and better exploit their competitive advantages (Chapman & Corso, 2005; Cumbers, Mackinnon & Chapman, 2003), through the use of several forms of capital, including social capital (Granovetter, 2005; Lin, 2008).

Social Network and Social Capital

Social network comprises connections or interactions among individuals within the fabric of social structure (Burt, 1997; Lin, 1999). In the network theory of social capital, Lin (1999) notes that a social network is made up of persons or entities, known as actors, who interact with each other to attain common or varied goals. Similarly in the knowledge-based economy, knowledge producers and knowledge users engage in various forms of interactions in the performance of their primary roles of knowledge production and innovation, respectively (Etzkowitz & Leydesdorff, 2000; Osterloh & Frey, 2000). One of such interactions is research collaboration.

Research collaboration consists of networks and the use of social capital (Katz & Martin, 1997). Accordingly working definitions of research collaboration, for instance by Perkmann and Walsh (2009) and Bukvova (2010), indicate that research collaboration comprises interactions, information sharing and co-ordination of activities by persons of diverse interests to undertake research and or disseminate or use the research findings to achieve a particular goal. The pursuit of a goal in research collaboration is consistent with the network theory of social capital (Lin, 1999; 2008) which illustrates that actors engage in social networks, in purposive action, to acquire social capital, aside human and physical capital.

Granovetter (1983), Coleman (1988) and Burt (1997) share similar views on social network as a medium for attaining social capital to achieve a particular goal. For instance, Coleman (1988) argues that '...social capital is productive, making possible the achievement of certain ends that in its absence would not be possible ... *and that it* inheres in the structure of relations between actors and among actors' (p. S98). Similarly Burt (1997) notes that loose connections, that is structural holes among network actors, produce social capital or opportunity for the network actor who bridges the divide among the loosely connected actors.

In spite of the agreement that social capital is network-based, there appears to be a lack of consensus on the exact meaning of social capital. For instance Coleman (1988) defines social capital to consist of some aspect of social structures, specifically obligations and expectations, information channels, social norms and closure, which facilitate actions of network actors. Closely related to Coleman's (1988) definition are those by Putnam (1995), Portes and Landolt (2000) and Kwon and Adler (2014). Putnam (1995) defines social capital to consist of features of social life. In a similar way, Portes and Landolt (2000) and Kwon and Adler (2014) define social capital as consisting of bonds of solidarity and goodwill, respectively.

On the other hand, Burt (1997; 2001) explains that social capital is a metaphor about advantage or opportunity arising from being better connected in society. The advantage could arise from trust and obligation to support others (Burt, 2001). Thus, Burt (2001) argues that holding certain position in the structure of exchanges can be an asset in the form of social capital defined as a concept of location effects in differentiated markets (Bolgatti & Halgin, 2011). Long, Cunningham and Braithwaite (2013) share a similar view on social capital which they describe as the advantage created by a person's location in a structure of relationships in contrast to human capital which explains a person's advantage in terms of personal attributes.

Although the definitions of social capital by Coleman (1988) and Burt (1997; 2000) tend to equate the features of social network to social capital (Lin, 2008), another major difference is that the authors identify the source of advantage of being better connected to different factors. Thus whereas Coleman (1988) attributes the advantage derived from social network to being closely connected, that is network closure, Burt (2001) following Granovetter's (1983) stead projects weak ties, which result in structural holes, as the key source of competitive advantage for the actor who bridges or links the loosely connected actors. Lin (2008), in the network theory of social capital, tries to connect the two divides by treating network closure and structural holes, or bonding and binding ties, as features of a network that can facilitate access to social capital.

There appears to be a growing recognition of the fact that a particular network activity may be characterised by bonding and bridging ties (Long et al., 2013; Saner & Yiu, 2011). For instance, Saner and Yiu (2011) acknowledge that bonding and bridging ties often interact to support the effective functioning of a social system while Long et al. (2013) reiterate the importance of brokers in facilitating access to novel information or resources, transfer of knowledge and co-ordinating efforts across networks. Kwon and Adler (2014) also share a similar view on social capital by arguing that the effects of social capital lies in information, influence and solidarity benefits that accrue to members of a collectivity and to actors, whether individual or collective, in their relations to other actors.

In relation to the diverse views on social capital as well as from the perspective of the network theory of social capital (Lin, 1999), social capital could be interpreted, within the scope of this thesis, as the advantage or benefits that accrue to an individual or collectivity due to the nature of the relationship that actors in a network have with each other. The advantage(s) could be described as goodwill whereas the source of the advantage(s), as illustrated by the network theory of social capital (Lin, 1999; 2008), consists of collective assets and structural and positional variations such as opportunities, norms and values and abilities of nodes (Kwon & Adler, 2014; Portes & Landolt, 2000).

From the preceding discussion, it can be concluded that social networks, such as research collaboration, are a means of accessing embedded resources in purposive action. The purposive action may be driven by individual and collective goals. Moreover, within the framework of the network theory of social capital (Lin, 1999; 2008), the outcome of a social interaction may be influenced by several factors categorised into collective assets and structural and positional factors. A number of these factors may be essential to network activity, irrespective of the driving force(s) for engaging in a particular network (Long et al., 2013; Saner & Yiu, 2011).

Planned Behaviour

The concept of planned behaviour is rooted in the theory of planned behaviour and reflects a bygone action that was well-thought of, or intention to act in the future, in relation to specific factors (Ajzen, 1991). According to Ajzen (1991), intention means the willingness to act. Ajzen (1991) further notes that intentions are an indication of how hard people are willing to try, and of how much of an effort they are planning to exert, in order to perform the behaviour. By this definition, intention is compatible with the concept of motivation explained by Ryan and Deci (2000) as to be moved to do something by factors that are intrinsic or extrinsic to the performance behaviour. Similarly, the theory of planned behaviour assumes intentions to capture the motivational factors that influence behaviour (Ingram et al., 2000). The factors are attitude towards behaviour, subjective norms and perceived behavioural control.

Comparatively, attitude towards behaviour is consistent with the concept of motivators or intrinsic factors as explained by Herzberg (1968/1987). According to the theory of planned behaviour (Conner & Armitage, 1998; Kautonen et al., 2011), attitude towards behaviour refers to the degree to which a person has a favourable or unfavourable evaluation of a given behaviour in relation to desired opportunities such as advancement and pleasure. Herzberg (1968/1987), in a like manner, describes intrinsic motivators to include advancement and achievement tied to a particular performance behaviour. Moreover, whereas attitude towards behaviour is regarded as the main predictor of intention in the theory of planned behaviour (Kautonen et al., 2011), intrinsic motivators are the primary source of performance satisfaction that influence persons to give off their best in performance behaviour (Herzberg, 1968/1987)

On the other hand, background factors enshrined in the concept of perceived behavioural control can be likened to hygiene or extrinsic factors. According to Cerasoli, Nicklin and Ford (2014), hygiene factors offer the prospect of instrumental loss or gain and include factors such as working conditions, rewards and policies (Herzberg, 1968/1987). Azjen (2011b) also illustrates perceived behavioural control as consisting of background factors such as availability of time and resources which dictate the likelihood of behavioural achievement. This feature of perceived behavioural control makes room for separation of the background factors from the primary factors that constitute perceived behavioural control. For instance, Ajjan and Hartshorne (2008) and Cheung and Vogel (2013) extended the theory of planned behavior by assessing perceived resource availability as an additional predictor of intention.

The primary importance of perceived behavioural control to consist of its capacity as a predictor of intention and, together with intention, as a predictor of actual behaviour, is well acknowledged in the theory of planned behaviour (French & Cook, 2012; Kautonen et al., 2011). Perceived behavioural control is defined, in the theory, as the perceived ease or difficulty of performing a given behaviour. According to Ajzen (1991) perceived behavioural control is closest in meaning to the concept of perceived self-efficacy as expounded by Bandura (1982). Bandura (1982, p. 188) explains that "Perceived self-efficacy is concerned with judgements of how well one can execute courses of action required to deal with prospective situations."

The third primary construct of planned behaviour is subjective norm which is defined as the perceived social pressure to perform or not to perform a given behaviour (Ajzen & Klobas, 2013; Bercovitz & Feldmann, 2006). The element of social pressure makes subjective norm compatible in meaning with the concept of social norm as defined by Granovetter (2005). Granovetter (2005) explains that social norm consists of shared ideas about the proper way to behave, and together with the threat of sanctions, social norm increases the likelihood of trust and meeting of obligations among close peers.

In relation to measurement of intention and its predictors, the theory of planned behaviour proposes indirect or belief-based measures for the assessment of intention to perform a given behaviour and associated determinants (Ajjan & Hartshorne, 2008; Xiao et al., 2011). According to the theory, beliefs are assumed to provide the cognitive and affective foundations for the three constructs. Therefore, measuring readily accessible or salient beliefs in memory provides insight into the underlying cognitive foundation or considerations that guide human behaviour, an important information for designing effective programmes of behavioural intervention (Espetvedt, 2013; Pearson & Hamilton, 2014). Three types of beliefs underlie the three constructs of attitude, subjective norm and perceived behavioural control. These are behavioural beliefs, normative beliefs and control beliefs.

Ajzen (1991) argues that behavioural beliefs are beliefs about the likely consequences of the behaviour. That is, behavioural beliefs yield favourable or unfavourable attitude towards the behaviour. Normative beliefs consist of beliefs about the normative expectations of others and result in perceived social pressure or subjective norm. Control beliefs are beliefs about the presence of factors that may facilitate or impede performance of the behaviour while control beliefs give rise to perceived behavioural control (Ajzen, 2011a; 2011b; Sedaf, Newby & Ertmer, 2012).

Summary

The review of related theories and concepts point to a number of key issues on research collaboration that is capable of driving economic growth and development in the knowledge-based economy. Firstly, Schumpeterian growth frameworks (Ang & Madsen, 2009; Zachariadis, 2003) and the knowledge spillover theory of entrepreneurship (Acs et al., 2009; 2013) show that research output, especially from the university, is critical for innovation-driven growth and development. Innovation as a driver of economic growth and development was illustrated by Schumpeter's (1983/1934) theory of economic development and the knowledge spillover theory of entrepreneurship.

The knowledge spillover theory of entrepreneurship (Acs et al., 2009; 2013) further demonstrates the importance of the intra-temporal spillover of tacit knowledge from knowledge producers, for example the university, to knowledge users for innovation. The knowledge flow is facilitated by recursive interactions such as research collaboration between academics and knowledge users. The interactions and the resultant knowledge flow are, however, dependent upon a number of factors elucidated by the network theory of social capital (Lin, 1999), the quadrant model of scientific research (Stokes, 1997) and the theory of planned behaviour (Ajzen, 1991). Some of the factors include the existence of the right support mechanisms reflected in the perceived environmental possibility and the structure and position of the collaborating parties as well as possession of the right research orientation by academics.

CHAPTER THREE

EMPIRICAL LITERATURE REVIEW AND CONCEPTUAL FRAMEWORK

Introduction

This Chapter of the thesis consists of review of related empirical studies on the four theories that underpinned the study, lessons learnt from the literature review and illustration of the conceptual framework of the study. The review begins with empirical studies on economic development followed by empirical review on knowledge spillover. The first two reviews are followed by empirical review on network and planned behaviour, respectively. The Chapter ends with presentation of the conceptual framework of the study which illustrates key concepts and relationships among the concepts.

Empirical Review on Economic Development

The central argument of the theory of economic development is that innovation, from within an economic system, drives economic development (Schumpeter, 1934/1983). This prediction has been operationalised and empirically tested at the macro and micro levels of an economy. At the macro-level, a study by Zachariadis (2003) illustrates that economic growth is based on the endogenous introduction of innovation while studies by Mueller (2005) and Ang and Madsen (2009) demonstrate the relevance of research collaboration to national innovation. At the firm level empirical studies by Gunday et al. (2011), and Abdi and Ali (2013) establish the impact of innovation on firm performance.

At the macro level, Zachariadis (2003) studied research and development (R&D), innovation and technological progress, in the US, through a test of the Schumpeterian growth framework without scale effects. Through a causal research design, the study sought to examine the impact, of R&D on the rate of patenting, the rate of patenting on technological progress and technological progress on economic growth. In addition, in line with the assumption that specific industries can draw from an aggregate pool of knowledge, Zachariadis (2003) assessed the effect of total manufacturing innovative activity variables on the average industry innovation success.

The US manufacturing industry comprised the study population due to the fact that the sector had accounted for more than 90 percent of R&D expenditures in the US until the late eighties, making it ideal to examine the validity of models of R&D-based growth. A panel of industries, at the two-digit SIC classification of US manufacturing for the period 1963-1988, were purposively employed in the study. On the premise that both capital and labour are included in R&D, Zachariadis (2003) measured R&D intensities as the fraction of output devoted to R&D expenditures. Through a system of equations, implied by a model of R&D-induced growth in steady state, Zachariadis (2003) used annual data on patents, R&D expenditures, gross output, and productivity to test the hypothesised predictions. Two key findings emerged.

Firstly, it was established that in a steady state there was a positive impact by R&D intensity on rate of patenting, by the rate of patenting on the rate of technological change, and by the rate of technological change on the growth rate of output per worker. Secondly, aggregate manufacturing R&D was shown to have a positive impact on industry patenting rates implying technology spillovers across manufacturing industries. A related study at the macro level, was conducted by Mueller (2005) in West Germany.

Contrary to Zachariadis (2003) who sought to establish the impact of R&D on economic growth, Mueller (2005) analysed how entrepreneurship and university-industry relations, in the form of research collaborations, stimulated economic growth in West German regions. Mueller (2005) used a Cobb-Douglas production function to estimate regional economic performance while regional entrepreneurial activity was measured by the number of new ventures formed per 1,000 employees in the respective region. Knowledge-related entrepreneurship was measured by the share of innovative start-ups while university-industry relations was measured by the amount of research grants given from firms in the private sector to universities per academic researcher and scientist at constant 1995 prices.

Furthermore, regional aggregate output was measured by regional gross value added of all industries at constant 1995 prices. Physical capital stock was estimated with gross fixed capital formation at constant 1995 prices. The share of employees devoted to R&D in the private sector measured R&D in private industries while public research was measured by the share of researchers and scientists, such as professors, research assistants and technical laboratory personnel, at universities per the respective region. Employees in the private sector with university degree in Engineering or Natural Science were used as proxy for employees engaged in R&D in private businesses. Panel data between 1992 and 2002 was secured from the establishment file of the German Social Insurance Statistics (IAB) and the ZEW foundation.

Regression analysis showed that research, entrepreneurship and university-industry relations, as well as physical capital, labour and regional knowledge stock, significantly influenced regional economic growth. According to Mueller (2005), the findings suggest that research relations are a significant vehicle to commercialise knowledge generated at universities, which is abundant but underexploited and the relations allow knowledge transfers in both directions. Furthermore, Mueller (2005) argues that firms with internal R&D strategies that focus on exploratory activities will allocate a greater share of their R&D resources to grants supporting university research. Moreover, the findings suggest that firms prefer universities as research partners when they are concerned with the appropriation of research results.

Contrary to Zachariadis (2003) and Mueller (2005) who analysed the impact of research, and research collaboration on innovation and economic growth in developed countries, Ang and Madsen (2009) examined the extent to which growth is driven by R&D in transition economies and sought to determine which second generation endogenous growth model was most consistent with the analysis. According to Ang and Madsen (2009), very little attention had been paid to the role of R&D in the context of modern endogenous growth frameworks. Data for the study consisted of annual data for six Asian miracle economies over the period of 1953 to 2006. The countries include China, India, Japan, Korea, Singapore and Taiwan.

The dependent variable was total factor productivity while the explanatory variables comprised research inputs or innovative activity, research output or ideas and innovation. Estimation of economic growth, that is total factor productivity (TFP), comprised real GDP, employment and non-residual capital stock based on the perpetual inventory model. Specifically, initial capital stock was obtained by dividing initial investment by the sum of depreciation rates, pegged at three percent, and the average geometric growth rates of real investment over the entire data period. Ideas were measured by the number of patents applied for by domestic residents. The stock of knowledge was computed using the perpetual inventory method with a depreciation rate of 15 percent. Innovative activity was measured by real R&D expenditures and number of R&D workers.

Robustness checks included control of factors such as trade openness and international knowledge spillovers as predictors of TFP. Series of analysis including panel cointegration tests and regressions performed at 5-year moving averages, to filter out the influence of business cycle and transitional dynamics, produced two key findings. Firstly, consistent with Schumpeterian growth framework, research inputs had a significant positive influence on total factor productivity. However within the semi-endogenous growth framework, only research inputs measured by R&D expenditures had a significant positive influence on total factor productivity.

In relation to the preceding findings, Ang and Madsen (2009) indicate that in regressions where both R&D growth and research intensity were significant, or where only research intensity was significant, growth was governed by research intensity in the long run. Furthermore, an R&D induced increase in research intensity leads to TFP growth in the short and medium term that exceeded the steady-state TFP growth due to the growth effects of R&D, providing evidence in support of Schumpeterian growth instead of semi-endogenous growth.

Secondly, idea production estimates revealed that coefficients of research intensity were statistically significant in all regressions in support of the Schumpeterian growth framework. Moreover, the coefficients of knowledge stock were highly significant and remarkably close to the prediction by Schumpeterian growth models. Ang and Madsen (2009) indicate that the constant return to knowledge production implies significant positive intertemporal knowledge spillovers as well as permanent growth effects of research intensity. Furthermore, the existence of the coefficients of research intensity, in their predicted range, indicates that some innovations were novel while others were duplications (Ang & Madsen, 2009).

According to Ang and Madsen (2009), the robustness checks showed almost all control variables predicting TFP in varying degrees. However, the coefficients of the growth in international knowledge spillovers were statistically significant in relatively fewer cases in the productivity-growth regressions and that growth in international knowledge spillovers was ineffective in boosting ideas production. The findings suggest, as explained by Ang and Madsen (2009), that imports of knowledge has been less important for growth in the Asian economies than for the mature OECD countries and that imports of knowledge do not play an important role for take-off as investment in domestic R&D.

At the micro or firm level, Gunday et al. (2011), through a causal mixed methods design, used a proportionate sample of 1674 manufacturing firms in Turkey to examine the effects of innovation types on firm performance. Innovation was operationalised to include organisational, marketing, process and product innovations while firm performance was operationalised to consist of production, market, financial and innovative performance. Innovation measures captured the extent to which innovation applications and practices were implemented in organisations while performance measures assessed the extent to which managers perceived the firm to be successful or not. All items were measured on five-point Likert-type scales to ascertain respondent's perceptions, within the last three years, in relation to perceived average condition prior to that period.

Data collection comprised mail surveys and face-to-face interviews of general managers which lasted seven months from 2006 to 2007. Data were analysed with the Statistical Product and Service Solutions (SPSS) version 13. Principal component analysis (PCA) with varimax rotation was conducted to ascertain the underlying dimensions of innovations and firm performance which produced four factors each with Cronbach alphas ranging from 0.7 to 0.93. The scale value of each factor was determined by a simple average of the respective items. Hypothesised relationships were analysed through correlation and regression analysis.

The key finding of the study was that higher product, process, marketing and organisational innovation capabilities were associated with increased innovative, production and market performances. Furthermore, structural equation modeling (SEM) revealed that innovative performance was directly and positively affected by organisational, product and marketing innovations. Moreover, an independent-samples t-test showed that innovative firms had higher sales and exports, and specifically, higher product innovation was correlated with higher market share.

Contrary to the definition of innovation types by Gunday et al. (2011), Abdi and Ali (2013) categorised innovation into administrative innovation, technical innovation and innovation strategy, and investigated the relationship between innovation and business performance. Abdi and Ali (2013) employed a correlational design to study hypothesised relationships using data from 143 officers and directors of selected telecommunication firms in Somalia. Administrative innovation was operationalised as redesign of work systems while technical innovation comprised change and application of new production-related processes. Innovation strategy involved assessment of future opportunities and threats through long-term formal planning and organising. Business performance was measured by the degree to which financial performance, such as sales growth and profitability, was attained.

In all, twenty innovation items and six performance items were measured on five-point-Likert-type scales. Data collection took place in 2013 and consisted of survey of 143 officers and directors of selected telecommunication firms in Somalia. Data were analysed with SPSS Version 16. Data analysis included principal component analysis (PCA) of the 20 innovation items which eventually yielded one component with strong loadings of items from the three innovation types and Cronbach Alphas ranging between .767 and .935. The items under the selected components were used to form a composite innovation variable.

Hypothesised relationships between innovation types and business performance on one hand, and between innovation and business performance, were analysed with Pearson correlation. The major findings of the study were that administrative innovation, technical innovation and innovation strategy had significant positive relationships with business performance. In addition, innovation had a positive correlation with business performance.

Empirical Review on Knowledge Spillover

The knowledge spillover theory of entrepreneurship posits that entrepreneurial activity will be greater where investments in new knowledge are relatively high because entrepreneurial start-ups will exploit spillovers from the source of knowledge production and vice versa (Acs et al., 2009; Braunerhjelm et al., 2010). Tacit knowledge and the spillover or flow of the knowledge from incumbents to users are central to the knowledge spillover argument (Acs et al., 2009). According to Johnson et al. (2002), tacit knowledge is a key source of competitive advantage for the pursuit of innovation. Johnson et al. (2002) further argue that the tacit nature of knowledge makes interaction or collaboration, as opposed to publication, the ideal medium for the transfer of the knowledge from incumbents to users.

Moreover interactions, such as research collaboration, serve as a platform for the production of the requisite knowledge and use of the knowledge in developing competitive innovations that advance the knowledge-based economy (Etzkowitz & Leydesdorff, 1995; Etzkowitz, 2003). In relation to these views, a number of related studies, by Acs et al. (2009), Perkmann and Walsh (2009), Baba et al. (2009), Grimpe and Fier (2010), Robin and Schubert (2010) and Hughes et al. (2011), were reviewed. Issues addressed in the studies included contribution of collaborative research to innovation, assessment of the relative contributions by academic researchers from various academic disciplines to collaborative research and the research orientation of academic opportunity within the economy. In addition, incumbent exploitation of knowledge and barriers to entrepreneurship, except personal income taxes, had the expected negative but insignificant effect on entrepreneurship. An implication of the findings, according to Acs et al. (2009), is that if incumbent firms appropriated all the rents of research and development, there would be no intra-temporal knowledge spillovers. Acs et al. (2009) further indicated that if intellectual property protection becomes too strong and all rents accrue to the producer of knowledge, it will reduce intra-temporal knowledge spillovers, and ultimately innovation and growth.

Contrary to Acs et al. (2009) who studied entrepreneurship as the primary medium for knowledge spillovers, Perkmann and Walsh (2009) explored research collaboration as a medium for knowledge transfer. Specifically, Perkmann and Walsh (2009) conducted an inductive qualitative study on university-industry relationships and examined the contribution of the collaboration to innovation. The study consisted of 43 interviews of academics in the Engineering discipline where collaboration was seen as more relatively important than just transfer of intellectual property. From the interview transcripts, the authors extracted information on 55 instances of collaborations or projects which formed the unit of analysis. Through an in-depth analysis of the nature of research projects, the authors identified four types of projects.

Firstly, Perkmann and Walsh (2009) identified research projects that aimed at seeking solutions to specific problems encountered in firms' research and development, engineering or manufacturing activities. They named such projects problem solving projects. Secondly, the authors recognised a number of projects that focused more directly on improving or developing specific technologies relevant to commercial users and mainly dealt with concepts, products or processes that were a step away from market readiness but were characterised by higher degrees of uncertainty. They named such projects technology development projects.

Thirdly, there were research projects that were inspired by the desire to explore potentially and commercially interesting ideas and these were called ideas testing projects. Perkmann and Walsh (2009) noted that ideas testing projects dwelt on specific ideas that emerged within firms' research and development or manufacturing units. Fourthly, the authors identified research projects that consisted essentially of academic research projects with industry participation, and named them knowledge generation projects. The knowledge generation projects, according to Perkmann and Walsh (2009), tended to be informed by challenges at the frontier of academic research but of broad interest to industry.

Perkmann and Walsh (2009) interpreted the findings in relation to type of research, specifically basic and applied research. They indicated that knowledge generation projects appeared to be mostly driven by the quest for fundamental understanding thereby reflecting basic research while the other types of research project were more of applied in nature. Moreover, through a cross-tabulation of degree of finalisation and agenda-setting, the authors found that projects that were more applied were likely to be shaped by industrial partners' agenda, while those that were more basic tended to be shaped by academics' agenda. In addition, it was established that knowledge generation projects were partially or completely supported by public research funding.

In another related study, Baba et al. (2009) analysed the effect of university-industry collaborations on the innovative performance of firms. However, whereas Perkmann and Walsh (2009) sought to explore the contribution of collaborative research to innovation via identification of collaborative research types, Baba et al. (2009) analysed the effect of collaboration on the innovative performance of firms as well as the relationship between research orientation and contribution to innovative performance of firms. The study by Baba et al. (2009) involved 455 firms into photocatalysis. The firms were purposively selected based on active involvement in photocatalysis and having had a minimum of five patent applications. The unit of analysis was an individual organisation.

The dependent variable of the study was research and development productivity measured by the number of registered patents taken by a firm. Using number of patent applications and average quality of publications, Baba et al. (2009) proposed a classification of the research organisations and the scientists per the Stokes quadrant. These included Star or Bohr scientists, Edison scientists, Pasteur scientists and others. Eventually, Baba et al. (2009) defined the independent variables of the study to consist of co-invention activity, that is, the number of collaborative patent applications, categorised into collaborations with Star scientists, Edison scientists and Pasteur scientists. The authors controlled for absorptive capacity and firm size. Data were analysed with binomial regression analysis.

The key findings of the study were that higher research and development productivity of firms operating in the photocatalyst sector was associated with greater number of collaboration with Pasteur scientists and Edison scientists, larger absorptive capacity and experience. Collaborations with Star scientists did not affect firms' innovative performance. Baba et al. (2009) interpret their findings as a confirmation of the need for corporate managers to select university partners with specific characteristics, which properly fit the industry's need to consult with scientists of high scientific value and technological experience. In addition, Baba et al. (2009) argue that the finding on the Star scientists underlines the absence of 'heterogeneity in the scientists' capabilities, which discriminates their ability to speak the language of the firm and to offer valid consulting for firms in the advanced materials sector' (p. 762).

Furthermore, Grimpe and Fier (2010) investigated research collaboration from the perspective of informal technology transfer on the premise that literature confined university technology transfer almost exclusively to formal mechanisms such as patents and licenses. As a result, Grimpe and Fier (2010) studied commercialisation, co-authorship and consulting as alternative mechanisms of informal technology transfer through a comparative survey of over 800 purposively selected university scientists from the US and Germany. The scientists were from the Life Sciences, Engineering and other natural sciences and a reference group from the Social Sciences and Humanities.

Data were collected in 2008 using an online survey instrument. Grimpe and Fier (2010) estimated several Probit models and regressed the three transfer mechanisms on different sets of explanatory variables controlling for the research environment, measured by size of peer group and research funding. The main finding of the study was that faculty quality, measured by number of patent applications, served as a major predictor of informal technology transfer activities. In assessing disciplinary effects, Grimpe and Fier (2010) found that all the studied disciplines were more likely to engage in informal technology transfer compared to the reference group of Social Sciences and humanities.

However, number of publications was not important at all for the decision to engage in any form of informal technology transfer. According to Grimpe and Fier (2010), the finding suggests that firms appear to appreciate the practice-oriented work of scientists that may be immediately integrated into firms' knowledge base. They further indicate that the finding is in contrast to arguments that university Star scientists were attractive partners for firm scientists to collaborate with. On the basis of the findings, Grimpe and Fier (2010) conclude that faculty, like all economic agents, respond to incentives, and until universities change their incentives, knowledge will continue to flow out of the backdoor.

Contrary to country specific studies conducted by Grimpe and Fier (2010) and Baba et al. (2010), Robin and Schubert (2010) conducted a cross-country study by evaluating the impact of collaboration with public research institutions, consisting of universities and research institutes, on firms' innovative activities in France and Germany. The premise for the study was twofold. Firstly, Robin and Schubert (2010) acknowledged that in innovation systems, interactions between industry and science is one of the most prominent institutional interfaces for knowledge diffusion and is central to innovation behaviour. Secondly, according to Robin and Schubert (2010), the study was conducted to take care of potential estimation biases, arising from self-selection and endogeneity, which were missing in previous studies.

Consequently, Robin and Schubert (2010) employed an econometric methodology that took care of the identified gap. Specifically, Robin and Schubert (2010) detailed the innovation production function as a two-equation generalised Tobit model. They named the first model selection equation which explained the propensity to innovate while the second model was called intensity equation which explained intensity of innovation activities within firms. In the first model, the dependent variable was an indicator of whether a firm has pursued innovation over the reference period of 2002-2004. In the second model, the dependent variable, innovation intensity, was measured as the share of sales due to new or innovative products or processes which includes proximity to basic research.

Thus, in the second model, Robin and Schubert (2010) estimated a Heckit model with endogenous explanatory variable and applied it to product innovation intensity and then, to process innovation intensity. Product innovation intensity was operationalised as the share of sales related to new products. On the other hand, process innovation intensity was operationalised as improvement in four firm processes. The improvements were extent of unit cost reduction, extent of cost reduction in materials, increase in production flexibility and increase in production capacity. The indicators of product and process innovation intensity were measured as categorical variables of low (0) to high (3) in the first model but were treated as continuous variables in the second model.

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The endogenous explanatory variable was a binary variable indicating whether, between 2002 and 2004, firms co-operated with a university or another public research institution. A number of variables reflecting technological opportunities were controlled. The variables included firm size, innovation expenditures and industry dummies. Census data from the fourth community innovation survey (CIS4) 2002 to 2004, for Germany and France, was used for the estimation. Through Probit modelling and IV regression analysis, several findings emerged.

Notably, in Germany and in France, collaboration with public research institutions had a significant positive influence on product and process innovation intensity. However, the impact was twice as high in Germany as the impact in France. Additionally, the control variables were significantly correlated with innovation intensity. Drawing on a comparison of institutional context of co-operation across both countries, Robin and Schubert (2010) interpreted the difference between the two countries as a result of the more diffusion-oriented German science policy.

According to Robin and Schubert (2010), public support for research collaborations, between firms and public research institutions in Germany is decentralised relying on technology transfer offices (TTOs) within German universities. However, in France, different instruments coexist at different levels from much centralised national policies to regional and local incentive structures which generate some confusion and multiple costs. Therefore, firms may find it difficult to identify proper public partner for starting a collaborative research. Furthermore, costs could lead to dispersion of public resources which may result in less effective support for research collaboration.

In another related study, Chang et al. (2011) examined how universities can develop a new organisational structure to cope with the rise of academic entrepreneurship in the form of knowledge creation and knowledge utilisation.

The study consisted of surveys of university administrators and 634 faculty members in 99 departments of six universities in China. It focused on departments of science, engineering and medical research on the assumption that they have the higher potential to commercialise their research results. In relation to academics' perception of knowledge creation and knowledge utilisation in their respective departments, a cluster analysis yielded 30 Pasteurian group departments, 12 Edison group departments, 31 Bohrian group departments and 26 Socratic group departments.

In addition, significant differences were established among the four groups using ANOVA F-test and discriminate test of Wilks' Lambda value. Specifically, the results indicated the Pasteurian group had the best performance, followed by the Edison group, Bohrian group, and Socratic group. The authors observed that the highly Pasteurian-oriented group outperformed those that were only knowledge creation or only knowledge utilisation oriented and concluded that the ability to be Pasteurian-oriented is, possibly, an important predictor of performance.

The preceding studies appear to highly focus on Science and related disciplines to the neglect of the Arts and Social Sciences or Humanities, as argued by Bakhshi et al. (2008). As a result, in a study titled hidden connections, Hughes et al. (2011) explored the research orientation of academics in the Arts and Humanities in UK's Higher Education Institutions. The study employed data from a business survey, academic survey and case study, conducted in 2008 and 2009. The business survey comprised a stratified sample of 25,015 firms. The stratification was based on business size, sector and region.

The academic survey consisted of a representative sample, by discipline, age, gender and professional seniority, of 125,900 academics in all disciplines, in all higher education institutions in the UK. The surveys were supplemented by 33 in-depth case studies of academics from the Arts and Humanities, who were purposively selected based on their involvement in collaborative work. The case studies were supported with interview of 39 business partners, who were reached through snowballing by the academic partners. Research orientation was defined according to Stokes' framework and definitions in the Frascati Manual (Manual, 2002).

Hughes et al. (2011) established, through descriptive analysis, that academics from the Arts and Humanities were much more likely to describe their research as basic compared to academics from other disciplines. However, academics from the Creative Arts and Media were more likely to consider their research as use-inspired or applied. Academics from the Arts and Humanities were also less likely to describe their research as use-inspired and the least likely of all disciplines to report their research as applied. In terms of the relevance or use of their research findings, Hughes et al. (2011) established that academics from the Arts and Humanities were more likely to report that their research was of no relevance for external users compared to other academics. They were also relatively less likely to have had their research applied in a commercial context and carried out research in a general area of commercial interest.

The foregoing review suggests that knowledge, in the form of research findings, is vital to innovation and economic growth (Acs et al., 2009; Robin & Schubert, 2010) and that research collaboration serves as an important means of facilitating tacit knowledge flow from incumbents to users (Perkmann & Walsh, The academic survey consisted of a representative sample, by discipline, age, gender and professional seniority, of 125,900 academics in all disciplines, in all higher education institutions in the UK. The surveys were supplemented by 33 in-depth case studies of academics from the Arts and Humanities, who were purposively selected based on their involvement in collaborative work. The case studies were supported with interview of 39 business partners, who were reached through snowballing by the academic partners. Research orientation was defined according to Stokes' framework and definitions in the Frascati Manual (Manual, 2002).

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The foregoing review suggests that knowledge, in the form of research findings, is vital to innovation and economic growth (Acs et al., 2009; Robin & Schubert, 2010) and that research collaboration serves as an important means of facilitating tacit knowledge flow from incumbents to users (Perkmann & Walsh, 2009). However, studies by Baba et al. (2009), Perkmann and Walsh (2009) and Grimpe and Fier (2010) and Chang et al. (2011) indicate the prevalence of use-inspired basic research in the collaborations studied. The situation is consistent with Stokes (1997) who argue that the Pasteurian research orientation is relatively ideal for advancing the knowledge base of an economy due to its capacity to meet the dual goals of advancing science and consideration of use by industry.

Furthermore, the findings of the studies suggest use-inspired basic research, applied research, idea testing research projects and technology development research projects as, relatively, more oriented towards innovation than basic research, knowledge generation research projects and problem solving research projects. Moreover, contrary to arguments, such as those by Chang et al. (2011), that elevate the STEM above other academic disciplines in their capacity to contribute to innovation, the study by Hughes et al. (2011) indicate that the Arts and Social Sciences or Humanities could consist of disciplines that are applied in nature and could make valuable contributions to collaborative innovation if given the needed policy support. Similar arguments have been raised by Bakhshi et al. (2008) in a study of the contributions of the Arts and Humanities, in the UK, to innovation.

The above-mentioned observations notwithstanding, a number of gaps have been identified in some of the reviewed studies. Firstly, although the study by Perkmann and Walsh (2009) contributes to understanding on the nature of collaborative research projects, it failed to elucidate the level or frequency of engagement in the various research projects by respondents. Analysis of the level of engagement in research projects is important to the identification of the more innovation-oriented research projects that are not often carried out so that intervention policies can be put in place to promote the projects.

Secondly, except the study by Hughes et al. (2011), all the reviewed studies focused on the Sciences, Technology, Engineering and Mathematics (STEM), in support of the argument by Moore et al. (2010) and Bakhshi et al. (2008) that the STEM is given preference over other academic disciplines in academic research-related studies as well as policy. Thirdly, scrutiny of the reviewed works suggests a strong skewness of research in the field towards advanced country experiences. Fourthly, with the exception of the study by Chang et al. (2011), significant differences in the perceptions of academics on their research orientation were not statistically tested. Such a test is important in informing policy on for instance, academic groups that need sensitisation towards the creation and commercialisation of knowledge necessary for feeding the knowledge base of an economy.

Empirical Review on Network and Social Capital

The knowledge-based economy functions on networks or interactions that facilitate the production of requisite knowledge and flow of the knowledge among the key actors in the economy. One indispensable network, in the knowledge-based economy, is research collaboration. Through research collaboration, the requisite knowledge is produced and utilised for competitive innovations that advance the knowledge-based economy (Leydesdorff, 2010; Robin & Schubert, 2010). However, fruitful research collaboration is not automatically given. The network theory of social capital illustrates the importance of collective assets and structural and positional factors to the engagement in frequent and fruitful interactions by network actors (Lin, 2008).

Similarly in order to attain active engagement by academic researchers in research collaboration, literature indicates the importance of support mechanisms that meet the aspirations of the actors in the knowledge-based economy (Henrekson & Rosenberg, 2001; Leydesdorff, 2010). Consequently, various studies were reviewed to learn about the involvement of academic researchers in research collaboration, assess the academic impact of research collaboration and analyse the challenges of research collaboration. The studies include those by Perkmann and Walsh (2009), D'Este and Perkmann (2010), Hughes et al. (2011) and Hughes and Kitson (2012).

Perkmann and Walsh (2009) conducted an inductive study on university-industry relationships, in 2006, using Engineering faculty as a means of widening the narrow IP perspective on life sciences, in much of the previous related literature. In order to minimise organisational variability, the study was done in a research intensive university in the UK. Perkmann and Walsh (2009) investigated, among other things, the involvement of respondents in collaborative research projects and specifically analysed the initiator(s) of the collaboration, the parties with whom respondents collaborated and impact of the collaboration on respondent's professional career. Respondents were selected through theory-driven sampling with the help of technology transfer officials and department heads. The study consisted of 43 interviews of academics in the Engineering discipline.

From the interview transcripts, the authors extracted information on 55 instances of projects which formed the unit of analysis. In-depth analysis of the nature of collaborative research projects in relation to firm size and initiator(s) of the projects, revealed a number of findings. Firstly, Perkmann and Walsh (2009) recognised that a third of the 55 projects involved small and medium-sized enterprises as partners. Secondly, knowledge generation projects were mostly initiated by academics. However, problem solving projects and technology development projects were found to be often initiated by firms that approached academics for assistance. Only occasionally had academic researchers developed technologies which attracted industry attention. Although idea testing projects also often originated from firms, they were sometimes developed by academics and sold to firms to pursue tentative exploration of their potential application.

Thirdly, according to Perkmann and Walsh (2009), pure basic research-oriented projects, in other words knowledge generation projects, were more likely to yield academically valuable knowledge than applied research projects. On the other hand, applied projects such as technology development and problem solving projects, were less conducive to scientific output for differing reasons. For example, Perkmann and Walsh (2009) indicated that knowledge or data produced from problem solving projects were not suitable for publication while idea testing projects were more likely to be affected by secrecy considerations.

Similarly, technology development projects sometimes demanded secrecy and did not yield academic results that were sufficiently interesting or novel. However, Perkmann and Walsh (2009) indicated that applied projects showed higher degrees of partner interdependence and enabled exploratory learning by academics, leading to new ideas and projects. The authors posit that

One key finding of the study was the rising importance of knowledge exchange reflected in the increase in income secured from knowledge exchange activities of UK HEIs. Moreover, the leading purpose or motivation of academics for engaging in knowledge exchange was the benefits that knowledge exchange could deliver to their research. Almost half of academics cited new insights for their work and new contacts in their fields as the leading impact on their research. The next higher level of impact was in relation to impact on teaching mainly in course delivery or material presentation and the course programme in terms of an increasing willingness to use real-world examples in teaching and deliver courses that are more directly relevant to the needs of future employers. The greatest challenge to knowledge exchange was lack of time, and this was followed by resource constraint.

Furthermore, Moore et al. (2010) explored perceived negative impact of knowledge exchange on academic researchers' activities through an assessment of their attitudes towards knowledge exchange interactions with external entities. In general, most academics were reported to have had a positive attitude towards interactions with external entities although approximately half of academics agreed that too much emphasis on the commercial application of research leads to a decline of academic standards. For instance, a third of academics agreed that the university had gone too far in attempting to meet the needs of industry to the detriment of their core teaching and research roles. This concern was expressed by almost half of the academics undertaking pure-basic research.

D'Este and Perkmann (2010), in a related study, investigated why academics engage with industry. The study comprised a survey of 4,337 university researchers in the UK. Data were analysed on two sets of information through ordered logit regressions using engagement in various types of channels as the dependent variables. The first analysis involved frequency of engagement, in the immediate past year, with industry through five channels of interaction. The five channels included joint research, contract research, consulting, spin-off firm establishment, and patenting. It was established that contract research, joint research and consulting were the three channels with the highest proportion of researchers engaging at least once in the reference period.

Subsequently, D'Este and Perkmann (2010) used the five channels, as dependent variables, to ascertain researchers' rationale for engaging with industry. The study used 12 items to measure academics motivations for engaging with industry. Using factor analysis, the 12 items were condensed into four, namely commercialisation, learning, access to in-kind resources and access to funding. Two key findings emerged after controlling for individual and organisational level factors such as individual experience and career-stage effects, as well as selection bias.

Firstly, commercialisation was the least important motivation for engaging with industry while research-related reasons, such as learning from industry and fund-raising dominated. D'Este and Perkmann (2010) concluded that academics main reason for engaging with industry was to support their academic research activities. The authors further indicated that subsequent positive impacts or benefits of collaborative research remain under-appreciated as an important aspect of public research. They described the benefits as backward linkages from applied technology which include gaining new insights, receiving feedback on research and accessing new knowledge that can lead to follow-on research or inform academic research agenda as well as the development of new scientific disciplines.

In another study, Hughes et al. (2011) sought to examine, what they termed, hidden connections on the premise that the Arts and Humanities were often ignored in studies on interactions between academia and external entities. The study involved survey of a representative sample of 125,900 academics in all UK higher education institutions, a stratified sample of 25,015 businesses in the UK, and 33 in-depth case studies of academics from the Arts and Humanities and their business partners totaling 39, who were reached through snowballing by the academic partners. Data collection took place in 2008 and 2009.

The business survey and case studies spanned activities in the public sector, private sector and third sector or what Hughes et al. (2011) alternatively described as charitable activities of the economy, as well as the local community. Some of the objectives of the study were to compare engagement in formal and informal channels of collaboration and to assess the sectors with which academics collaborated, initiator(s) of collaboration, purpose and challenges of collaboration. Data were analysed with descriptive statistics.

In general, Hughes et al. (2011) found a relatively higher involvement of academics in broader knowledge exchange or indirect commercialisation activities including informal research collaboration as against direct or formal activities such as patenting and licensing through technology transfer offices (TTOs), formation of spin-outs and consultancy. Moreover, in relation to widespread knowledge exchange, the broad pattern of interactions was found to be similar among all disciplines although academics from the Arts and

Humanities were proportionately less likely to be involved in problem-solving interactions which consisted of contract research.

Furthermore, Hughes et al. (2011) established that academics were generally found to collaborate with the private, public and third sectors, though the highest collaborations were made with the public sector. However, the Arts and Humanities had the highest collaborations with the third sector which was above the average for all other academics. In addition, on the premise that knowledge is exchanged rather than transferred, Hughes et al. (2011) found that collaborations were initiated most frequently by individuals often associated with the organisations that academics partner with. The authors explained that the capacity to connect is an important factor in the knowledge exchange process making necessary boundary spanning skills for connecting between academia and external entities.

Moreover, the overriding purpose of collaboration, according to Hughes et al. (2011), was the need to seek resources in support of research and teaching. This was particularly important for the Creative Arts and Media whose primary motivation was to advance their research. Specifically, the interactions helped most academics in their research, mainly, in identification of new insights for future research. In terms of teaching, the impact reflected in changes or improvement in course content and delivery, employability of students and reputation of the academic.

However external engagement was, in general, considered to have lower impact on career advancement which was assessed to include promotion based on research and publication. Hughes et al. (2011) stressed the need to interpret this finding cautiously since external engagement supports and strengthens research and teaching, two media through which career advancement is attained. Moreover, the collaborations were fraught with a number of challenges. The leading constraint was lack of time, associated with most senior academics, and difficulties caused by internal bureaucracy.

Hughes and Kitson (2012) also investigated knowledge exchange mechanisms and the strategic role of UK universities in national growth and development. Hughes and Kitson's (2012) study differed from the preceding studies in that it examined the purpose(s) for which businesses interact with academia. In the study, Hughes and Kitson (2012) categorised knowledge exchange mechanisms into four types, namely, people-based interactions, problem-solving interactions, commercialisation and community-based interactions.

Hughes and Kitson (2012) also analysed interactions between academics and partners in the private, public and third sectors of the UK economy, and specifically defined the third sector to comprise voluntary organisations, charities and social enterprises. The study involved over 22,000 responses from a web-based survey of the entire academic community in UK, together with over 2,500 responses from a postal survey of a sample of businesses, which were stratified by size, sector and region. Data collection took place from September, 2008 to June, 2009 Data were analysed using descriptive statistics and multivariate probit analysis controlling for possible confounding factors such as age and gender.

The key findings of the study were that knowledge exchange involved academics from all disciplines, embraced partners from the public, private and third sectors and that academics employed several knowledge exchange mechanisms in interacting with external entities. The main constraints to knowledge exchange interactions included a lack of time, insufficient internal capability to manage relationships and insufficient information to identify partners. According to Hughes and Kitson (2012), problems concerning cultural differences between academics and business and disputes concerning intellectual property were not prominent, hence, they interpret that the notion of an academic "ivory tower" seems to be a myth.

From the users' perspective, Hughes and Kitson (2012) found that British businesses interacted with academia first, to support marketing, sales and support services followed by innovation activities, human resource management and logistics, procurement and operations. Some specific findings on type of interaction mechanism and interactions by academic discipline were presented. Firstly, the most frequent form of interaction with external entities were people-based interactions, such as student placement and network activities, followed by problem-solving interactions which consisted of contract research and informal advice. Direct commercialisation pathways were in the distinct minority of all interactions. Secondly, academics from the Arts and Humanities were considerably less likely to be engaged in problem-solving interactions, compared to academics from other disciplines.

Academics from the STEM led in direct commercialisation whereas those from Arts, Social Sciences and Humanities (ASSH) were relatively small and much below the average for all academics. In addition, the STEM had the highest level of interaction with the private sector while the Social Sciences were among the disciplines that interacted most with the public sector. On the other hand, the Arts and Humanities were among the disciplines with the highest level of engagement with the third sector. Overall, the average number of academics who interacted with the third sector was found to be slightly higher than the level of engagement with the private sector.

The foregoing review indicates that studies on research collaboration and related concepts, is an evolving phenomenon which is studied from different perspectives. However, a number of issues were addressed by the reviewed studies. The issues include purpose of research collaboration, sectors with which academic researchers collaborate, essentials of research collaboration and challenges of research collaboration. The studies by Perkmann and Walsh (2009), and D'Este and Perkmann (2010) provide important information on the types of research collaboration and collaborative research projects, respectively.

Nonetheless, the reviewed studies appear to lack sound theoretical frameworks which are critical to the development of research design, as well as setting the limits for interpreting research findings (Creswell, 1994; Webster & Watson, 2002). As much as Hughes et al. (2011) and Hughes and Kitson (2012) examined the positive impact of research collaboration on the profession of academic researchers, the negative impact of research collaboration and assessment of the welfare-related impact of research collaboration, appeared missing in the studies. According to the network theory of social capital, examination of these forms of impact is critical to decision-making on future interactions (Lin, 1999; 2008).

Empirical Review on Planned Behaviour

The theory of planned behaviour posits that actual behaviour can be predicted with much accuracy from intention to engage in the behaviour and intention can be predicted by attitude towards the behaviour, subjective norms and perceived behavioural control while perceived behavioural control could alone predict intention to engage in the behaviour. As a result, a study by Bozeman and Gaughan (2007) was reviewed. Studies by Ajjan and Hartshorne (2008), Côté et al. (2012) and Cheung and Vogel (2013) provide insights on the efficacy of the theory of planned behaviour as a useful theory for predicting intention to engage in behaviours of different kinds as well as ascertaining the determinants of the intention.

Bozeman and Gaughan (2007) investigated the impact of grants and contracts on academic researchers' interaction with industry. Data were secured from questionnaires of the Research Value Mapping Survey of academic researchers in the Sciences and Engineering at the 150 Carnegie Extensive Research Universities in the US who produced at least one PhD graduate in 2000. The study sample was 1564. Nine items including request by industry for research-related information, serving as paid consultant, engaging in technology-related research and co-authorship were used to compute industrial involvement scale of respondents. Through factor analysis and regression analysis, several findings emerged.

Firstly, funding in the form of grants and contracts from industry had significant effect on academics' propensity to work with industry. Secondly, academics on industry grants were twice as likely to be asked about their research by industry, to serve as paid consultants, to work in a company or to own a company. Thirdly, academics on industry grants were about three times more likely to initiate collaboration in the form of asking industrial researchers about their research as well as to engage in technology-related research, co-authorship with industry personnel and to place students in industry jobs. Fourthly, these academics were four times as likely to have worked with industry on research that yields a patent or copyright.

Ajjan and Hartshorne (2008) investigated faculty decisions to adopt Web 2.0 technologies. Whereas the study by Bozeman and Gaughan (2007) did not rely on a specific theoretical framework, Ajjan and Hartshorne (2008) employed the theory of planned behaviour to ascertain the factors that best predict faculty's decision to adopt the technology as a supplement to traditional classroom instruction. The study by Ajjan and Hartshorne (2008) consisted of a survey of 136 faculty members at a university in southeastern United States. Participation in the study was voluntary.

Ajjan and Hartshorne (2008) operationalised attitude towards behaviour to consist of perceived usefulness, perceived ease of use and compatibility while subjective norm was defined as social pressures from superiors, peers and students, on the behaviour under investigation. Perceived behavioural control consisted of self-efficacy in terms of personal comfort with using the technology on the one hand and, on the other hand, facilitating conditions. Specifically, facilitating conditions reflected the availability of resources such as time, money and other resources needed to use the technology. The principles of TACT, recommended by Azjen (2002; 2011a) in the development of measures, were largely adhered to. However, on the specification of the time frame for delving into the accessible memory of respondents, specific time frame was missing except for intention to use the technology which was specified as 'next semester'.

Questionnaire items, on faculty's intention to use Web 2.0 technologies in course delivery, were measured on a five point Likert-scale from strongly disagree to strongly agree. Reliability tests were conducted to assess the internal reliability of the scale items. According to Ajjan and Hartshorne (2008), all the scales were reliable with values ranging from 0.67 to 0.98. Furthermore, collinearity among variables was tested and all correlations were significant and in the right direction with no correlation exceeding .83. Eventually with a path analysis model, Ajjan and Hartshorne (2008) conducted regression analysis to test the hypothesised relationships.

The regression results indicated that attitude towards behaviour and perceived behavioural control had significant positive effect on faculty's intention to adopt Web 2.0 technologies. According to Ajjan and Hartshorne (2008), path analysis confirmed that attitude was the only determinant that had a very significant effect on behavioural intention. In addition, intention to use the technologies strongly predicted actual behaviour. However, subjective norm had no significant effect on behavioural intention. Ajjan and Hartshorne (2008) interpreted the insignificant effect of subjective norm on behavioural intention as a result of, possibly, the high degree of independence that faculty have when developing their classroom environment.

In another study, Côté et al. (2012) analysed the determinants of nurses' intention to integrate research evidence into clinical decision making through an explanatory correlational study. The purpose of the study was to identify factors influencing research utilisation by nurses that could be targeted by interventions. The study by Côté et al. (2012) differed from that by Ajjan and Hartshorne (2008) in that whereas Ajjan and Hartshorne (2008) employed the three main constructs of the theory of planned behaviour (TPB) in the study on faculty decision on Web 2.0 technologies, Côté et al. (2012) used an extended version of the TPB by including moral norm as an additional predictor of behavioural intention. Côté et al. (2012) argued for the inclusion of moral norm on the basis of prior studies that had established the critical role of good morals in the nursing profession.

In addition, whereas Ajjan and Hartshorne (2008) predicted behavioural intention using composite variables developed from scale items, Côté et al. (2012) constructed the composite variables of the TPB after regressing the belief measures of each construct variable on behavioural intention, as a means of determining which belief-based measures were fundamental to behavioural intention. As a result, Côté et al. (2012) identified three moral norm belief items out of four, three normative belief items out of seven and two out of six control beliefs items, as important contributors to the prediction of nurses' intention to use research findings in clinical decision making.

The study, by Côté et al. (2012), comprised a census of all nurses at post in a university hospital in Canada between February and March 2008. A total of 336 nurses participated in the study. Data were analysed using descriptive statistics of the model variables, Pearson correlations and multiple linear regression. The key finding of the study was that moral norm, normative beliefs, perceived behavioural control and past behaviour explained nurses' intention to use research findings in clinical decision making. However, moral norm was the most important predictor of behavioural intention. Côté et al.

(2012) concluded that an extended psychosocial theory is useful in identifying the determinants of nurses' intention to integrate research findings into their clinical decision making.

In another related study, Cheung and Vogel (2013) sought to explain user acceptance of collaborative technologies by using a decomposed version of the theory of planned behaviour. Whereas Ajjan and Hartshorne (2008) and Côté et al. (2012) utilised the three composite variables of attitude, subjective norm and perceived behavioural control in predicting behavioural intention, Cheung and Vogel (2013) predicted behavioural intention by regressing attitude, self-efficacy and decomposed variables on subjective norm as well as sharing and perceived resource availability, on intention. Specifically, subjective norm was measured in reference to three significant others, namely, peers, the media and lecturers and each group was independently regressed on behavioural intention.

Cheung and Vogel (2013) conducted the study with the primary purpose of enhancing an emerging technology acceptance model in explaining factors that influence the acceptance of Google applications for collaborative learning. The study consisted of a survey of 150 students enrolled in a full-time degree programme in a Hong Kong University that used Google Applications to facilitate collaborations on student project work. Questionnaire items consisted of self-reported experiences measured on a seven-point Likert scale with answer choices varying from "strongly disagree" (1) to "strongly agree" (7). The experiences were not associated with a particular time frame except for the use of the word 'frequently' in items measuring actual usage of the Applications.

Data from 136 questionnaires were analysed with structural equation modeling (SEM), specifically, the partial least squares (PLS) technique.

The analysis showed that the average variance explained (AVE) of items for the various constructs of the study were within acceptable limits, varying between 0.57 and 0.94, with Cronbach Alphas between 0.81 and 0.95. Following recommendations in literature, Cheung and Vogel (2013) created construct variables of the theory of planned behaviour by three selection criteria. Firstly, Cheung and Vogel (2013) selected items that were significant and had factor loadings exceeding 0.5. Secondly, the items had reliabilities exceeding 0.7. Thirdly, the items had AVE of 0.5 and above. The construct variables were subjected to regression analysis.

The main finding of the study was that attitude, self-efficacy, sharing and subjective norm-peer had significant positive influence on intention to use the Google applications in the student project. However, subjective norm-lecturers and subjective norm-peers did not have significant effect on intention. Path analysis showed subjective norm-peers had a negative moderating effect on the link between attitude and behavioural intention. According to Cheung and Vogel (2013), the implication of the moderating effect is that the effect of attitude on behavioural intention would decrease with any increase in peer influence.

Lessons Learnt

The foregoing review of related literature provides a number of useful methodological lessons for research in allied fields. The issues include operationalisation of the term research collaboration and study design. Other methodological lessons can be derived in relation to measurement of variables, scale of measurement, sampling procedure and data analysis. First and foremost, the outcome of the review suggests that empirical inquiry on research collaboration is an evolving phenomenon. Therefore, research collaboration was studied, for example by Hughes and Kitson (2012) and Moore et al. (2010), as part of the broad spectrum of knowledge exchange activities. In other instances, for example studies by Grimpe and Fier (2010) and Baba et al. (2009), research collaboration was defined to include one or a combination of activities such as joint research, contract research, consulting and co-authorship.

A possible inherent drawback in defining research collaboration solely as co-authorship or co-invention (Baba et al., 2009; Katz & Martin, 1997) is that it limits the scope of applicability of research findings by ignoring other essential forms of collaboration such as contract research, consulting and technology transfer or commercialisation. These other forms of collaboration may involve research work with significant contributions to the knowledge base of an economy and, yet, may not yield a publication or patent due to secrecy considerations, as established in the study by Perkmann and Walsh (2009). Therefore, it will be appropriate to operationalise research collaboration in such a way as to capture all relevant forms of interactions, between academic researchers and external parties, geared towards the production of research output for innovation.

In addition to the operationalisation of research collaboration, the reviewed literature suggests that mixed methods, descriptive and causal research design (Hughes et al., 2011; Hughes & Kitson, 2012) might be appropriate for subsequent studies that seek to make predictions and explain the outcome of the predictions. Studies by Côté et al. (2013) and Ajjan and Hartshorne (2008) indicate the possibility of using an extended theory of planned behaviour. Ajzen (1991; 2011b) and Ajzen and Klobas (2013) stipulate that the addition of variables should be done in accordance with laid down procedures such as following the principle of compatibility in defining variables.

A number of other lessons can be learnt from the theory of planned behaviour (Ajzen, 1991; 2002), in the development of belief-based measures. Firstly, Ajzen (1991; 2011a) suggests that behaviour should be defined by its target, action, context and time span (TACT). It can be inferred from the review of related empirical literature that the time period for tapping into the accessible memory is dependent on what is being studied. For example, Ajjan and Hartshorne (2008) described the time period as next semester, in analysing faculty decision to use web. 2.0 technologies in course delivery while Cheung and Vogel (2013) resorted to the word 'frequently' in assessing actual usage of Google applications in student project work.

Secondly, Ajzen (2002; 2011a) recommends the use of double items in assessing each belief-based measure. For example, in assessing normative belief, the normative belief strength and motivation to comply should be measured. Thirdly, the theory stresses the need to measure each construct or factor with at least five to six items (Ajzen, 2011a). In addition, variables, such as belief-based measures of the theory of planned behaviour, can be measured on five-point Likert-type scales, as can be inferred from Ajjan and Hartshorne (2008), or seven-point semantic differential or Likert-type scales (Ajzen, 2011a), as demonstrated in the study by Cheung and Vogel (2013).

In order to examine differences across academic disciplines, it appears that categorisation by academic discipline should be done in close alignment with terminologies that are used by the study institutions. This is essential in avoiding overlapping groups since in certain instances, the Social Sciences could be described as the Humanities or part of Humanities, while in other instances, like the study by Hughes et al. (2011), Humanities was considered separate from the Social Sciences. However, grouping of the Sciences, Technology, Engineering and Mathematics as one academic discipline was consistent in the related reviewed studies (Hughes et al., 2011; Hughes & Kitson, 2012).

Lessons on data analysis are threefold. Firstly, the study by Chang et al., (2011) suggests that differences among groups could be examined by conducting a one-way between-groups analysis of variance. Secondly, in order to ascertain the fundamental factors that are likely to explain a given phenomenon, factor analysis must be conducted (Ajjan & Hartshorne, 2008; Cheung & Vogel, 2013). Studies by Ajjan and Hartshorne (2008) and Cheung and Vogel indicate that the selection of variables should be guided by the factor loadings of the items as well as the reliability of the composite scale items. For example, Cheung and Vogel (2013) used factor loadings of .5 and above and Cronbach Alpha of .7 and above as important selection criteria. Thirdly in regression analysis, correlated items should not have coefficients of more than .7 (Pallant, 2011) and in extreme cases .8 (Cheung & Vogel, 2013), since a high correlation indicates duplication of concepts.

Conceptual Framework of Research Collaboration for Attainment of a Knowledge-based Economy

On the basis of prior studies, particularly that by Perkmann and Walsh (2009) and Robin and Schubert (2010), research collaboration was operationalised as interaction(s) between academic researchers and knowledge users for the production of research output that is useful for innovation and problem solving. The relevance of research collaboration to economic development is demonstrated by the Schumpeterian growth models, such as Zachariadis (2003), and the knowledge spillover theory of entrepreneurship by Acs et al. (1999). The models and theory demonstrate that research output is a critical source of knowledge for the development of competitive innovations that drive economic development.

As a result academic researchers are expected to collaborate in the conduct of research, especially, with industry (Etzkowitz & Leydesdorff, 1995; Robin & Schubert, 2010), so that through the use of embedded resources or social capital of the interaction (Lin, 2008), the right knowledge will be produced and eventually utilised for the development of competitive innovations (Gunday & et al., 2011; Johnson et al., 2002; Schumpeter, 1934/1983). Consequently, the conceptual framework on research collaboration for attainment of a knowledge-based economy seeks to communicate three key issues.

Firstly, in line with the theory of planned behaviour (Ajzen, 1991; Cheung & Vogel, 2013), it is proposed that attitude towards research collaboration, perceived behavioural control over research collaboration, subjective norm on research collaboration and environmental possibility for research collaboration could influence the intentions of academic researchers to engage in research collaboration, as illustrated in the conceptual framework of the study (Figure 4). According to Ajzen (2011b; Côté et al., 2012), intention to perform a particular behaviour is a strong predictor of actual behaviour. A study of intentions and associated determinants is, therefore, imperative to decision-making and the design and implementation of informed interventions in support of research collaboration (Ajzen, 2002; 2011b).

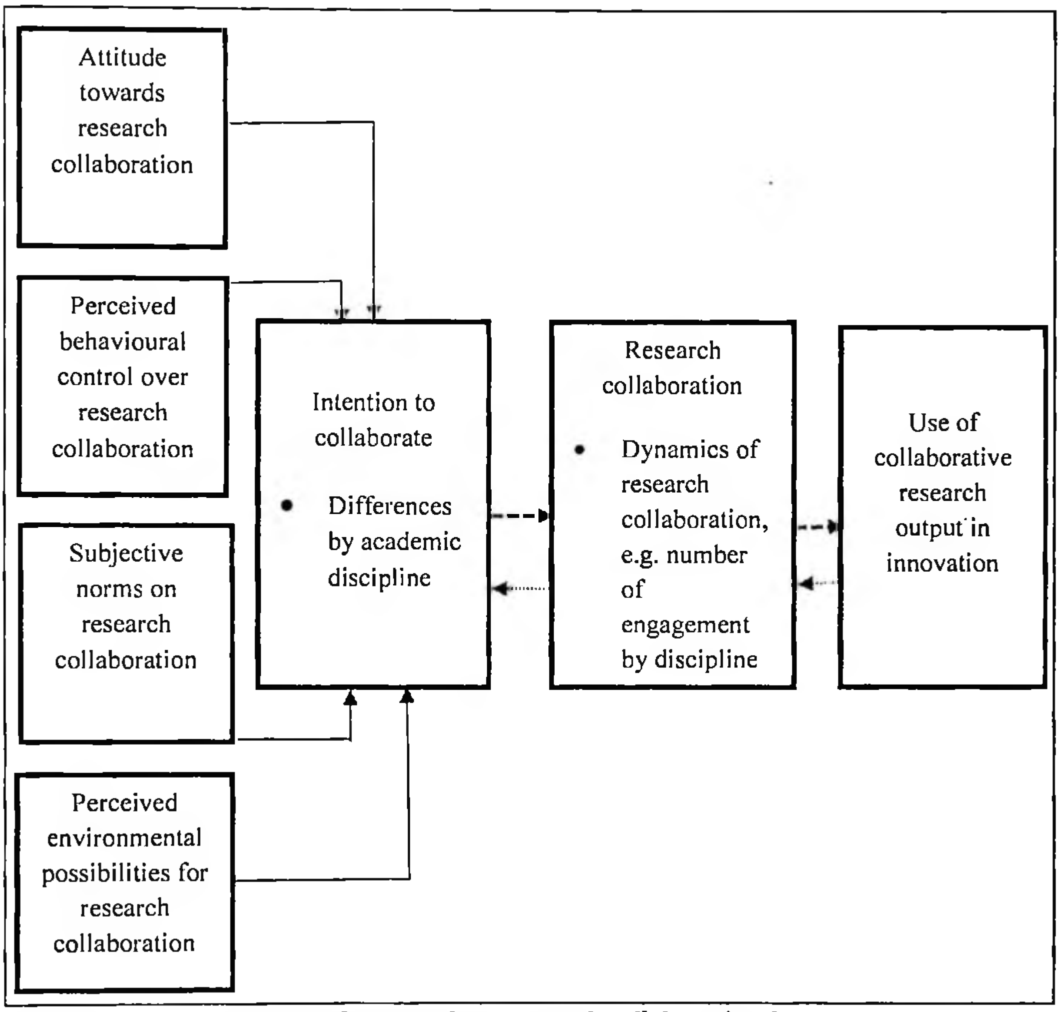

Figure 4: **Conceptual framework on research collaboration for attainment of a knowledge-based economy**

Source: Author's construct (2014) based on the views of various authors

Key:

→ Relationships that were tested

- - - → Relationships that were not tested

······→ Feedback loops (not tested)

Secondly, the conceptual framework (Figure 4) proposes that examination of past collaborative research experiences, captioned as dynamics of research collaboration, is essential to the advancement of the knowledge-based economy. The rationale is that there are some critical issues, from past experiences, that could promote or discourage future research collaboration. The issues include the research orientation of academics vis à vis the knowledge requirements of users, type of research collaboration, type of research project, purpose of collaboration, parties with whom academic researchers collaborate, and impact and challenges of the collaboration. For instance, empirical studies by Baba et al. (2009) and Perkmann and Walsh (2009) showed that collaborative research projects that were applied in nature were more relevant to firm innovation than pure basic research projects.

Thus, applied research projects and use-inspired basic research projects are more innovation-oriented and should be encouraged, since innovation is indispensable to economic development (Ahlstrom, 2010). As a result, assessment of the dynamics of research collaboration, within the framework of the network theory of social capital (Lin, 1999; 2008) and the theory of economic development (Schumpeter, 1934/1983), is critical to decision-making on strategies for promoting collaborative research that advances the knowledge-based economy.

Thirdly, the interactive and purposive nature of research collaboration signifies the use of social capital, in networks, for specific outcomes (Hughes et al., 2011; Lin, 2008). However, the network theory of social capital (Lin 1999; 2008) posits that variations could occur in social capital due to differences in collective assets and especially differences in the structure and position of network actors. The implication is that, intention to collaborate and some dynamics of research collaboration, for example frequency of collaboration, could significantly differ among academics from various academic disciplines, if substantial differences exist, for example, in the determinants of the intention to collaborate and essentials of research collaboration, respectively.

Within the framework of the theory of planned behaviour (Kautonen et al., 2011; Pearson & Hamilton, 2014) intention is expected to influence actual behaviour, as illustrated in Figure 4 with the broken arrow. Other possible relationships are feedback loops from the use of collaborative research findings in innovation, back to intention to collaborate. The feedback loops conform to recursive interactions (Etzkowitz, 2003; Etzkowitz & Leydesdorff, 2000) in the knowledge-based economy, whereby experiences from forward linkages could inform backward linkages, for example, challenges associated with the application of knowledge to the development of innovation could inform academic research. These relationships were, however, not tested since the acquisition of the requisite data, in the form of longitudinal data (Ajzen, 2011a; Kautonen et al., 2011; 2015) was beyond the scope of the study.

CHAPTER FOUR

RESEARCH METHODOLOGY

Introduction

This Chapter of the thesis discusses the methodology of the study. Research methodology, according to Leedy and Ormrod (2010), is the general approach that a researcher takes in carrying out a research project. In other words, 'methodology is a research strategy that translates ontological and epistemological principles into guidelines that show how research is to be conducted' (Sarantakos, 2005, p. 31). Consequently, research methodology may reflect positivism or symbolic interactionism, or both, yielding different research tools or methods in the form of sampling procedures and instruments for data collection and analysis (Sarantakos, 2005; Taylor, Sinha & Ghoshal, 2006). In addition, Kothari (2004) explains that the methodology of a study serves as a guide to the conduct of research.

As a result, in this Chapter of the thesis, background information on the study institutions as well as research design and study design, are presented. This is followed by a description of the study population and sampling procedures. Afterwards, in relation to the objectives of the study, the data requirements as well as instrument design are specified. Subsequently the procedures and outcomes of pilot study and data collection are outlined. Finally, challenge(s) of fieldwork, procedures and methods for data management and data analysis, are presented.

Study Organisations

The institutions of interest were the University of Cape Coast (UCC) in the Central Region of Ghana and the Kwame Nkrumah University of Science and Technology (KNUST) in the Ashanti Region of Ghana (Figure 5). The study was conducted in these institutions because they provided a comprehensive population of the STEM, the Arts and the Social Sciences, which was needed to test hypothesised differences by academic discipline. The test of differences by academic discipline was meant to contribute towards the debate as to whether the STEM should continue to take precedence over other academic disciplines, particularly, in the promotion of the knowledge-based economy (Bakhshi et al., 2008; Chang et al., 2011).

Figure 5: Map of Ghana
Source: Dzobo (2013)

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Settlement Research and the Kumasi Centre for Collaborative Research into Tropical Medicine (see Table 50 in Appendix A). The KNUST, like UCC, renewed its commitment to research in 2013 by establishing the Office of Grants and Research (OGR).

The Kwame Nkrumah University of Science and Technology (KNUST), through the OGR, promotes research collaboration by offering information on grants and research opportunities and providing assistance in the implementation of secured awards. The KNUST operates the Technology Consultancy Centre (TCC) whose mandate is to work with the university's academic departments to research, co-develop and transfer technology to support small and medium scale industries in Ghana. The university also hosts research collaboration-related programmes such as the Development Research Uptake in Sub-Sahara Africa (DRUSSA), in creating awareness on the usefulness of research and, particularly, collaborations that will lead to the uptake of research findings. Other structural support includes the establishment of a research fund which was expected to give two premier awards in 2015.

Research Design

Research design is an activity and time-based plan, developed on the basis of research questions and or hypotheses, which serve as a guide to the research process (Cooper & Schindler, 2011). Zikmund et al. (2013) indicate that research design stipulates the methods and procedures for the measurement of variables, as well as collection and analysis of data. Therefore, an effective and efficient research design yields maximum information with minimal expenditure of effort, time and money (Kothari, 2004; Leedy & Ormrod, 2010).

Creswell (1994) explains that research paradigm, that is a particular orientation to research, plays a critical role in the choice of research design.

Positivism, and symbolic interactionism and phenomenology are the two primary research paradigms in social research (Sarantakos, 2005; Schrag, 1992). According to Sarantakos (2005) and Taylor et al. (2006), positivism consists of a realist or objectivist ontology which assumes, for example, that reality and truth exist objectively and can be adequately measured. As a result, positivism dwells on an empiricist epistemology and guides the strategy of quantitative research. On the other hand, symbolic interactionism and phenomenology comprises a constructionist ontology, which is based on a number of assumptions including the assumption that there is no objective reality as well as absolute truths and, hence, the world is constructed by people who live in it. Therefore, symbolic interactionism follows an interpretivist epistemology and serves as a guide to qualitative research (Johnson & Onwuegbuzie, 2004; Sarantakos, 2005).

Thus, if the researcher's orientation to research is rooted in positivism, then the research design will constitute quantification of the phenomenon under study, resulting in a quantitative research approach. Alternatively, if the researcher is oriented towards symbolic interactionism, then the research design shall constitute qualification of the research phenomenon that yields a qualitative research approach. However, if the researcher is oriented towards positivism and symbolic interactionism, then both quantification and qualification of the research phenomenon shall occur, giving rise to the mixed methods approach or mixed research. Therefore, social research may either adopt the quantitative approach, qualitative approach or mixed methods approach to research (Creswell, 1994; Schrag, 1992; Venkatesh, Brown & Bala, 2013).

Quantitative research is defined by Zikmund et al. (2013) as research that addresses research objectives through empirical assessments consisting of numerical measurement and analysis of data. Thus, the quantitative research approach is based on the ontological assumption that reality is based on experiences and facts (Kothari, 2004). Therefore, Cooper and Schindler (2011) explain that quantitative research is employed when the focus of research is to describe, explain or predict, while the researcher maintains a distance from the research to avoid biasing the results. Another feature of quantitative research is that the research design is determined before commencing the research project. It also employs probability sampling and statistical analysis, and yields results that can be generalised to the study population (Cooper & Schindler, 2011; Zikmund et al., 2013).

Quantitative research has several advantages, notable among them is that it is ideal for studying large samples and is relatively cost-effective and time saving. Moreover, quantitative research permits the generalisation of the research findings to the study population, when the findings are reliable and valid (Leedy & Ormrod, 2010). However, Cooper and Schindler (2011) caution that quantitative research may be limited by the opportunity to probe respondents for more insight. Sarantakos (2005) also argues that the predetermined research procedure may limit the effectiveness of the research process.

Conversely, qualitative research addresses objectives through techniques that allow the researcher to provide elaborate interpretations of phenomena without depending on numerical measurement (Zikmund et al., 2013). Its focus is on discovering underlying motives and new insights (Singh, 2010; Zikmund et al., 2013) based on the principle that reality is self-constructed. Therefore, Leedy and Ormrod (2010) enumerate the goals of qualitative research to include the quest to understand and interpret, as well as build theory. As a result, qualitative research uses flexible or fixed research design which may be adjusted in the course of the research.

Moreover, qualitative research is subjective in nature, is characterised by high researcher involvement, has small sample size, employs non-probability sampling, and data analysis involves a search for themes. Some merits of qualitative research are that it is relatively flexible in design and creates deeper level of understanding of the phenomenon under investigation. Nonetheless, qualitative research does not produce representative results of a population, hence, the results cannot be generalised to the study population (Kothari, 2004; Sarantakos, 2005; Taylor et al., 2006).

In order to overcome the individual shortcomings of quantitative and qualitative research approaches as well as to capitalise on the strengths of the two approaches, the two research approaches are often employed together, resulting in the mixed methods approach or methodological triangulation (Johnson, Onwuegbuzie & Turner, 2007; Zikmund et al., 2013). Thus, mixed methods research involves integration of quantitative and qualitative research in the collection and analysis of data on a phenomenon under investigation (Fetters, Curry & Creswell, 2013; Zikmund et al., 2013). Fetters et al. (2013) identify three basic types of mixed methods design comprising exploratory sequential, explanatory sequential and convergent or concurrent mixed methods designs.

In the exploratory sequential mixed methods design, the researcher collects and analyses qualitative data and uses the findings of the qualitative research to inform subsequent quantitative data collection. On the other hand, in the explanatory sequential mixed methods design, the researcher collects and analyses quantitative data whose findings inform the qualitative data collection. The convergent mixed methods design comprises the simultaneous collection and analysis of quantitative and qualitative data collection. Although by nature, the mixed methods approach could be time consuming and costly, it has the combined advantages of both quantitative and qualitative research approaches (Cooper & Schindler, 2011; Östlund, Kidd, Wengström & Rowa-Dewar, 2011; Venkatesh et al., 2013).

Generally, Jogulu and Pansiri (2011) argue that the triangulation or the combination of methodologies in mixed methods design implies that mixed methods have complementary strengths and no weaknesses. The strength of mixed research lies, primarily, in its capacity to enhance research findings so that researchers can make inferences with confidence (Jogulu & Pansiri, 2011; Fetters et al., 2013). For instance, Kothari (2004) and Leedy and Ormrod (2010) argue that the mixed methods approach often provides a more complete picture of a given phenomenon and helps the researcher to highlight similarities and differences in various aspects of the phenomenon under investigation. According to Fetters et al. (2013), this particular strength of mixed research is derived when integration is done at the three levels of design, methods, and interpretation and reporting.

As a result the mixed methods approach, specifically the explanatory sequential mixed methods design, was employed in this study. The explanatory sequential mixed methods approach constituted, largely, quantitative study or survey of academic researchers followed by qualitative study in the form of interview of key informants. The survey of academic researchers was essential in capturing versatile experiences and facts on research collaboration while the interviews provided the platform for gaining insights into specific issues that emerged from the survey results. Thus, the qualitative data helped in assessing the validity of the quantitative findings.

In addition to utilising the basic design of explanatory sequential mixed methods approach, the connecting approach was employed at the methods level (Fetters et al., 2013). Thus, interview participants were selected from the population of academic researchers who responded to the survey in order to ensure effective triangulation that would allow for proper interpretation for the confirmation, expansion or discordance of findings. Moreover, interpretation and reporting of findings followed the weaving approach whereby both the quantitative and qualitative findings were written together on a theme-by-theme basis, hence, permitting quicker assimilation of the research findings (Cooper & Schindler, 2011; Fetters et al, 2013).

Study Design

The study design, informed by the chosen research approach, constituted primarily a survey design which was both descriptive and predictive, or analytical in nature. A survey design, according to Taylor et al. (2006, p. 7), 'seeks to gain an understanding of a particular facet of a defined population by directing the enquiry to a subset of that population through taking a sample'. A survey design can be descriptive and or analytical. Singh (2010) explains that descriptive research attempts to determine, describe or identify a phenomenon, while analytical research attempts to establish why the phenomenon is that way, or how it came to be. Thus, whereas a descriptive survey involves description, classification, measurement and comparison of a given phenomenon, analytical survey usually aims at establishing cause-effect relationships (Kothari, 2004; Singh, 2010).

Accordingly, the study sought to employ a descriptive design in answering all the research questions except for the second research question which required an analytical or predictive design. The study, largely, followed a descriptive design due to the fact that empirical studies on research collaboration, per the reviewed related literature and extensive literature search, constituted an evolving phenomenon with more to be learnt. Moreover, the result of the review suggested that existing literature was mainly informed by developed country experiences, hence, the need to learn more about the dynamics of research collaboration and, more importantly, from a developing country perspective.

As a result, the descriptive design focused on analysis of intention to collaborate within the framework of the theory of planned behaviour (Azjen, 1991; 2011) and assessment of various dimensions of research collaboration, such as involvement in research collaboration, as informed by the network theory of social capital (Lin, 1999; 2008). In addition, on basis of the theory of economic development (Schumpeter, 1934/1983), the descriptive design comprised exploration of the use of collaborative research findings in innovation. Furthermore, the descriptive design constituted examination of the research orientation of academics, by employing the quadrant model of scientific research by Stokes (1997).

On other hand, the analytical design of the study comprised procedures that aimed to establish the determinants of intention of academic researchers to collaborate. The design was necessitated by an apparent limited number of empirical studies that sought to establish cause-effect relationships in studies on research collaboration. Therefore with the aid of the theory of planned behaviour (Ajzen, 1991; 2011b) several factors, identified in literature as necessary in influencing the intentions of academic researchers to collaborate, were subjected to factor analysis and eventually, regression analysis.

Moreover the survey design constituted an exploratory design which, through interviews and fact-finding, aimed at gaining insights into key findings of the survey. Furthermore, on the basis of time span, the study design was cross-sectional in nature (Sarantakos, 2005) and was necessitated by the quest to study various dimensions of research collaboration based on units from different sections of the population studied over the same period of time, without a look at changes over time (Leedy & Ormrod, 2010). According to Zikmund et al. (2013), a cross-sectional study is one in which various segments of a population are sampled and data collected at a single moment in time as against a longitudinal study in which the research subjects or phenomena are studied at different times, allowing analysis or response continuity and changes over time.

Population

Population '…is defined as the total collection of elements about which we wish to make some inferences' (Cooper & Schindler, 2011, p. 364). Thus, a population is used in the statistical sense to mean the totality of persons or objects or phenomena that constitute the focus of research and about which inferences would be drawn (Taylor et al., 2006; Cooper & Schindler, 2011). The population of the study comprised all academic senior members of the University of Cape Coast and the Kwame Nkrumah University of Science and Technology.

Academic senior members are university employees with teaching, research and outreach responsibilities (University of Cape Coast, 2012a; Kwame Nkrumah University of Science and Technology, 2005). Following the use of synonymous terms such as research-oriented academics by Perkmann and Walsh (2009) and academics by Hughes et al. (2011) and Hughes and Kitson (2012), the subjects of the study were described as academics or academic researchers. The study population included persons from the rank of assistant lecturer to professor, and equivalent positions. The population was finite with a fixed number of elements (Kothari, 2004).

As a result, a register of all academic senior members was secured from the central administration of each university. The registers contained the names of academic senior members as of December, 2013 and January, 2014 for the Kwame Nkrumah University of Science and Technology (KNUST) and the University of Cape Coast (UCC), respectively. Per the definition of academic senior members used in this study, the names of four persons were deleted from the UCC register due to their non-involvement in teaching, as defined by their positions, at the time of research. On similar grounds, the names of nine persons were deleted from the KNUST list. This yielded a total study population of 1531 academic senior members. Forty one percent of the total population was from UCC while KNUST accounted for 59 percent.

At the time of data collection, the elements of the population belonged to various academic departments situated in colleges at the KNUST and faculties at UCC. The colleges at KNUST were six in number and included the College of Science and the College of Humanities and Social Sciences. On the other hand, the academic structure of UCC constituted six faculties such as the Faculty of Education and the Faculty of Science. The elements of the population belonged to various academic disciplines which were similar in nature across the two study institutions thereby, subsequently, permitting stratification of the study population into three academic disciplines of Science, Technology, Engineering and Mathematics (STEM), Social Sciences and Arts. In all, the STEM had 896 academic researchers, Social Sciences had 408 while the Arts had 227, resulting in a total population of 1,531.

Sampling Procedure

Sampling is the process of selecting some elements of a population for study so that conclusions can be drawn on the basis of findings emerging from the selected elements (Kothari, 2004; Zikmund et al., 2013). The alternative to sampling is a census, of the study population, which Taylor et al. (2006) defines as a complete coverage of a population of interest, as opposed to a partial coverage or a survey of the population. Sampling was chosen instead of a census due to a number of reasons, including the need to economise time and the fact that a census of the population may not offer substantial advantage over a sample survey (Sarantakos, 2005). There are two categories of sampling, namely, probability sampling and non-probability (Kothari 2004; Sarantakos, 2005).

Probability or random sampling is the procedure of choosing a sample in such a way that each member of the population has an equal chance of being selected (Leedy & Ormrod, 2010; Singh, 2010). Examples of probability sampling are simple random sampling and stratified random sampling. Leedy and Ormrod (2005) indicate that probability sampling is employed when the researcher seeks to generalise the findings of a study to the study population. The lottery method, random numbers method and computer method are the means by which a random sample can be selected from the study population (Leedy & Ormrod, 2005; Sarantakos, 2005).

In contrast, non-probability sampling is the procedure which does not afford any basis for estimating the probability that each item in the population has an equal chance of being included in the sample (Kothari, 2004; Singh, 2010). Examples of non-probability sampling techniques are judgment sampling and convenience sampling. According to Cooper and Schindler (2011), non-probability sampling is done in order to work with a relatively smaller sample size that permits intensive probing of respondents, for detailed insights into the phenomenon under investigation. The sampling procedure for the study consisted of both probability and non-probability sampling due to the quest to examine, predict and interpret various aspects of research collaboration through the explanatory sequential mixed methods approach to research.

As a result, a sample size of 511 academic researchers and 11 key informants were determined and selected through proportional stratified sampling and judgment sampling, respectively. Sarantakos (2005) and Zikmund et al. (2013) explain that proportional stratified sampling consists of dividing a relatively heterogeneous study population, on the basis of some characteristics, into relatively homogenous groups, called the strata, and selecting a predetermined number from each stratum in proportion to the population size of the stratum. Judgment sampling, on the other hand, is a non-probability sampling technique in which an experienced individual selects the sample based on his or her judgment about some appropriate characteristics required of the sample members (Zikmund et al., 2013).

The sample size determination table, by Krejcie and Morgan (1970), was used to determine the sample size of the study. The formula for the sample size determination table is based on the assumed proportion of .5 that yields the largest possible sample. It consists of the desired margin of error of 5 percent. The formula is given as follows:

$$n = \frac{X^2*N*P*(1-P)}{(ME^2*(N-1))+(X^2*P*(1-P))}$$

where:

n = Sample size

X^2 = Chi-square for the specified confidence level at 1 degree of freedom

N = Population size

P = Population proportion (assumed to be 0.50)

ME = Desired margin of error (expressed as a proportion)

Estimating the sample size, through the sample size determination table, involved identification of the approximate population size for the study population and its corresponding sample size (Sarantakos, 2005). The population of the study was 1531. From the sample size determination table, the approximate population size was 1,600 which would have resulted in a sample size of 310. However, literature indicates that the minimum sample size can be increased, especially, if the study involves stratified samples (Henson & Roberts 2006; Sola, 2014). Henson and Roberts (2006) argue that increasing the sample size, for studies that seek to compare sub-groups, ensure that the sample size is sufficiently large to permit reasonable estimation.

Furthermore, Reise, Waller and Comrey (2000) explain that a larger sample size is necessary in conducting factor analysis, in which sample size has implications for the communalities of variables, level of over-determination of factors and sampling error. MacCallum, Widaman, Zhang and Hong (1999) define communality of a variable as the portion of the variance of that variable that is accounted for by the common factors whereas over-determination of variables consists of the number of variables that load on each factor which is expected to be at least three or four (Reise et al., 2000; Pallant, 2011). According to Reise et al. (2000), small unique factor weights indicate high communalities and vice-versa. Hence, when the unique factor weights are small, implying high communalities, the impact of sampling error will be small regardless of the sample size (Reise et al., 2000; Pallant, 2011).

In other words when communalities are high, that is greater than 0.6, and there is over-determination of variables whereby each factor is defined by several items, the sample size can be small (Henson & Roberts, 2006; Sola, 2014). However, Henson and Roberts (2006) argue that because one cannot know for sure how strong the communalities will be until the data are analysed, conceivably, the best rule of thumb to follow is to get the largest possible sample for a factor analysis. Considering the fact that analysis of variance had to be conducted across academic disciplines and factor analysis was to be done to establish the essentials of research collaboration as well as challenges of research collaboration, the sample size of the study had to be increased.

According to Leedy and Ormrod (2010) and Pallant (2011) a larger sample size, apart from maximising the validity and reliability of measures and the fulfilment of parametric assumptions, is an important means of reducing Type 1 and Type 2 errors as well as enhancing the power of tests such as analysis of variance. Pallant (2011) explains that Type 1 error occurs when a test shows differences between groups when there is actually no difference, thus rejecting the null hypothesis. On the other hand, Type 2 error consists of concluding that groups do not differ, when they do differ, leading to failure in rejecting the null hypothesis (Leedy & Ormrod, 2010; Pallant, 2011). As a result, the sample size of the study was increased.

Literature recommends that, for the determination of stratified samples, the sample size for each primary stratum should be determined and eventually summed up to constitute the sample size for the study (Research Advisors, 2006). Following this recommendation, the corresponding sample sizes for UCC and KNUST were read. For the population of 631 in UCC, the approximate population on the sample size determination table was 650 with corresponding sample size of 242. On the other hand for KNUST, the sample size for the population of 900 academics was 269. Eventually, the sample sizes for the two strata were put together, amounting to a total study sample of 511.

Subsequently, all the population elements for each institution were divided into three strata, namely, Sciences, Technology, Engineering and Mathematics (STEM), Social Sciences, and Arts. The groupings were informed by categorisations in previous studies, such as those by Hughes and Kitson, (2012) and Moore et al (2010), which found differences among academics in, for example, their research orientation. Therefore, all academics in the Sciences, Technology, Engineering and Mathematics departments formed the STEM group (see Table 50 in Appendix A). Academics in departments that teach and research into various forms of expressions of human experience rooted in culture, constituted the Arts. The Social Sciences comprised academics in departments that research into society, its structure, systems, functions and relationships (Hughes & Kitson, 2012; Bakhshi et al., 2008).

The process yielded six different strata, that is, three strata per institution. The proportion of the size of each stratum in relation to the size of the entire study population, was determined. The resulting proportion for each stratum was multiplied by the sample size of 511 to arrive at the sub-sample size for each stratum (Table 1). Eventually, respondents from each stratum were selected using the computer method. The selection involved instructing the computer to give a set of random numbers equal to the number of sample units in each stratum. Thereafter, with a simple command, the computer was further instructed to choose names from the list of each stratum totaling the sample size for the respective stratum (Leedy & Ormrod, 2010; Sarantakos, 2005).

Table 1: Stratified Sample Sizes for the Study Institutions

Academic discipline	UCC	KNUST	Total
	Population (sample size)	Population (sample size)	population (sample size)
STEM	251 (82)	645 (215)	896 (297)
Social Sciences	278 (92)	130 (46)	408 (138)
Arts	102 (35)	125 (41)	227 (76)
Total	631 (209)	900 (302)	1531 (511)

Source: Field survey (2014)

The second phase of the sampling procedure consisted of determination and selection of key informants for the qualitative phase of the study. A list of key informants from each study organisation was secured from the DRIC in UCC and the OGR in KNUST. A copy of the letter of request for key informants can be found in Appendix B. Eleven key informants were selected through judgment sampling (Zikmund et al., 2013). The key informants comprised three heads of research directorates and technology transfer office, and eight academic researchers with long-standing experiences in research collaboration. Two out of the three heads of research directorates were from KNUST while one was from UCC due to the fact that KNUST had two central offices, one in charge of research and the other responsible for technology transfer, while UCC had one office for research, innovation and consultancy.

Out of the eight academic researchers, four each were selected from the two study institutions, with representatives from the three academic disciplines of concern. That is, one academic researcher was selected from the STEM, Social Sciences and Arts in each study institution, yielding a total of six respondents. The extra two key informants were selected from the STEM in

KNUST, and Social Sciences, specifically Education, in UCC. The rationale for the additional respondents from the STEM and Social Sciences was to ensure that the relatively larger population sizes of these two academic disciplines in the respective institutions, as presented in Table 1, reflected in the number of respondents for the qualitative study.

Data Needs

Data, as defined by Zikmund et al. (2013), are facts or recorded measures of certain phenomena. Issues on which data were required, in accordance with the conceptual framework and the objectives of the study, were twofold. Firstly, data were needed to analyse the determinants of intention to collaborate. Secondly, data were required to examine the dynamics of research collaboration including the involvement of academics in research collaboration, the use of collaborative research findings in innovation, the research orientation of academics, the impact of research collaboration and the challenges of research collaboration.

Primary data were needed to address all the objectives of the study as against secondary data. Kothari (2004) distinguishes between primary and secondary data by indicating that primary data are items or units of information which are collected afresh and for the first time, and thus happen to be original in character whereas secondary data are those that have already been collected by someone else and are undertaken through statistical processes (Sarantakos, 2005). The requirement for primary data was necessitated by their inherent advantage over secondary data, as argued by Leedy and Ormrod (2010) and

Cooper and Schindler (2011) that primary data reflect proximity to the truth and give the researcher the ability to control for errors.

In accordance with the explanatory sequential mixed methods approach to the study (Fetters et al., 2013), both quantitative and qualitative primary data were required. Zikmund et al. (2013) explain that quantitative data represent phenomena which are assigned numbers in an ordered and meaningful way while qualitative data are not characterised by numbers and are instead textual, visual, or oral in nature (Singh, 2010). Quantitative and qualitative primary data were required to address all the objectives of the study as well as to answer the corresponding research questions. However, for each objective, a greater percentage of the data needs were quantitative in nature while the qualitative data were required to provide deeper insights into key findings from the quantitative data.

The primary quantitative data consisted of both categorical and numerical data. Lind, Marchal and Wathen (2005) define categorical data as values or measures expressed in different groups, either by name such as sex or by rank such as level of education. Numerical data, on the other hand, are values or measures expressed in numbers (Leedy & Ormrod, 2010). Categorical data, such as academic discipline of respondents, were required to analyse differences in certain dimensions of research collaboration, for example, the research orientation of academics and use of collaborative research in innovation, by academic discipline.

Use of the numerical data was in line with the theory of planned behaviour (Ajzen, 2002; 2011b; Cheung & Vogel, 2013), which was the overarching theory in the conceptual framework of the study. The theory of planned behaviour (Ajzen, 2002; 2011b) stipulates the use of numerical data for the test of hypotheses developed within the framework of the theory. Accordingly, the numerical data were needed to test hypothesised predictive influences in the form of determinants of research collaboration as well as to examine various aspects of the dynamics of research collaboration such as involvement in research collaboration. On the basis of the explanatory sequential mixed methods approach to the study, data were secured from two main sources and through two data collection methods.

Specifically, the quantitative primary data were acquired from academic researchers of the two study organisations whereas the qualitative primary data were obtained from key informants in the institutions. The quantitative data were obtained through the questionnaire method of data collection while the qualitative data were acquired through the in-depth interview method of data collection. According to Kothari (2004), the questionnaire method of data collection consists of written or typed sets of questions, which are often given out to study participants for completion, whereas interviewing involves oral questioning of respondents to generate data (Taylor et al., 2006). The two methods were selected because the questionnaire method is mostly used for quantitative research while the interview method is commonly used for qualitative studies (Sarantakos, 2005).

Although data collection by the questionnaire method is, usually, slow and may yield low return and response rates, it was employed because it provides respondents the opportunity to have adequate time to give well thought out answers and permits the use of large samples from which reliable and valid results can be obtained (Singh, 2010; Zikmund et al., 2013). Conversely, the interview method was used because it allows for greater flexibility in data collection as well as the collection of more information for greater insights into responses (Kothari, 2004; Taylor et al., 2006). The use of questionnaire and interview methods of data collection implied that a questionnaire and an interview guide be used as instruments for data collection.

Data Collection Instruments

Questionnaire and two interview guides were the instruments used to collect data. A questionnaire is a data collection instrument, made up of items, delivered to research participants for completion and to be returned to the researcher after completion (Cooper & Schindler 2011; Zikmund et al., 2013). On the other hand, an interview guide is a formal list of questions used in interviews to aid the systematic collection of data through elaborate questioning (Taylor et al., 2006).

Kothari (2004) distinguishes between a questionnaire and interview guide by indicating that a questionnaire has definite, concrete and pre-determined questions, often, requiring responses in a particular manner while an interview guide contains general guidelines on the type of information needed for respondents to provide answers in their own words. Questionnaire was used for the study due to the choice of the questionnaire method for the collection of primary quantitative data and the fact that a questionnaire has the potential to generate relatively valid and reliable responses which permit generalisation to the study population (Jogulu & Pansiri, 2011; Zikmund et al., 2013).

Similar to a questionnaire, Taylor et al. (2006) indicate that an interview schedule has fixed content, wording and sequence while an interview guide (Sarantakos, 2005) does not, and serves only to provide the interviewer with an outline of issues to be probed during the interview session. Choice of the interview guide over the interview schedule was necessitated by the relative flexibility of the interview guide (Taylor et al., 2006). Specifically, Taylor et al. (2006) explain that the interview guide gives the interviewer freedom to ask supplementary probing questions and to vary questions as and when needed to obtain in-depth information in specific areas of the study, which the interview schedule does not, to a larger extent.

In spite of the merits of the questionnaire and the interview guide, they have some disadvantages. One key disadvantage of a questionnaire is that it is susceptible to high non-return rate (Leedy and Ormrod, 2011) as well as response bias, whereby respondents either consciously or unconsciously tend to answer questions with a certain slant that misrepresents the truth (Zikmund et al., 2013). In order to reduce the tendency for non-return or non-response rate and response bias, the questionnaire was designed following guidelines for questionnaire construction. For example, question design involved the use of simple, uncontroversial and unambiguous language and the questions were sequenced according to the funnel technique of asking general questions first before specific questions (Cooper & Schindler, 2011; Zikmund et al., 2013).

On the other hand, a key disadvantage of the interview guide is that it has the tendency of producing a lot of data that are difficult to analyse (Sarantakos, 2005; Taylor et al., 2006). In order to limit the tendency for information overload, Taylor et al. (2006) recommends that the researcher includes only relevant questions in the guide, as is also the case for questionnaire construction. The recommendation was adhered to in the design of the instruments. Generally, design of the data collection instruments involved creation of sections, operationalisation of variables under the various sections, determination of measurement scales and type of questions. Provisions made for the questionnaire are presented first, followed by that for the interview guide.

The questionnaire consisted of five sections (see Appendix C) in addition to an introductory letter from the Institute of Development Studies (Appendix D), University of Cape Coast, and a cover letter (Appendix E) which introduced the respondents to the researcher and the research topic. Sequencing of questions, in the questionnaire, did not correspond to the order of the study objectives due to the need to encourage and facilitate active and effective participation of respondents, by placing general questions or items first, and specific questions in the latter part of the instrument, as recommended by Cooper and Schindler (2011) and Zikmund et al. (2013).

Consequently, the first section of the questionnaire solicited for background information of respondents followed by the second section which comprised items that assessed the research orientation of all respondents. The third section consisted of items that measured the determinants of research collaboration, that is, factors which respondents deemed important in influencing their willingness to engage in research collaboration, in the future. The fourth and fifth sections measured various aspects of the dynamics of research collaboration such as involvement of academic researchers in research collaboration and challenges of research collaboration.

Design of the various sections of the questionnaire, largely, followed guidelines of the theory of planned behaviour (Ajzen, 1991; 2002) and lessons learnt from related empirical studies such as that by Moore et al. (2010) on research orientation, Cheung and Vogel (2013) on intention and its predictors and Hughes and Kitson on the dynamics of research collaboration. The guidelines included operationalisation of variables according to the target, action, context and time (TACT) of the given behaviour, use of multiple items to measure variables, especially, intention and its determinants, and measuring items on the semantic differential scale.

In accordance with the TACT principle (Ajzen, 2002; Ajzen & Klobas, 2013), the target for the study was the academic researcher, the action was to do research, the context was doing research with input from others who were likely to use the research findings in innovation and or problem solving, and the time frames were the next four years for future research collaboration, and the past ten years for past research collaboration. Lessons learnt from review of related studies suggest that the time frame for a planned behaviour is situation-specific, hence, the time frames for this study were determined based on the outcome of a pilot study which dealt with four years for future research collaboration and five years for past research collaboration.

The time frame for past research collaboration was changed to 10 years for the actual data collection, in order to garner more responses. Thus, four years into the future was considered ideal for cognitive analysis into a future that will be relatively much certain for decision-making by respondents while 10 years into the past was considered ideal for learning about the versatile experiences of respondents on the dynamics of research collaboration.

Moreover, in defining the TACT, the principle of compatibility was observed. The principle states that variables should be defined in terms of exactly the same elements (Ajzen, 2002; Espetvedt et al., 2013). Table 51, in Appendix F, gives an indication of the operationalisation of variables of the study.

Some of the key variables of the study were intention to collaborate as the dependent variable, and the independent variables comprised attitude towards research collaboration, perceived behavioural control over research collaboration, subjective norm on research collaboration and environmental possibility for research collaboration. For example, intention to collaborate was operationalised with three items to fulfil the need for multiple measures, compatibility and in compliance with the TACT principle. Specifically, intention to collaborate was operationalised as the extent to which one intends to, will try to and plan to conduct research with an individual or entity, within the next four years, with inputs from others interested in the research findings.

In addition, the four predictors of intention were operationalised with items ranging from two to eight, as informed by reviewed related literature. Moreover, each item was measured in pairs (see Table 51 in Appendix F). Specifically, in accordance with the theory of planned behaviour (French & Cook, 2012; Pearson & Hamilton, 2014), each scale item under attitude towards research collaboration, captured belief strength and outcome evaluation of the respective item while each item under perceived behavioural control over research collaboration was a measure of belief strength and control belief power of the item. Similarly, each item under subjective norm on research collaboration captured normative belief strength of the item and motivation to comply, while each item under environmental possibility for research collaboration measured belief strength and outcome evaluation of the item.

Innovation was another key concept of the study. Following definition of innovation by Schumpeter (1934/83) and operationalisation of the concept by Gunday et al. (2011) and Abdi and Ali (2013), innovation was operationalised to consist of six main types (see Table 51 in Appendix F). These were product innovation, service innovation, technological innovation, process innovation, administrative innovation and opportunity-related innovation. Specifically, the data requirement constituted the extent to which collaborative research findings, within the past ten years, was beneficial to external collaborating parties in terms of improving upon or developing any of the seven types of innovation.

In addition to innovation, research orientation was operationalised (see Table 51 in Appendix F) into three types, on the basis of the Stokes' quadrant (Stokes, 1997) and definitions in empirical studies such as that by Chang et al. (2011) and Moore et al. (2010). The research orientation included basic research, applied research and use-inspired basic research. Basic research was defined as research in pursuit of understanding while applied research was defined as the conduct of research with consideration of applying the research findings in innovation or problem solving. Use-inspired basic research constituted both research for understanding and application (Stokes, 1997; Moore et al., 2010).

Furthermore, the study sought to examine various aspects of past research collaboration (see Table 51 in Appendix F) based on the network theory of social capital (Lin, 1999; 2008). However, after extensive search of literature yielded no findings on operationalisation of concepts within the theory, it was assumed that there were no laid-down principles for the design of measures, hence, definition of concepts were informed by related empirical literature such as Perkmann and Walsh (2009) and the theory of planned behaviour (Ajzen, 1991; 2002), which was the overarching theory of the study.

The semantic differential scale, as recommended by Ajzen (1991; 2002) in the theory of planned behaviour, was employed in the measurement of numerical variables. A semantic differential scale, according to Zikmund et al. (2013) is a measure of attitudes that consists of a series of seven-point rating scales that use bipolar adjectives to anchor the beginning and end of each scale. The scale is usually assumed to provide an interval level data thereby fulfilling one of the assumptions for parametric analysis (Ajzen, 2002; Lind et al., 2005; Pallant, 2011). Scoring can be unipolar, that is all positive or all negative or bipolar with scoring from negative to positive (Ajzen, 2011a; Zikmund et al., 2013). For ease of analysis, unipolar scoring was used for all semantic differential scales, which also consisted of closed-ended items.

Generally, items in the questionnaire were closed-ended except for years of service and number of research collaboration. Closed-ended items, as explained by Sarantakos (2005), are fixed alternative questions that offer a set of responses from which the respondent has to choose while open-ended items allow respondents to state their answers in the way they deem appropriate. Open-ended items have the advantage of offering more details to responses than closed-ended items. However, more closed-ended items were used in accordance with theoretical requirements (Ajzen, 1991; 2011a) and due to the capacity of such questions to control for the amount of information given, and the propensity to compare responses, which was central to the study (Sarantakos, 2005; Taylor et al., 2006).

Apart from design of the questionnaire, two interview guides were designed to probe into key issues that emerged from analysis of the data from the questionnaire administration. The first interview guide (see Appendix G) was designed, mainly, to solicit for information on the experiences of academic researchers who had, and were actively, engaged in research collaboration within the time frame of past ten years. The guide consisted of an introductory part followed by questions and associated prompts (Jacob & Furgerson, 2012; Sarantakos, 2005) on key issues such as determinants of research collaboration and involvement in research collaboration.

On the other hand, the second interview guide (see Appendix H) was designed to solicit for information from heads or directors of the research units and or technology transfer office of the study institutions. The design of the instrument was necessitated by the fact that structural and positional variations, as explained by the network theory of social capital (Lin, 1999; 2008), are sources of inequality that could affect the outcomes of social interactions. Therefore, the interview guide consisted of items and prompts, for example, on institutional provisions for promoting research collaboration and use of the internally created opportunities by academic researchers for research collaboration.

Moreover, upon completion of the administration of questionnaires and analysis of data, key findings from the data analysis informed the redesign of the two interview guides. Specifically, the interview guides were updated to include questions and prompts on those key findings. For example, analysis of the quantitative data, from the administered questionnaire, indicated that importance and availability of funding, rewards and administrative support from employers were the key components of environmental possibility as a predictor of intention to collaborate. Therefore, prompts were developed to direct the researcher in probing into the importance and availability of the three underlying factors of environmental possibility for research collaboration.

Pilot Study

Pilot study is a small scale research project that collects data from respondents similar to those to be used in the full study (Zikmund et al., 2013). The pilot study was conducted for a number of reasons including the need to determine costs, pre-test the questionnaire on its content, wording and sequencing of items and gauge response rate, as well as to offer the field research team the opportunity to familiarise itself with the research environment. Generally, the pilot study was necessary in ensuring that the planning of the main study and the instruments for data collection were correct, appropriate, reliable and valid (Leedy & Ormrod, 2010; Sarantakos, 2005).

Prior to the pilot study, the face validity and content validity of the questionnaire and interview guides were assessed and confirmed by a team of five independent and experienced researchers. Specifically, the team assessed the accuracy of measures as well as the extent to which items truthfully represented the respective concepts (Leedy & Ormrod, 2010; Zikmund et al., 2013). The outcome of the judgment analysis was positive with recommendations to rephrase certain items and improve upon measurement scales. After addressing the recommendations from the judgment analysis, the pilot study was conducted.

The pilot study took place at the Kwame Nkrumah University of Science and Technology (KNUST) from September, 2014 to October, 2014. The choice of the KNUST was necessitated by the need for the field research team to familiarise itself with the study environment and to secure information that might be relatively close to what was expected in the main study, for necessary action. According to Sarantakos (2005), in a pilot study, a small sample is selected and respondents are asked to respond to all or part of the questionnaire. As a result, ten percent of the study sample (51 elements) was selected from the KNUST sampling frame for the pilot study.

Specifically, 51 subjects were selected from the list of randomly generated sample of the KNUST in the three academic disciplines of STEM, Social Sciences and Arts. The selection was done based on the proportion of each stratum, in the study population, to the sample size of the study. The procedure resulted in the selection of 29 study subjects from the STEM, 14 from the Social Sciences and eight from the Arts. Afterwards, the names of the selected respondents were deleted from the sampling frames since the sampling procedure was without replacement (Leedy & Ormrod, 2010; Sarantakos, 2005). The response rate was 39 percent, which is considered low. According to Leedy and Ormrod (2010) a return rate of 50 percent or less is low.

The underlying reason for the low response rate was difficulty in reaching research subjects, which was attributable to the busy schedule of academics. The low response rate suggested the need to step up efforts at increasing the response rate for the main data collection exercise.

Consequently, an earlier instruction on the instrument that requested respondents with research collaboration experience to ignore Section C of the questionnaire, which contained measures on intention to collaborate and possible determinants, was changed so that all respondents could complete that section.

Another alteration to the questionnaire was the number of items that measured the research orientation of respondents. The questionnaire that was pre-tested had three items measuring basic research, applied research and use-inspired basic research, respectively. However, inspection of responses from the pre-test showed that inclusion of the item on use-inspired basic research confused some respondents. As a result, the item that measured use-inspired basic research was removed after consultation with supervisors of the thesis. The rationale for the removal was that use-inspired basic research is a combination of basic and applied research, hence, a composite variable of use-inspired basic research could be computed from data on basic and applied research.

After the pilot study, reliability of the scales in the questionnaire were ascertained. The scales included intention to collaborate, attitude towards research collaboration, perceived behavioural control over research collaboration, subjective norm on research collaboration and perceived environmental possibility for research collaboration. The reliability tests were essential in ensuring that items that made up each scale did measure the same underlying construct (Leedy & Ormrod, 2010; Pallant, 2011). Results of the tests (see Table 51 in Appendix I) showed that all the scales were reliable with

Cronbach's Alpha coefficients of close to or above .7 (Leedy & Ormrod, 2010; Pallant, 2011).

Ethical Procedures

Ethical procedures constitute an essential part of conducting credible research and ensuring that good data are generated for analysis (Cooper & Schindler, 2011; Zikmund et al., 2013). Leedy and Ormrod (2010) indicate that researchers are expected to uphold ethical principles such as anonymity, confidentiality and informed consent, as well as seek permissible entry for data collection. As a result, the data collection instruments were designed with utmost care in order not to violate any of the principles of research ethics (Kothari, 2004; Zikmund et al., 2013). Furthermore, interview sessions were conducted in a professional manner to avoid interviewer and interviewee bias while verbal and written assurances of upholding the principles of confidentiality, anonymity and the use of responses for academic purpose, were complied with.

Moreover, prior to administration of the data collection instruments, ethical clearance (Appendix J) was sought from the Institutional Review Board of the University of Cape Coast, in August, 2014. In order to gain entry into the study institutions, the researcher and field assistants briefed administrative staff of the departments, where the subjects of the study had to be located, about the research. In addition, respondents were served with an introductory letter (Appendix D) from the Institute for Development Studies, UCC and a cover letter to the questionnaire (Appendix E), while interviewees were served with copies of the ethical clearance (Appendix J) as well as letters requesting for interview (Appendix K).

Data Collection Procedures

Data collection took place from November, 2014 to June, 2015. The administration of the self-administered questionnaire spanned November, 2014 to March, 2015 while interviews were conducted in May, 2015 and June, 2015. Whereas interviews of the eleven key informants of the study were conducted by the researcher, seven field assistants were recruited from the study organisations to assist in the distribution and retrieval of questionnaires. Out of the seven field assistants, two were assigned to assist the researcher in the University of Cape Coast (UCC) while the remaining five assisted at the Kwame Nkrumah University of Science and Technology (KNUST), with constant supervision by the researcher.

The fieldwork was preceded by orientation of the seven field assistants. The orientation consisted of briefing the assistants on the research purpose, the research participants, compliance with ethical principles, timelines for distribution and retrieval of questionnaires and how to manage the data collection exercise, as informed by experiences during the pilot study. During the orientation, field assistants were taken through a template, for records keeping, which consisted of the sample list by academic discipline with columns designed to capture information such as date of first contact, appointment for retrieval of questionnaire and general remarks, such as respondents who were on study leave (see Appendix L).

During data collection, questionnaires were delivered to research participants at their offices. However, if a participant was not met in the office after about three visits, the questionnaire was left with the person's assistant or placed in his or her pigeon hole with permission from the administrator of the general office of the respective department. Although some research participants opted to personally return the questionnaire to the research team, most of the questionnaires had to be retrieved by appointment. On average, it took a minimum of two weeks to a maximum of twelve weeks to retrieve completed questionnaires. The research team concluded the administration of questionnaires in March, 2015 as no more completed questionnaires were either coming in or were being retrieved, upon several follow-ups. The response rate stood at 53 per cent. Thus, a total of 271 questionnaires were retrieved.

Completion of the administration of questionnaires in March gave way for data analysis and subsequently, interview of key informants in May and June, 2015. The interviews were conducted, by the researcher, in the offices of interviewees. The response rate was 100 per cent. Prior to the interviews, appointments were sought from the participants who reserved time slots on their schedule for the interview. As a result there were, virtually, no distractions during the interviews. Except in one instance whereby an interviewee declined to be audiotaped, the interviews were recorded to augment transcribing of the data. On average, an interview session lasted between 20 to 35 minutes.

Field Challenge

The data collection exercise was generally smooth sailing except for the challenge that most of the study participants had busy schedules and, though they were willing to complete the questionnaire, they were not able to keep to appointments for retrieval of the instrument. In order to manage the situation the field team consented, with research participants, to follow up through telephone calls. The strategy contributed to the retrieval of more completed questionnaires than that which were retrieved in the pilot study.

Data Processing and Analysis

Data management and analysis constituted screening of questionnaires, entry and analysis of data from the questionnaires as well as transcribing of interview report, and identification of common themes. Both quantitative data and qualitative data were analysed. The quantitative data were from the questionnaires while the qualitative data were from interview transcripts. The quantitative data were analysed with the IBM Statistical Product and Service Solutions (SPSS) Version 19. Prior to data entry, all the questionnaires were scrutinised for the number of non-response items, in all applicable sections of the instrument.

Eventually five questionnaires, with scanty responses to items in all applicable sections, were excluded from data entry. A number of the remaining 266 questionnaires had complete responses in some sections while other sections had few useful responses. The less useful sections were marked for exclusion in data entry. After data entry, the "sort cases" command was used to screen the entire data for possible errors in entry. Results of the screening were inspected for deviations from entries in the code book of the study. All identified errors were traced to the respective questionnaires using the corresponding questionnaire IDs on which the errors were reported. The questionnaires were retrieved for identification of exact responses, and correction of the errors.

Prior to data analysis, composite variables were created. Firstly, a composite variable of use-inspired basic research was created. Specifically, the scores for basic research and applied research were aggregated and averaged to form use-inspired basic research which, by definition, constitutes both basic and applied research conducted for understanding and application (Hughes & Kitson, 2012; Stokes, 1997). Secondly, in line with the theory of planned behaviour (Ajzen, 2002; 2011a; Ajjan & Hartshorne, 2008), construct variables of the theory were generated.

The variables included intention to collaborate, as the dependent variable, and the four independent construct variables of attitude, perceived behavioural control, subjective norm and perceived environmental possibility. The intention to collaborate scale (α = .88) consisted of three items, namely, "intend to", "will try to "and "plan to" collaborate. On the other hand, double measures of the independent variables (see Table 52 in Appendix I) had to be transformed, through averaging, into scale items. Attitude towards research collaboration had ten measures, perceived behavioural control had four measures, subjective norm had eight measures, while perceived environmental possibility had sixteen measures (see Table 52 in Appendix I) resulting in five (α = .877), two (α = .724), four (α = .893) and eight (α = .954) scale items, respectively, after the transformation (see Table 7 on page 179).

Eventually the three scale items for intention to collaborate were aggregated and subsequently averaged into a composite variable of intention to collaborate. On the other hand, the 19 scale items of the independent variables were subjected to factor analysis for the identification of the items that strongly held together for the various independent variables. Scale items for each of the construct variables that passed the factor analysis were transformed, through averaging, into the four independent construct variables that made up the determinants of intention to collaborate. Afterwards, code books, for data on the various objectives, were generated for summaries of responses and cases.

Subsequently, descriptive analysis of all data was conducted to provide a general overview of the research findings. Specifically, frequencies were generated for categorical data while the mean or, in some instances, the median, standard deviation, skewness and kurtosis were computed for numerical data. In addition, parametric analysis and non-parametric analysis were done. The parametric analysis included one-way between-groups analysis of variance (ANOVA), factor analysis and standard multiple regression, as well as the Kruskal-Wallis test, which is the non-parametric alternative to ANOVA.

Reporting of the mean, that is the arithmetic mean, as a measure of central tendency was based on the distribution of data denoted by skewness and kurtosis of the respective data. Whereas skewness provides information on the symmetry of a distribution, kurtosis gives an indication of the shape of the distribution in terms of it being peaked or flat (De Carlo, 1997; Kim, 2013). Literature shows that data from the Social Sciences hardly have perfect distributions, denoted by zero skewness and kurtosis (Osborne, 2013; Pallant, 2011). As a result, several interpretations have been offered as reference points for the detection of substantial departure from normality, in which case the median becomes the ideal measure of central tendency. For example, Curran, West and Finch (1996) proposed that statistics below 2.0 for skewness and below 7.0 for kurtosis, do not indicate substantial departure from normality.

In a similar way Lind et al. (2005) explain that, according to the Pearson's coefficient of skewness, a value of ±1.63 signifies moderate skewness while a value near ±3 shows considerable skewness (Lind et al. 2005). Robustness tests of the violations of the assumption of normality by Schmider, Ziegler, Danay, Beyer and Bühner (2010) and Lantz (2013) pegged highly skewed data at 2.00. Examination of the various interpretations show a near convergence at below ±2 skewness and below ±7 kurtosis that may permit the use of the mean as the ideal measure of central tendency as well as the conduct of parametric analysis (Kim, 2013).

According to Taylor et al. (2006) parametric analysis involves methods of data analysis that 'have as their basis the most ... assumptions about parameters of the data...' (p. 133) whereas non-parametric analysis have the least or no assumptions (Ferrer, 2015; Pallant, 2011). Parametric assumptions, as explained by Lind et al. (2005) and Leedy and Ormrod (2010), include probability sampling of respondents, normal distribution of study population, theoretically large sample size (Lantz, 2013; Pallant, 2011; Schmider et al., 2010), interval or ratio level data and objectively verifiable data. Leedy and Ormrod (2010) and Schönbrodt and Perugini (2013) explain that sample correlations converge to the population value with increasing sample size, but the estimates are often inaccurate with small samples.

However, just like the specification of skewness, there is no one universally accepted definition of what is a theoretically large sample size. Following definitions by Schmider et al. (2010), Lantz (2013) specifies 5 as a small sample and 25 as a large sample. In other instances, samples of 30 and above or above 200 have been described as large (Pallant, 2011). Kim (2013) varies the definition by adding what he describes as medium-sized samples. According to Kim (2013) a sample size of less than 50 is small, 50 but less than 300 is medium-sized, and larger than 300, is large. Schönbrodt and Perugini (2013), in a study that sought to find an answer to the question "At what sample size do correlations stabilize?", established that in typical scenarios the sample size should approach 250 for stable estimates.

Therefore, in conformity to Schönbrodt and Perugini's (2013) finding, the sample size (n = 511) and total valid response (267) of this study can be described as large. In addition, all other assumptions were met for the conduct of parametric or non-parametric analysis. Other assumptions that are specific to each statistical analysis were adhered to and presented as part of the study findings. Of particular importance was the assumption of homogeneity of variance in the conduct of ANOVA. According to Pallant (2011), an insignificant Levene's statistic is an indication of the fulfillment of the assumption of homogeneity of variance. A second major requirement for the use of ANOVA, as explained by Schmider et al. (2010), is to use samples of 25 participants per condition to circumvent possible negative influences of violation of the assumption of normality.

Consequently, out of the five hypotheses aimed at testing differences in various variables across academic discipline, two were subjected to ANOVA whilst the remaining three were analysed with the Kruskal-Wallis test, due to the presence of conditions with less than 25 participants. Specifically, ANOVAs were performed to assess possible variations in the intention of academic researchers to collaborate as well in the determinants of intention to collaborate, across academic disciplines. On the other hand, Kruskal-Wallis tests were done to test for possible differences in the number of research collaboration, use of collaborative research findings in innovation and the research orientation of academics, across academic discipline (see Table 51 in Appendix I).

The ANOVAs and the Kruskal-Wallis tests were conducted as a means of contributing to the debate of whether the STEM has supremacy over other academic disciplines in their capacity and contribution to the knowledge-based economy (Chang et al., 2011; Hughes & Kitson, 2012). On the basis of the theory of planned behaviour (Ajzen, 1991; 2011b), standard multiple regression was conducted to ascertain the determinants of intention to collaborate. Furthermore, informed by the network theory of social capital (Lin, 1999; 2008), principal component analysis (PCA) was done to ascertain the essentials of research collaboration and challenges of collaboration.

The PCAs were conducted, primarily, to ascertain the level of interdependency among variables and to identify the variables that strongly relate to each other. As a result, the PCA involved the use of the Oblimin rotation, which assumes correlation among variables (Lind et al., 2005; Pallant, 2011). The results of the various analyses were important in contributing towards the emerging literature on research collaboration and in informing future behavioural intervention programmes on research collaboration (Ajzen, 2002; Lin. 2008; Hughes et al., 2011).

The survey results were supported with interview results from 11 academic researchers, eight of whom had actively engaged in research collaboration while the remaining three managed units that promoted research collaboration. Interview transcripts were prepared after each interview, as much as possible, or latest by the close of the day on which the interview was conducted. The transcribed data were supported with auditory data. The auditory data were very useful in validating findings from the interview transcripts and in identifying quotations in support of the survey results (Sarantakos, 2005; Zikmund et al., 2013).

Analysis of the qualitative data involved coding of similar and contrasting themes in relation to the survey data. In line with the weaving approach to the interpretation and reporting of research findings (Cooper & Schindler, 2011; Fetters et al, 2013), the qualitative results were integrated into the relevant aspects of the quantitative results.

CHAPTER FIVE

DETERMINANTS OF INTENTION TO COLLABORATE

Introduction

This Chapter of the thesis comprises presentation and discussion of background characteristics of respondents and results on the first objective of the study. The first objective was to establish the determinants of the intention of academic researchers to collaborate. The objective and corresponding hypotheses were studied within the framework of the theory of planned behaviour (1991; 2011b) and supported by the knowledge spillover theory of entrepreneurship (Acs et al., 2009; 2013) and the network theory of social capital (Lin, 1999; 2008).

The knowledge spillover theory of entrepreneurship (Acs et al., 2009; 2013) illustrates that for knowledge, particularly tacit knowledge, to have the most impact on economic development, the knowledge must flow or spill over from knowledge producers to users, who will transform the knowledge into competitive innovations. Research collaboration serves as a vital medium for the production and transfer of the requisite knowledge from academics to knowledge users, hence, the need for academics to interact with knowledge users in the conduct of research as well as in the use of the research findings for innovation (Leydesdorff & Etzkowitz, 1998; Mueller, 2005; Robin & Schubert, 2010).

In the face of the apparent under-utilisation of research results for innovation in the Ghanaian economy (UNCTAD, 2011), it was imperative to analyse the intentions of academics to collaborate using the theory of planned behaviour (Ajzen, 2011b; Kautonen et al., 2011), which illustrates intention as a strong predictor of actual behaviour. Ajzen (2002) explains that an understanding of intention and its determinants is imperative to the design of appropriate interventions for the promotion of the desired behaviour. However, propositions by the network theory of social capital (Lin 1999; 2008) suggest that variations could occur in social interactions due to differences in social capital. The implication is that intention to collaborate as well as the determinants of intention to collaborate could differ among academic researchers from different academic disciplines.

Consequently, a one-way between-groups analysis of variance (ANOVA) was conducted to evaluate the intention of academics to collaborate, across academic discipline, while standard multiple regression analysis was performed to ascertain the determinants of intention to collaborate. Prior to the regression analysis, factor analysis was done to identify the underlying factors or items which strongly held together for the computation of each of the four construct explanatory variables of intention to collaborate. The variables were attitude towards research collaboration, subjective norm on research collaboration, perceived behavioural control over research collaboration and environmental possibility for research collaboration.

Furthermore, one-way between-groups analysis of variance (ANOVA) tests were conducted to assess whether academic researchers from the Sciences, Technology, Engineering and Mathematics (STEM), the Social Sciences and Arts, differ in the determinants of intention to collaborate. The ANOVAs, together with the ANOVA on intention to collaborate, were necessitated by debates that suggest the STEM as the primary focus, of policy makers, in the promotion of the knowledge-based economy (Bakhshi et al., 2008; Moore et al., 2010) with the possible consequence of relatively low intention to collaborate among academics from the Social Sciences and Arts.

Intention to collaborate and the determinants of intention to collaborate were analysed with survey data comprising a maximum of 262 responses on intention to collaborate and a maximum of 258 responses on the determinants of intention to collaborate. Except for the demographic characteristics of respondents which included disaggregation of the data based on the study organistions, the rest of the analysis that involved data disaggregation focused on analysis across academic disciplines as specified in some of the objectives of the study. All the assumptions for parametric analysis were met, particularly the assumptions of normality which were assessed with skewness of ±2 and kurtosis of ±7 (Curran et al., 1996; Kim, 2013). The survey results were supported by interview results from the 11 key informants for the study.

Demographic Characteristics of Respondents

Four background characteristics of respondents were assessed. These included sex, rank, academic discipline and years of service. Total responses were 266 for sex, 265 for rank, 256 for academic discipline and 261 for years of service (Table 2). The majority (76%) of respondents were males while females constituted the minority (24%). In terms of rank of respondents, senior lecturers were more (48%) while professors formed the minority (2%), although the majority of respondents from UCC were lecturers (40%). In addition, a greater percentage (62%) of respondents belonged to the academic disciplines of the Sciences, Technology, Engineering and Mathematics (STEM), while the minority was from the Arts (13%).

Table 2: Sex, Rank and Academic Discipline of Respondents

	Frequencies (N) and Valid Percent (%)		
	UCC	KNUST	Totals
Sex			
Males	93 (46)	108 (54)	201 (76)
Females	19 (29)	46 (71)	65 (24)
Sub-totals	112 (42)	154 (58)	266 (100)
Rank			
Assistant lecturer	17 (15)	11 (7)	28 (11)
Lecturer	45 (40)	43 (28)	88 (33)
Senior lecturer	33 (29)	95 (63)	128 (48)
Associate professor	14 (12)	2 (1)	16 (16)
Professor	4 (4)	1 (1)	5 (2)
Sub-totals	113 (100)	152 (100)	265 (100)
Discipline			
STEM	47 (42)	112 (75)	159 (62)
Social Sciences	43 (38)	21 (14)	64 (25)
Arts	17 (15)	16 (11)	33 (33)
Sub-totals	107 (100)	149 (100)	256 (100)

Source: Field survey (2015)

Descriptive analysis of years of service showed that the minimum and maximum years that respondents had worked in their capacity as academic were one year and 39 years, respectively, while the mean stood at ten years with a standard deviation of 6.699, a kurtosis of .675 and a skewness of .761. The standard deviation and the skewness indicate wide dispersion of the years of service about the mean with most respondents clustering around the low end of the distribution, respectively (Leedy & Ormrod, 2010; Pallant, 2011). That is, the skewness suggests that most respondents had served in their respective institutions as academic researchers for not more than ten years. A cross-tabulation of the sex of respondents by academic discipline and rank provided extra insights on the nature of respondents (Table 3).

Table 3: Sex and Academic Discipline

Item	STEM N (%)	Social Sciences N (%)	Arts N (%)	Total N (%)
Males	123 (77)	50 (78)	20 (62)	193 (76)
Females	36 (23)	14 (22)	12 (38)	62 (24)
Total	159 (62)	64 (25)	32 (13)	255 (100)

Pearson chi-square (χ^2) =3.472, p = .176
Source: Field survey (2015)

Primarily, Table 3 shows that males constituted the majority in the three academic disciplines. Specifically, 77 percent, 78 percent and 62 percent of respondents in the STEM, Social Sciences and Arts were males, respectively. However, the proportion of males, in the three academic disciplines, was not significantly different from the proportion of females (p = .176), suggesting the absence of a strong association (χ^2 = 3.472) between sex and academic discipline of respondents. Furthermore, although females formed the minority in all academic disciplines, the ratio of males to females in the Arts (approximately 3:2) was, comparatively, lower than the ratios of males to females in the STEM (approximately 3:1) and the Social Sciences (approximately 3:1). The sex and rank of respondents were also analysed (Table 4).

Table 4: Sex and Rank

Item	Assistant lecturer	Lecturer	Senior lecturer	Associate professor	Professor	Total
	N (%)	N (%)	N (%)	N (%)	N (%)	N (%)
Male	19 (68)	71 (82)	90 (70)	14 (87)	5 (100)	199 (75)
Female	9 (32)	16 (18)	38 (30)	2 (13)	0 (0)	65 (25)
Total	28 (11)	87 (33)	128 (48)	16 (6)	5 (2)	264 (100)

Pearson chi-square (χ^2) = 7.343, p = .119
Source: Field survey (2015)

The cross-tabulation of sex of respondents by rank revealed that males formed the majority in all ranks except for the professorial status which constituted only males (Table 4). The rank of associate professor had the least representation of females (13%) while the rank of assistant lecturer (32%) had the highest representation of females followed by the rank of senior lecturer (30%). The Pearson chi-square of the cross-tabulation of sex of respondents by rank indicated no significant association between sex and rank of respondents [χ^2 (2, n = 264) = 7.343, p = .119].

Intention to Collaborate

The conceptual framework of the study (Figure 4) illustrates intention to collaborate as a means of understanding the willingness of academics to engage in research collaboration, in the future. In order to analyse the intention of academic researchers to collaborate, the theory of planned behaviour (Ajzen, 1991; 2011b) was employed in the operationalisation of intention to collaborate and analysis of the respective data, whereas the network theory of social capital (Lin, 1999; 2008) aided the assessment of possible differences among academics in their intentions to collaborate, by academic discipline.

As recommended by Ajzen (2002), intention to collaborate was examined as a construct variable, that is, a composite measure of three items, namely, "intend to", "will try to" and "plan to" collaborate within the next four years. Furthermore, each of the three items was measured on a seven-point semantic differential rating scale of a minimum of one, representing very low agreement or intention to collaborate, to a maximum of seven, representing very strong agreement or very high intention to collaborate (Ajzen, 2002; 2011a; Cheung & Vogel, 2013).

Results of descriptive analysis of the three measures of intention to collaborate showed mean scores of 5.77, 5.51 and 5.94 of academics' agreement with "intend to collaborate", "will try to collaborate" and "plan to collaborate", respectively (Table 5). Although the skewness and kurtosis did not demonstrate perfectly normal (0) data distribution, the respective statistics were below skewness of ±2 and kurtosis of ±7, signifying that the departure from non-normality was not substantial (Curran et al., 1996; Kim, 2013), hence, the mean could be reported as the measure of central tendency.

Table 5: Scale Items for Intention to Collaborate

Item	N	Min.	Max.	Mean	SD	Skewness	Kurtosis
Intend to collaborate	265	1	7	5.77	1.076	-1.288	2.920
Will try to collaborate	263	1	7	5.51	1.328	-1.266	1.843
Plan to collaborate	264	1	7	5.94	1.218	-1.748	3.633
Overall intention to collaborate	262	1	7	5.74	1.076	-1.374	3.037

Cronbach Alpha (α) = .88
Source: Field survey (2015)
Note:
Min.: Minimum
Max.: Maximum
Std. Dev.: Standard Deviation

The Cronbach Alpha of the intention to collaborate scale was .88. Eventually, descriptive analysis of overall intention to collaborate showed quite high intention to collaborate with mean score of 5.74, standard deviation of 1.01 and skewness and kurtosis values of -1.374 and 3.037, respectively (Table 5). The skewness indicated that the intention to collaborate scores, to some extent, clustered at the high end of the distribution whereas the kurtosis values signified that the distribution was, somehow, peaked, though not alarming.

Propositions by the network theory of social capital (Lin, 1999; 2008) and empirical studies by Grimpe and Fier (2010) and Chang et al. (2013) suggest that significant differences could exist among academics, from different academic disciplines, in their intention to collaborate. Therefore, in line with the first hypothesis (Hypothesis 1(a)) of the study which sought to test for differences among academics in their intention to collaborate, a one-way between-groups analysis of variance (ANOVA) was conducted. The academic disciplines included the Sciences, Technology, Engineering and Mathematics (STEM), Social Sciences and Arts (Table 6).

Table 6: Intention to Collaborate by Academic Discipline

Academic Discipline	N	Mean	SD	Std. Error	Min.	Max.	95% CI for Mean	
							LB	UB
STEM	156	5.78	.999	.080	1	7	5.62	5.94
Social Sciences	63	5.77	.939	.118	2	7	5.54	6.01
Arts	32	5.36	1.277	.226	2	7	4.90	5.82
Total	251	5.72	1.029	.065	1	7	5.60	5.85

Source: Field survey (2015)
Note:
STEM: Science, Technology, Engineering and Mathematics
CI: Confidence Interval
LB: Lower Bound
UB: Upper Bound

In Table 6 descriptive statistics of the ANOVA, based on 251 responses, showed that the three academic disciplines had similar mean scores (5.36-5.78), which is an indication that intention to collaborate for each academic discipline was quite high. Comparatively, the STEM had the highest intention to collaborate (5.78) closely followed by the Social Sciences (5.77). The Arts had the lowest intention to collaborate (5.36). Inspection of the test results of the ANOVA on intention to collaborate showed an insignificant Levene statistic of

p = .257, at α = .05, an indication that the assumption of homogeneity of variance was not violated (Pallant, 2011; Zikmund et al., 2013). The ANOVA revealed the absence of a statistically significant difference, at $\alpha = .05$, in the intention to collaborate scores for the three academic disciplines [F (2, 248) = 2.258, p = .107].

On the basis of the ANOVA results, the null hypothesis (H_0), which stated that academic researchers from the STEM, Social Sciences and Arts did not differ, significantly, in their intentions to collaborate, was accepted. The findings suggest the absence of differences in support mechanisms as well as other factors which respondents consider important to their intention to collaborate, as implied in the network theory of social capital (Lin, 2008). Therefore, a number of potential explanatory factors or determinants of intention to collaborate were subjected to factor analysis, regression analysis and eventually a one-way between groups analysis of variance to arrive at an answer.

Factor Analysis of the Determinants of Intention to Collaborate

The conceptual framework of the study, in accordance with the theory of planned behaviour by Ajzen (2011b; Cheung & Vogel, 2013), illustrates that intention to collaborate is a function of four construct variables. The constructs were attitude towards research collaboration, perceived behavioural control over research collaboration, subjective norm on research collaboration and perceived environmental possibility for research collaboration. On the basis of the theory of planned behaviour (Ajzen, 1991) and reviewed empirical literature, scale items for each of the construct variables had to be subjected to factor analysis to arrive at the factors that truly make up the respective construct variables (Ajjan & Hartshorne, 2008; Cheung & Vogel, 2013).

Table 7 consists of 19 items of the determinants of intention to collaborate scale, which were subjected to principal component analysis (PCA). Prior to conducting the PCA, the suitability of the data for factor analysis was assessed. Examination of the correlation matrix of the data showed the presence of several coefficients of .3 and above (see Table 53 in Appendix I). The Kaiser-Meyer-Olin value of sampling adequacy (Pallant, 2011) was .894, exceeding the recommended value of .6 and the Bartlett's Test of Sphericity (Pallant, 2011) reached statistical significance, supporting the factorability of the correlation matrix.

Eventually, a three-factor principal component analysis (PCA) yielded eigenvalues exceeding 1 (Table 8) explaining a total of 53.398 percent of the variance. Inspection of the scree plot revealed a clear break after the third component in support of the three-factor solution, with component 1 contributing 37.893 percent, component 2 contributing 9.825 percent and component 3 contributing 5.680 percent, to the total variance of 53.398 percent. To aid in the interpretation of the three components, Oblimin rotation was conducted. The rotated solution showed the presence of a simple structure (see Table 54 in Appendix I), with the three components demonstrating a number of strong loadings of .5 and above (Pallant, 2011), and all variables loading substantially on only one component (Cheung & Vogel, 2013).

Table 7: Measures of the Determinants of Intention to Collaborate

	N	M-M	Mean	SD	S	K
Attitude towards research collaboration (α=.877)						
Collaboration will advance research	261	2-7	5.95	.958	-1.323	2.909
Collaboration will improve teaching	262	2-7	5.89	.936	-.876	1.071
Collaboration will fast track promotion	259	1-7	5.68	1.229	-1.471	3.231
Collaboration will bring extra income	265	1-7	5.12	1.391	-.947	.865
Collaboration will improve reputation	262	1-7	5.59	1.177	-1.530	3.438
Perceived behavioural control (α=.724)						
Ability to relate	261	3-7	5.89	.827	-.566	.285
Ability to conduct various types of research	260	3-7	5.64	.829	-.643	.949
Subjective norms on collaboration (α=.893)						
Institutional expectation to collaborate	260	1-7	5.75	1.060	-1.643	4.117
Peers approval of collaboration	249	1-7	5.56	1.019	-.891	1.192
Head's support for collaboration	259	1-7	5.47	1.090	-1.149	2.176
Community leader's expectation on collaboration	257	1-7	4.83	1.420	-.870	.282
Environmental possibilities (α=.954)						
Availability of funding for collaboration	264	1-7	5.02	1.094	-.630	.754
Availability of reward for collaboration	263	1-7	4.70	1.330	-.779	.263
Availability of EIPR	261	1-7	5.22	1.158	-.853	.958
Availability of infrastructure for collaboration	260	1-7	5.29	1.017	-.759	1.521
Availability of AS for collaboration	259	1-7	5.33	1.072	-1.286	2.861
Availability of collaborating partner(s)	260	2-7	5.47	.955	-.722	1.590
Availability of capable user of research output	260	1-7	5.43	1.067	-1.207	3.042
Availability of time for collaboration	264	1-7	2.61	1.009	1.101	1.656

Source: Field survey (2015); Note the meaning of the following acronyms: EIPR: enforceable intellectual property rights; AS: administrative support. M-M: minimum and maximum scores; S: skewness; and K: kurtosis

Examination of the factor loadings, as presented in Table 8, revealed that variables under perceived behavioural control (PBC) over research collaboration and subjective norm (SN) on research collaboration loaded strongly on component 1. Variables under environmental possibility for research collaboration (EP) loaded strongly on component 2 while variables on attitude towards research collaboration (ATT) loaded strongly on component 3. Literature on factor analysis suggests .4 and above (Pallant, 2011), or .5 and above (Cheung & Vogel, 2013; Kautonen et al., 2011) as strong factor loadings to guide the selection of variables for inclusion in a scale. Following Cheung and Vogel (2013) the .5 mark was used since it provided a clearer focus for the selection of variables under each component for subsequent interpretation.

However, in instances where a variable loaded highly on two components, for example, "collaboration will bring extra income", the highest loading was considered (Pallant, 2011). Further assessment of the factor loadings (Table 8) pointed to two variables that did not load under the component which had most of their counterpart variables loading above .5. The variables were community leader's expectation on collaboration and availability of collaborating partner(s).

Community leader's expectation on collaboration was assessed as a subjective norm and was, therefore, expected to load together with the other subjective norm items, on component 1. It loaded, however, on only component 2 which largely contained variables on environmental possibility for research collaboration. Similarly, availability of collaborating partner did not load together with its counterpart variables under component 2 but appeared only under component 1.

Table 8: Factor Loadings of Measures of the Determinants of Intention to Collaborate

	Component		
	1	2	3
Collaboration will advance research (ATT1)	.454		.560
Collaboration will improve teaching (ATT2)	.474		.434
Collaboration will fast track promotion (ATT3)			.899
Collaboration will bring extra income (ATT4)		-.573	.620
Collaboration will improve reputation (ATT5)	.438		
Ability to relate (PBC1)	.716		
Ability to conduct various types of research (PBC2)	.720		
Institutional expectation on collaboration (SN1)	.738		
Peers approval of collaboration (SN2)	.728		
Head's support for collaboration (SN3)	.751		
Community leader's expectation to collaborate (SN4)		-.535	
Availability of funding for collaboration (EP1)		-.597	
Availability of reward for collaboration (EP2)		-.817	
Availability of EIPR (EP3)	.410	-.417	
Availability of infrastructure for collaboration (EP4)	.381	-.409	
Availability of AS for collaboration (EP5)	.413	-.508	
Availability of collaborating partner(s) (EP6)	.577		
Availability of capable user of research output (EP7)	.332	-.488	
Availability of time for collaboration (EP8)		.309	
Eigenvalues	7.200	1.867	1.079
Total variance explained (%)	37.893	9.825	5.680
Cumulative variance explained	37.893	47.719	53.398

Source: Field survey (2015)

As a result, community leader's expectation on research collaboration and availability of collaborating partner(s) were not selected for interpretation, although they had factor loadings of .5+. The rationale for excluding these items from the analysis was to have factor loadings that strongly load on only one component to aid in easy and reasonable interpretation of results (Pallant, 2011). The analysis further showed that perceived behavioural control had all its two variables loading strongly (above .7) on component 1.

The results suggest that perceived behavioural control, assessed as the importance and ability of academic researchers to conduct various research types and relate well with their collaborating partners, were fundamental to their intention to collaborate within the next four years, as illustrated in the conceptual framework of the study (Figure 4). In other words, self-efficacy which dwells on expertise and boundary spanning or relational skills (Bandura, 1982; Hughes et al., 2011; Hughes & Kitson, 2012) were important to academics' willingness to collaborate.

In relation to subjective norm, three out of the five variables loaded strongly (above .5) on component 1. These were firstly, the expectations of the university, secondly, expectations of colleagues and thirdly, expectations of immediate superior(s) on research collaboration, in the next four years, and readiness of respondents to comply with the expectations of these significant others. The three subjective norm items are similar to those used by Ajjan and Hartshorne (2008) who investigated faculty decisions to adopt Web 2.0 technologies. Ajjan and Hartshorne's (2008) subjective norm comprised social pressures from superiors, peers and students.

Variables on environmental possibility for research collaboration loaded negatively and mainly on component 2. Three of the variables had strong loadings of -.5 and above. The variables were availability and importance of rewards, funding and administrative support. Assessment of the double items measuring rewards (see Table 52 in Appendix I), funding and administrative support on the basis of their availability and importance revealed relatively higher mean scores of 5.08, 5.60 and 5.70, respectively, for importance as against their availability with mean scores of 4.31, 4.42 and 4.94, respectively. The finding is supported by interview results of eleven academic researchers all of whom indicated the relevance of rewards, funding and administrative support for collaboration but bemoaned the limited nature of these forms of support.

From the interviews, respondents stressed the importance of both monetary and non-monetary rewards to their intention to collaborate in the subsequent years. Some respondents emphatically noted that investing one's time in "extra teaching", such as on distance education programmes, was becoming relatively lucrative while others sought for non-monetary forms of appreciation such as receiving a letter of appreciation from university authorities which, they indicated, was not forthcoming. These comments came up irrespective of the fact that the interview transcripts showed that the institutions surveyed either had an award system for recognising the research efforts of academics or had designed an award system pending approval by top management.

The interview results further showed that at the time of the study, provisions on research-related awards, funding and administrative support were recent phenomena, beginning from 2013. Moreover, the emerging schemes were the initiatives of the various institutions and did not flow from a common national agenda. Interviewees expressed their worry about the limited funding opportunities for research in general and the fact that there was no clear national research agenda and funding. The implication is that the current funding, administrative support and reward systems do not adequately cater for the expectations of academics in relation to their intentions to collaborate.

The relevance of public support for research collaboration has been expressed by Robin and Schubert (2010) and Hughes and Kitson (2012). Robin and Schubert (2010) argue for a decentralised support system that relies on technology transfer offices in the facilitation of collaboration between academia and industry while findings from Hughes and Kitson's (2012) study suggest the need for an administrative system manned by capable personnel, who will liaise between academia and external parties. In that regard, technology transfer offices (TTOs) have been found to be very instrumental in addressing funding, information and other challenges of collaboration (Bercovitz & Feldmann, 2006). For example, TTOs can be a central point for the co-ordination of venture capital funds which have been instrumental in the promotion of fruitful university-industry interactions in the US (Henrekson & Rosenberg, 2001).

Further inspection of Table 8 revealed that Component three had a clear pattern emerging with loadings from items on only attitude towards research collaboration, which the conceptual framework of the study illustrates as a possible determinant of intention to collaborate. The items reflected the conviction and relevance expressed by academic researchers that collaboration will advance their research work, fast track their promotion and bring extra income with factor loadings of .560, .899 and .620, respectively. The finding is supported by interview results whereby all eight interviewees from the various academic disciplines indicated that research collaboration is a vital medium for advancing research, teaching and promotion. For instance, an interviewee explanation on the relevance of research collaboration to research was that "it helps to sharpen one's research skills".

The finding is consistent with Moore et al.'s (2010) view, established in a related study, that almost half of academics cited new insights for their work and new contacts in their fields as the leading impact on their research while teaching was positively affected mainly in terms of increasing willingness to use real-world examples in teaching and to deliver courses that were more directly relevant to the needs of future employers. Subsequent to the factor analysis, reliability analysis was conducted for items that loaded highly under each construct variable (Table 9).

The results of the reliability tests, as presented in Table 9, showed Cronbach Alphas of .694 for scale items under attitude towards research collaboration, .724 for perceived behavioural control over research collaboration, .815 for subjective norm on research collaboration and .728 for environmental possibility for research collaboration. According to Ajjan and Hartshorne (2008) and Pallant (2011), measurement scales of .6 or .7 indicate the possibility of using the measures as separate scales. Therefore, based on Ajjan and Hartshorne's (2008) and Cheung and Vogel's (2013) recommendations, items in the respective scales were transformed, through aggregation and averaging, into composite variables for regression analysis.

Table 9: Selected Determinants of Intention to Collaborate

	Component			
	1	2	3	α
Attitude towards research collaboration (ATT)				.694
Collaboration will advance research (ATT1)			.560	
Collaboration will fast track promotion (ATT3)			.899	
Collaboration will bring extra income (ATT4)			.620	
Perceived behavioural control over research collaboration (PBC)				.724
Ability to relate (PBC1) during collaboration	.716			
Ability to conduct various types of research (PBC2)	.720			
Subjective norms on research collaboration (SN)				.815
Institutional expectation on collaboration (SN1)	.738			
Peers approval of collaboration (SN2)	.728			
Head's support for collaboration (SN3)	.751			
Perceived environmental possibilities for research collaboration (PEP)				.728
Availability of funding for collaboration (PEP1)		-.597		
Availability of reward for collaboration (PEP2)		-.817		
Availability of AS for collaboration (PEP5)		-.508		

Source: Field survey (2015)

Regression Analysis of the Determinants of Intention to Collaborate

In relation to the first objective and the conceptual framework of the study (Figure 4), it was hypothesised (Hypothesis 1(b)), in line with the theory of planned behaviour (Ajzen, 1991; 2011b), that attitude towards research collaboration, subjective norm on research collaboration, perceived behavioural control over research collaboration and perceived environmental possibility for research collaboration, could significantly influence intention of academic researchers to collaborate. In order to ascertain the actual predictors of intention to collaborate, standard multiple regression analysis was done. Prior to the regression analysis descriptive analysis, including normality test and suitability of the data for regression analysis, were conducted.

Descriptive statistics of the regression analysis (Table 10) showed that the dependent and independent variables, measured on scales with minimum scores of one and maximum scores of seven, had mean scores from 5.02 to 5.82. The mean scores signify that intention to collaborate, attitude towards research collaboration, perceived behavioural control over research collaboration, subjective norm on research collaboration and perceived environmental possibility for research collaboration, were quite high among the academic researchers surveyed. Comparatively, attitude towards research collaboration had the highest mean score of 5.82 (SD =.954) while perceived environmental possibility had the lowest mean score of 5.02 (SD =.936).

Table 10: Intention to Collaborate and its Determinants

	N	Min.	Max.	Mean	5% Trim. Mean	SD	Skewness	Kurtosis
INT	262	1	7	5.74	5.83	1.013	-1.374	3.037
ATT	255	1	7	5.82	5.90	.954	-1.414	3.795
SN	247	1	7	5.62	5.69	.885	-1.448	4.109
PBC	257	3	7	5.77	5.80	.725	-.498	.676
PEP	258	2	7	5.02	5.07	.936	-.838	1.097

Source: Field survey (2015)

Assessment of the skewness and kurtosis values, as shown in Table 10, indicated tolerable departures from the assumption of normality which only becomes problematic when the skewness is above ±2 and when the kurtosis is beyond ±7 (Schmider et al., 2010; Kim, 2013). In addition, inspection of the normal probability plot (see Figure 6 in Appendix I) of the regression standardised residual showed the data points appearing in a reasonably straight diagonal line from bottom left to top right suggesting no major deviation from normality (Lind et al., 2005; Pallant, 2011).

Furthermore, preliminary analysis showed no violation of the assumptions of multicollinearity, linearity, and homoscedasticity. Thus, assessment of the correlation matrix (see Table 55 in Appendix I) indicated that the independent variables showed some relationship with the dependent variable whereas the correlation between each of the independent variables was not too high (that is, all were below .7). Pallant (2011) explains that correlations of .7 and above suggests that the variables tend to measure almost the same concept and one must be dropped or the two may be averaged into one variable.

In addition, Table 11 indicates high (above .10) tolerance levels and variance inflation factors (VIF) of less than 10 in support of the absence of multicollinearity (Pallant, 2011; Zikmund et al., 2013). Moreover, the scatterplot of the standardised residuals showed that the residuals were roughly rectangularly distributed, with most of the scores concentrated in the centre. According to Pallant (2011), outliers are cases with standardised residuals of more than 3.3 or less than -3.3 and the presence of a few does not require any action to be taken. Consequently, the four construct variables were regressed on intention to collaborate.

Table 11: Regression Results of the Determinants of Intention to Collaborate

Determinants	B	SE	Beta	t	Sig.	Partial Corr.	Tol.	VIF
(constant)	1.544	.506		3.053	.003			
ATT	.404	.067	.380*	5.990	.000	.364	.779	1.284
SN	-.057	.086	-.050	-.668	.505	-.044	.555	1.800
PBC	.231	.099	.165*	2.335	.020	.151	.628	1.594
PEP	.165	.071	.153*	2.332	.021	.150	.732	1.366

R^2 = .264, Adjusted R^2 = .251, *α = .01
Dependent variable: intention to collaborate
Source: Field survey (2015)
Note: SE means standard error; Partial Corr. means partial correlation, Tol. means tolerance and VIF means variance inflation factor

Evaluation of the regression model summary, in Table 11, indicated an R Square of .264 and an adjusted R Square of .251 reaching statistical significance at $\alpha = .01$. Thus, the model explained 26.4 per cent of the variance in intention to collaborate. Inspection of the Beta values in the Coefficients Table (Table 11) showed that attitude towards research collaboration, perceived behavioural control over research collaboration and perceived environmental possibility for research collaboration, made significant contributions to the model with attitude towards research collaboration making the highest contribution by explaining 38 per cent (*beta* = .380, *p* = .000) of the variance in intention to collaborate.

Perceived behavioural control over research collaboration explained 16.5 percent (*beta* = .165, *p* = .020) while perceived environmental possibility for research collaboration explained 15.3 percent (*beta* = .153, *p* = .210) of the variance. However, subjective norm on research collaboration did not make a significant contribution to the model (*beta* = - .050, *p* = .505). The findings are consistent with those of Ajjan and Hartshorne (2008) and Cheung and Vogel

(2013), which showed attitude towards behaviour, perceived behavioural control and environmental possibility, significantly, influencing behavioural intention.

However, Cheung and Vogel (2013) disaggregated subjective norm and established that peers had a significant impact on behavioural intention. A similar approach was adopted in this study but the result was insignificant, hence, the findings on subjective norm were much consistent with Ajjan and Hartshorne (2008), possibly due to the fact that this study and that by Ajjan and Hartshorne (2008), surveyed academics, contrary to Cheung and Vogel (2013) who studied university students. In agreement with Ajjan and Hartshorne (2008), it can be said that subjective norm did not play a significant role in determining the respective behavioural intentions due to the high degree of independence that academics have in decision-making on certain aspects of their professional duties.

Thus three out of the four determinants of intention to collaborate, illustrated in the conceptual framework of the study (Figure 4), had significant influence on the intention of academics to collaborate. The determinants are attitude towards research collaboration, perceived behavioural control over research collaboration and environmental possibility for research collaboration. Subjective norm on research collaboration did not have a significant influence on the intention of academics to collaborate. Therefore, three out of the four sub-null hypotheses (H_0s), contained in the composite Hypothesis 1(b), were rejected while the remaining sub-null hypothesis on subjective norm was accepted.

In order to direct policy attention to the academic discipline(s) in most need of intervention, four sets of one-way-between-groups analysis of variance (ANOVA) were conducted to assess whether academic researchers, from the STEM, Social Sciences and Arts, differ in the four determinants of intention to collaborate. Each determinant of intention to collaborate was measured on a scale of one to seven, representing very low to very high scores. The distribution of data for the respective determinants were within tolerable limits of below ±2 skewness and below ±7 kurtosis (Curran et al., 1996; Schmider et al., 2010), as previously shown in Table 12. Attitude towards research collaboration was analysed with 244 responses, across the three academic disciplines, namely, the STEM, Social Sciences and Arts.

Assessment of the descriptive statistics, as shown in Table 12, indicated similar arithmetic mean scores around 5.00 for attitude towards research collaboration, interpreted as quite high across the three academic disciplines. Thus, respondents quite strongly agreed that research collaboration will advance their research work, fast track their promotion and enable them earn extra income. Comparatively, with an arithmetic mean score of 5.98 ($SD = .819$), the Social Sciences had the highest attitude towards research collaboration followed by the Arts with a score of 5.93 and a standard deviation of .722. The STEM had the lowest attitude towards research collaboration with a mean score of 5.73 and a standard deviation of 1.016, an indication that the scores for the STEM were, relatively, more widely dispersed about the mean than those of the Social Sciences and the Arts.

Table 12: Attitude towards Research Collaboration across Academic Discipline

Discipline	N	Mean	SD	Std. Error	95% Confidence Interval for Mean LB	UB	Min.	Max.
STEM	151	5.73	1.016	.083	5.56	5.89	1	7
Social sciences	62	5.98	.819	.104	5.77	6.19	2	7
Arts	31	5.93	.722	.130	5.66	6.19	4	7
Total	244	5.82	.940	.060	5.70	5.93	1	7

Source: Field survey (2015)
Note:
SD: Standard Deviation
LB: Lower Bound
UB: Upper Bound

Results of the ANOVA showed an insignificant Levene statistic of p = .121, at α = .05, which means that the assumption of homogeneity of variance was not violated (Lind et al., 2005; Zikmund et al., 2013). The ANOVA revealed absence of a statistically significant difference, at α = .05, in the attitude towards research collaboration scores for the three academic disciplines [F (2, 241) = 1.879, p = .155]. Therefore, it can be concluded that academic researchers from the STEM, Social Sciences and Arts did not differ, significantly, in their attitude towards research collaboration.

Thus, respondents from the three academic disciplines had similar levels of attitude towards research collaboration by considering research collaboration as quite essential in advancing their research and promotion, and as a means of earning extra income. A possible inference from the finding is the growing appreciation of collaboration as a useful medium for the acquisition of resources for the promotion of academic research (D'Este & Perkmann, 2010) as well as in securing extra income for personal and institutional gains (Moore et al., 2010). ANOVA was also performed on perceived behavioural control over research collaboration, interpreted as the importance and ability of academic researchers to conduct various research types and relate well with their collaborating partners.

The descriptive statistics of the test are shown in Table 13. The results indicate that the Arts had the highest perceived behavioural control over research collaboration (M = 5.89, SD = .822) while the STEM had the lowest (M = 5.74, SD = .694). The mean score of each discipline indicates that the academics in each discipline had quite high perceptions of perceived behavioural control over research collaboration. The Levene's statistic of the ANOVA was insignificant (p = .121), at α = .05, indicating non-violation of the assumption of homogeneity of variance (Pallant, 2011). Per the results of the ANOVA, there was no statistically significant difference, at α = .05, in the scale scores for perceived behavioural control [F (2, 244) = .530, p = .589].

Table 13: Perceived Behavioural Control across Academic Discipline

					95% Confidence Interval for Mean			
Discipline	N	Mean	SD	Std. Error	LB	UB	Min.	Max.
STEM	156	5.74	.694	.056	5.63	5.85	3	7
Social Sciences	61	5.78	.767	.098	5.59	5.98	4	7
Arts	30	5.89	.822	.150	5.58	6.20	4	7
Total	247	5.77	.727	.046	5.68	5.86	3	7

Source: Field survey (2015)
Note:
SD: Standard Deviation
LB: Lower Bound
UB: Upper Bound

On the basis of these findings, it can be stated that the STEM, Social Sciences and Arts did not differ, significantly, in perceived behavioural control over research collaboration. In line with the views of Moore et al. (2010) and Hughes et al. (2011), research capability and boundary spanning skills are vital for collaborations between academia and external entity, hence, the requisite competences must be built to contribute to the success of such interactions. Subjective norm on research collaboration (Table 14) was also assessed across academic discipline. Subjective norm was operationalised as the extent to which the university, immediate superiors and colleagues expected respondents to collaborate, and the willingness of respondents to comply with the expectations.

Table 14: Subjective Norm across Academic Discipline

					95% Confidence Interval for Mean			
Discipline	N	Mean	SD	Std. Error	LB	UB	Min.	Max.
STEM	153	5.63	.770	.062	5.51	5.75	2	7
Social sciences	56	5.72	.860	.115	5.49	5.95	4	7
Arts	29	5.67	.869	.161	5.34	6.00	3	7
Total	238	5.66	.802	.052	5.56	5.76	2	7

Source: Field survey (2015)

Inspection of the descriptive statistics (Table 14), based on a total of 238 responses, showed that the Social Sciences recorded the highest subjective norm ($M = 5.72$, $SD = .860$), followed by the Arts ($M = 5.67$, $SD = .869$). The STEM had the lowest subjective norm ($M = 5.63$, $SD = .770$). The subjective norms of all the three academic disciplines can be interpreted as quite high indicating quite strong agreement that the university, colleagues and immediate superior's expected academics to engage in research collaboration, and respondents were ready to comply with that expectation. With a Levene's statistic of 1.629 (p = .198), a one-way-between-groups analysis of variance was conducted (ANOVA). The ANOVA showed a statistically insignificant difference, at α = .05, in subjective norm across the three disciplines [F (2, 235) = .277, p = .758].

Thus, academic researchers from the STEM, Social Sciences and Arts did not differ, significantly, in their subjective norm on research collaboration. An implication of the finding, from the perspective of the network theory of social capital (Lin, 1999) is that, the university, immediate superiors and colleagues could play an essential role, for example, in the mobilisation of requisite resources (Moore et al., 2010), and in the use of the resources in pursuit of fruitful research collaboration (Kwon & Adler, 2014). The final determinant of intention to collaborate analysed across academic discipline was environmental possibility for research collaboration (Table 15), interpreted as the importance and availability of rewards, funding and administrative support for collaboration.

Table 15: Environmental Possibility across Academic Discipline

Discipline	N	Mean	SD	Std. Error	5% Confidence Interval for Mean LB	UB	Min.	Max.
STEM	153	5.08	.882	.071	4.94	5.22	2	7
Social sciences	63	4.95	.945	.119	4.71	5.19	2	7
Arts	32	4.99	.970	.172	4.64	5.34	2	7
Total	248	5.04	.908	.058	4.92	5.15	2	7

Source: Field survey (2015)

Descriptive statistics of the test, illustrated in Table 15, revealed that whereas the mean score for environmental possibility for research collaboration for the STEM was, relatively, high ($M = 5.08$, $SD = .882$), that of the Arts ($M = 4.99$, $SD = .882$) and the Social Sciences Arts ($M = 4.95$, $SD = .945$) were lower. In line with the scale of measurement, the perception of environmental possibility for research collaboration by academics in the STEM, can be interpreted as quite high while those of the Arts and Social Sciences were average. The Levene's statistic (.623) for the one-way between-groups analysis of variance (ANOVA) was insignificant ($p = .537$), signifying non-violation of the assumption of homogeneity of variance and suitability of the data for the conduct of ANOVA.

The results of the ANOVA, [F (2, 245) = .492, $p = .612$], indicated that there was no statistically significant difference, at $\alpha = .05$, in perceived environmental possibility for research collaboration, across the three academic disciplines. Consequently, it can be concluded that academic researchers from the STEM, Social Sciences and Arts did not differ, significantly, in perceived environmental possibility for research collaboration. In addition to this finding, the mean scores for environmental possibility for research collaboration (Table 15) were lower than those of the other three determinants of research collaboration, presented in Tables 12, 13 and 14.

The theory of economic development (Schumpeter, 1934/1983), Schumpeterian growth models (Ang & Madsen, 2009) and the network theory of social capital (Lin, 2008), demonstrate the essential role that resource availability, such as funding, plays in motivating persons to engage in network activity for purposive actions. Therefore, the relatively lower perceived environmental possibility for research collaboration could be a source of discouragement for academics to actualise their intention to collaborate, in the future.

The preceding analysis and findings led to acceptance of the null hypothesis (Hypothesis 1(c)) which stated that there is no significant difference, among academic researchers from the STEM, Social Sciences and Arts, in their attitude towards research collaboration, perceived behavioural control over research collaboration, subjective norm on research collaboration and environmental possibility for research collaboration. In conformity with the network theory of social capital (Lin, 1999; 2008), the findings were consistent with the absence of statistically significant differences in the intention of academic researchers to collaborate, established in the preceding sub-section of the Chapter.

According to the network theory of social capital (Lin, 1999; 2008), absence of significant variations in structural and positional situation of network actors could account for insignificant differences in network activity and vice versa. An implication of the findings is that interventions, on the promotion of research collaboration, should not discriminate among the STEM, Social Sciences and the Arts, particularly, in terms of raising attitudes, behavioural control and environmental possibility for research collaboration that will advance the knowledge-based economy of Ghana.

Summary

A key finding of this Chapter was that the intention of academic researchers to collaborate was quite high with no statistically significant difference across academic discipline. The determinants of intention to collaborate consisted of attitude towards behaviour, perceived behavioural control over research collaboration and perceived environmental possibility for research collaboration, as illustrated in the conceptual framework of the study (Figure 4). In line with absence of statistically significant difference in intention to collaborate across academic discipline, no statistically significant difference was found in the determinants of intention to collaborate, across academic discipline.

As much as an understanding of intentions to collaborate and determinants of intention to collaborate is critical to the design of appropriate intervention(s) for the promotion of fruitful research collaboration, it is also imperative to support such interventions with experiences from actual involvement in research collaboration. Moreover, insights into actual research collaboration would be highly useful in providing a developing country perspective to discussions on the emerging literature on research collaboration.

CHAPTER SIX

INVOLVEMENT IN RESEARCH COLLABORATION

Introduction

A fundamental argument of this study is that the Ghanaian economy might be suffering from the Swedish paradox which consists of under-exploitation of entrepreneurial opportunities generated through investments in knowledge production, within a given economy (Braunerhjelm et al., 2010; Ejermo & Kander, 2006). The basis for this argument is that in spite of the volumes of academic research that are produced each year, the research findings remain under-utilised in innovation, possibly, due to a number of reasons such as limited research collaboration between academic researchers and knowledge users, in the economy. Consequently, this Chapter focuses on the second objective that sought to examine the involvement of academic researchers in research collaboration.

Several dimensions of research collaboration were examined. The dimensions included number of research collaboration within the past ten years, purpose(s) of the collaboration, types of research collaboration and the essentials of research collaboration. Evaluation of the essentials of research collaboration consisted of analysis of the extent to which academic researchers, based on their past collaborative research experiences, considered certain factors important for research collaboration. The respective analysis were largely informed by the network theory of social capital (Lin, 1999; 2008) and supported by the knowledge spillover theory of entrepreneurship (Acs et al., 2009; 2013).

The network theory of social capital (Lin, 1999) demonstrates social interactions as constituting networks whose effectiveness depends on the interplay of factors, such as wealth and status, enshrined in the concept of social capital, while the knowledge spillover theory of entrepreneurship illustrates that tacit knowledge, in the form of research output, must spill over from knowledge producers to knowledge users (Acs et al., 2009; Johnson et al., 2002). Hence, research collaboration serves as a vital medium through which academics can employ social capital, embedded in the collaboration, to facilitate the spillover of tacit knowledge to users for innovation. It is upon this premise that the conceptual framework of the study (Figure 4) illustrates the relevance of understanding the dynamics of research collaboration.

Survey and interview data were used to examine the involvement of academic researchers in research collaboration and to analyse the essentials of research collaboration. The survey data consisted of a maximum of 133 data points on the characteristics of research collaboration and the essentials of research collaboration. However, the analysis began with a look at 262 responses on the participation of academics in research-related interactions throughout their professional career. Data were analysed through frequencies, descriptive statistics and Kruskal-Wallis tests. Factor analysis was conducted to ascertain the essentials of research collaboration.

Characteristics of Research Collaboration

The characteristics of research collaboration were examined in line with the conceptual framework of the study (Figure 4) which proposes research collaboration to constitute several dynamics that could provide answers to the question of under-utilisation of research results, as advanced in the problem statement of the thesis. Engagement in research collaboration is critical to bridging the knowledge filter, which Acs et al. (2009) and Braunerhjelm et al. (2010) explain as the gap that exists when investment in knowledge creation produces new knowledge that is yet to be put to commercial use.

Assessment of the characteristics comprised description of various dimensions of the collaboration and a test of hypothesised difference in number of research collaboration among academics from the STEM, the Social Sciences and the Arts. The dimensions included engagement in research collaboration during one's professional career, initiator of the collaboration(s), sector of collaborating partner(s) and purpose(s) of the collaboration. Other characteristics were type of collaboration and inputs of academic researchers to the collaboration.

Empirical studies by Perkmann and Walsh (2009) and Robin and Schubert (2010) affirm the relevance of the engagement of academics in collaboration as a means of providing the requisite knowledge for innovation. As a result, engagement of academics in research collaboration was assessed, firstly, through frequency distribution. The frequency distribution, based on 262 responses, showed a relatively higher percentage (64.1 percent) of respondents indicating that, throughout their professional career, they had done research with or for another person or entity.

However, the figure reduced to 52.8 percent respondents out of a total of 254, who consented that the collaborative research findings were used for purposes other than acquiring an academic degree or promotion. Thus, 11.3 percent of the collaborating academics interacted with persons in or related to academia. Although the academic-centred interactions could prove beneficial to the career advancement of the collaborating parties, the interactions can yield more and diverse benefits to the network actors and society, in general, if they are extended to collaborations with industry and other knowledge users who are responsible for innovation in the knowledge-based economy (Cooke & Leydesdorff, 2006; Etzkowitz & Leydesdorff, 1995; 2000).

The additional benefits of collaborating with external parties, including knowledge users, lie in the opportunity to access heterophilous resources which are embedded in interactions outside one's usual social circles, which is rather characterised as homophilous and less versatile in resource capabilities (Fu et al., 2012; Rivera et al., 2010). According to the network theory of social capital (Lin, 2008), as one reaches out of the inner circle, there is an increase in the likelihood of encountering ties with more diverse and, possibly, better characteristics and resources for the attainment of individual and collective goals, hence the need to engage in bonding social relations besides binding and bridging interactions.

The results of the descriptive analysis also indicated that 35.9 percent of the respondents had not collaborated before, implying that the knowledge-based economy in Ghana falls short of the tacit knowledge that may be embedded in the non-interacting academic researchers. The finding points to an important shortfall in the dynamics of research collaboration, illustrated in the conceptual framework of the study (Figure 4). According to Johnson et al. (2002) and Rinne and Koivula (2005) tacit knowledge is not easily transferrable, hence, collaboration facilitates the transfer of the knowledge since by its nature, tacit knowledge is embedded in the holder of the knowledge (Gibbons et al., 1994) who must be involved in the process of knowledge transfer. As a result, the conceptual framework of the study (Figure 4) advocates for active involvement of all academics in research collaboration.

The finding on non-collaborating respondents contradicts the primary expectation, in the knowledge-based economy, that closer interactions must take place between knowledge producers and knowledge users (Mueller, 2005; Robin & Schubert, 2010). Moreover the presence of non-collaborating academic researchers may imply the existence, to an extent, of an ivory tower (Martin & Etzkowitz, 2000; Shapin, 2012) within the institutions surveyed. Thus, there is a higher likelihood that the research work of the non-collaborating respondents were disengaged from meeting the needs of society in general (Shapin, 2012) and rather dwelt on producing knowledge for its own sake and passing it on to students to enable them to develop their full potential (Martin & Etzkowitz, 2000).

As a result, the initiator of research collaboration was assessed as a means of delving further into the possible existence of an ivory tower between academic researchers and knowledge users. Inspection of frequency results showed an almost equal percentage of 49.4 percent of initiation by academic researchers and 50.6 percent initiation by collaborating partners. The finding suggests an absence of an ivory tower in the interactions between respondents and collaborating knowledge users and is in line with Rinne and Koivula's (2005) assertion that the "the fall of the ivory tower" is evidenced by demands and expectations that pour in from students, the work environment and the state.

Nonetheless, a further important dimension of the ivory tower concept is the sector from which collaborating partners originated. Examination of who must be involved in the process of knowledge transfer. As a result, the conceptual framework of the study (Figure 4) advocates for active involvement of all academics in research collaboration.

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Nonetheless, a further important dimension of the ivory tower concept is the sector from which collaborating partners originated. Examination of frequencies (Table 16) on sector of collaborating partner(s) revealed that more collaborations (52%) were with the third sector, comprising the local community, NGOs and international development partners (Alcock & Kendall, 2011; Hughes & Kitson, 2012) in and outside Ghana, while relatively fewer collaborations (22.6%) took place with the private sector, which is the main industrial stay of the Ghanaian economy (Mensah & Nyadu-Addo, 2012). From interview results, the highest number of collaborations in the third sector was with international funding institutions such as the World Bank and NUFIC which necessitated that the recipients of funds worked with public sector institutions such as relevant government ministries and public universities.

Research collaborations with the private sector were, mainly, with small and medium-sized enterprises (SMEs) especially those into artwork, farming, manufacture of energy-related products, and food processing. There were few collaborations with large enterprises. The finding indicates possible existence of the ivory tower concept between academic researchers and the private sector, whereby there is relatively fewer engagements between the two sides in knowledge production and usage (Etzkowitz & Leydesdorff, 2000; Rinne & Koivula, 2005; Shapin, 2012).

Table 16: Sector of Collaborating Partner(s)

Sector	Frequency (N)*	Percent (%)
Private sector	72	22.6
Public sector	81	25.4
Third sector	166	52.0
Total	319	100

Source: Field survey (2015)
*Multiple response

However, the ivory tower explanation may not, entirely, reflect reality since interview results showed that the closer collaboration with the third sector, including international development agencies, and national and foreign NGOs, was as a result of the existence of relatively more funding opportunities in the sector. Interview results revealed that all interviewees had engaged in research collaboration funded by international organisations and, with the exception of two interviewees, all the collaborations depended on external funding.

The finding conforms to that by Bozeman and Gaughan (2007) that funding, in the form of grants and contracts from industry, had significant effect on academics' propensity to work with industry. In a review of a report on eight flagship African universities, Schalkwyk (2015) observed that universities engaged more in activities such as consulting and service-oriented work because of the need to secure external research funding.

Closely associated with the sector of collaborating partner is the resource-related purpose of research collaboration, which the network theory of social capital categorises into instrumental purpose and expressive purpose (Lin, 1999; 2008). Frequency results showed that 53.4 percent of respondents had an instrumental purpose, that is, they sought to obtain additional resources as against the expressive purpose (46.6) of sharing resources. The finding is consistent with those of Chang et al. (2011) and Hughes et al. (2011) that academics sought instrumental gains in the form of resource acquisition. Purpose of research collaboration was further analysed (Table 17) according to the ultimate goals of respondents in terms of the quest to advance one's research or teaching, or to help others and or make money.

Table 17: Purpose of Research Collaboration

Purpose	Frequency (N)*	Percent (%)
Advance research	123	33.5
Promote teaching	96	26.2
Help others	102	27.8
Make money	46	12.5
Total	367	100

Source: Field survey (2015)
*Multiple responses

Frequency results, in Table 17, indicated that the leading purpose of collaboration was to advance research work (33.5%) followed by the goal of helping others (27.8%). An interviewee communicated the dual purpose of advancing research work and helping others by stating that research collaboration "...helps to sharpen one's research skills... We don't know it all and need to complement each other." Other reasons provided by some interviewees for having the purpose to advance their research work were the need to get international perspectives on their research areas and to have access to state-of-the-art research equipment. On the quest to help others, some interviewees expressed the desire to find solutions to local problems, assist SMEs to add value to their operations and products, improve upon the lot of farmers, enhance food supply in Ghana and tackle water pollution.

The results are similar to D'Este and Perkmann's (2010) and Moore et al.'s (2010) findings that academic researchers engaged in collaborations mainly to advance their research work. It, therefore, implies that opportunity to advance one's research work is an imperative to the willingness of academic researchers to engage in research collaboration, as established in the analysis of the determinants of research collaboration, in Chapter five of the thesis. The finding also implies, within the conceptual framework of the study (4), that opportunities to advance academic research should be present for academics to actively engage in research collaboration. Type of research collaboration also has implications on the knowledge-based economy and was analysed with responses of 10 to 90 per type of collaboration.

Table 18 consists of descriptive statistics on the number of engagement in various types of research collaboration that took place within the reference period of the past ten years. Inspection of the results showed standard deviations varying from .216 to 2.322, and positive skewness from .256 to 3.162 which are indications that the scores were widely dispersed around the mean with most of the scores clustering at the lower end of the distribution (Lind et al., 2005; Pallant, 2011).

Table 18: Type of Research Collaboration

	N	Min.	Max.	Mean	SD	Skewness	Kurtosis
Contract research	90	1	10	2.92	2.089	1.482	1.952
Joint research	74	1	10	2.57	1.881	1.746	3.625
Consulting	64	1	10	2.56	2.322	2.249	4.656
Business founding	15	1	3	1.80	.676	-.256	.126
Technology transfer	10	1	2	1.10	.316	3.162	10.00

Source: Field survey (2015)

However, except consulting (*Median* = 2, *Interquartile Range* = 2) which had a skewness of 2.249 and technology transfer projects (*Median* = 2, *Interquartile Range* = 1) with a skewness of 3.162 and kurtosis above 7, skewness and kurtosis values for the other types of research collaboration were within tolerable limits, that is below ±2 and ±7, to permit the use of the mean as the measure of central tendency (Curran et al., 1996; Schmider et al., 2010). Assessment of the descriptive statistics revealed lower mean scores of number of engagement in all types of research collaboration.

Nonetheless, research collaboration that involved technology transfer had the least number of engagement (M = 1.10, SD = .316; *Median* = 1.00, *Interquartile Range* = 0), followed by business founding (M = 1.69, SD = .793; *Median* = 2.00, *Interquartile Range* = 1). Contract research recorded the highest number of engagement (M = 2.92, SD = 2.08; *Median* = 2.00, *Interquartile Range* = 3). Comparatively, the relatively higher involvement of respondents in contract and consulting-based research is consistent with findings by Bozeman and Gaughan (2007) that grants and contracts have significant effect on academics' propensity to work with industry.

However, the relatively low involvement of respondents in technology transfer and business founding is similar to Hughes and Kitson's (2012) findings. They assessed various forms of knowledge exchange mechanisms in the UK and found that direct commercialisation pathways were in the distinct minority of all interactions. An implication of the findings on engagement in research collaboration, is that funding is important to the type of collaboration that academic researchers are likely to engage in. Inputs to research collaboration were also analysed on a scale of least provided input (1) to the most provided input (7).

Results of the analysis (Table 19) showed the provision of research expertise as the most provided input (M = 5.84, SD = 1.23), during collaborations in the past ten years. This was followed by the expenditure of time (M = 5.62, SD = 1.166) and provision of information (M = 5.57, SD = 1.150). The results are in line with the primary expectation in the knowledge-based economy that the university, represented by academics, produce knowledge to feed the knowledge base of the economy (Perkmann & Walsh, 2009; Leydesdorff, 2012b). In addition to the dimensions of research collaboration discussed so far, the study sought to examine number of research collaboration within the past ten years.

Table 19: Inputs to Research Collaboration

Input	N*	Min.	Max.	Mean	SD	Skewness	Kurtosis
Research expertise	134	1	7	5.84	1.123	-1.270	2.207
Time	133	1	7	5.62	1.166	-1.015	1.380
Information provision	131	1	7	5.57	1.150	-1.011	1.684
Idea transfer	104	2	7	5.42	1.236	-.606	-.307
Provision of good or service	83	1	7	5.22	1.397	-.838	.320
Process transfer	79	2	7	5.08	1.308	-.637	-.312
Infrastructure provision	86	1	7	5.06	1.490	-.560	-.299
Jointly secured funding	95	1	7	4.64	1.879	-.625	-.655
Own funding	117	1	7	4.35	2.031	-.288	-1.174
Personally secured funding	98	1	7	4.29	1.990	-.357	-1.127
Provision of equipment or tool	73	1	7	4.16	1.849	-.302	-1.009

Source: Field survey (2015)
*Multiple response

With respect to the number of research collaboration, within the reference period, the descriptive analysis showed skewness of 2.577 and kurtosis of 10.328 which are an indication of substantial departure of the distribution of the data from the tolerable limits of below ±2 skewness and ±7 kurtosis (Kim, 2013; Lantz, 2013). As a result, the median (5) instead of the mean was reported. The median score of 5 (*Interquartile Range* = 7) indicates that, within the past ten years, there were years that academic researchers did not engage in research collaboration.

In addition, the variance and the skewness signify wide dispersion of the number of collaborations about the mean with most of the collaborations clustering around the low end of the distribution, respectively (Leedy & Ormrod, 2010; Pallant, 2011). Generally, it can be inferred that within the past ten years, there were fewer collaborations by respondents and that a small number of respondents reported more collaborations which inflated the median. In relation to the conceptual framework of the study, it can be said that there was not much dynamism in the involvement of academics in research collaboration, and possibly, lesser use of academic research findings in innovation.

A comparison of the preceding findings to that of previous studies shows that the mean number of collaborations, within the past ten years, was relatively low. For instance in a related study in the UK, D'Este and Perkmann (2010) established that the highest proportion of researchers engaged, at least, once in the reference period of the immediate past year in contract research, joint research and consulting. In accordance with the network theory of social capital (Lin. 1999; 2008), the disparity between the findings of this study and that by

D'Este and Perkmann (2010) may be due to differences in collective assets and structural and positional variations, such as differences in support systems.

Thus, whereas this study was conducted in a developing country that is beset with several institutional, financial and infrastructural challenges (Robson & Obeng, 2008; UNCTAD, 2011) the study by D'Este and Perkmann (2010) was done in a developed country with relatively advanced institutions and support systems. Hence, the relatively lower engagement in research collaboration by the academics surveyed may be attributable to limited support for research collaboration as also confirmed by interviewees who decried the limited opportunities, particularly infrastructure and funding opportunities, in Ghana (Buertey & Asare, 2014; Robson & Obeng, 2008).

Studies by Grimpe and Fier (2010) and Hughes et al. (2011) suggest that academic discipline could have an influence on the involvement of academic researchers in research collaboration. For example, in an investigation of academics' engagement in alternative mechanisms of informal technology transfer, Grimpe and Fier (2010) established that academics from the Sciences, including Life Sciences, Engineering and other Natural Sciences, were more likely to engage in informal technology transfer compared to the Social Sciences and Humanities. In order to explore the impact of academic discipline on number of research collaborations within the past ten years, a Kruskal-Wallis test was conducted. The test was based on 130 responses. The test results showed that the STEM had the highest number of collaborations with a mean rank of 71.66 while the Arts had the least with a mean rank of 44.55 (Table 20).

Table 20: Number of Research Collaboration by Academic Discipline

Academic Discipline	N	Mean Rank
STEM	79	71.66
Social Sciences	41	58.74
Arts	10	44.55
Total	130	

Source: Field survey (2015)

The Kruskal-Wallis test showed a statistically significant difference in the number of research collaboration, across the three academic disciplines at α = .0, [(Group 1, n = 79: STEM, Group 2, n = 41: Social Sciences, Group 3, n = 10: Arts), χ^2 (2, n = 130) = 6.596, p = .037]. The STEM had the highest median score (6) while the Arts recorded the lowest median score of 3.50 (Table 21).

Table 21: Median Scores for Research Collaboration by Academic Discipline

Academic Discipline	N	Median
STEM	79	6.00
Social Sciences	41	5.00
Arts	10	3.50
Total	130	5.50

Source: Field survey (2015)

In order to control for type 1 error, post-hoc analysis was done with the Mann-Whitney U test. According to Pallant (2011), in using the Mann-Whitney U test for post-hoc analysis, the Bonferroni adjustment should be applied. The Bonferroni adjustment involves dividing the alpha level of .05 by the number of tests and using the new alpha level as the criteria for determining significance. Three Mann-Whitney U tests were conducted, implying an alpha level of .017.

First and foremost, a Mann-Whitney U test was conducted between the STEM and the Social Sciences. The test showed no statistically significant difference, at $\alpha = .017$, in the number of research collaboration by the STEM ($Md = 6$, $n = 79$) and the Social Sciences ($Md = 5$, $n = 41$), $U = 1285.000$, $z = -1.861$, $p = .063$. The next Mann-Whitney U test was between the STEM and the Arts which also resulted in statistically insignificant difference, $\alpha = .017$, in the number of research collaboration by the STEM ($Md = 6$, $n = 79$) and the Arts ($Md = 3.50$, $n = 10$), $U = 243.000$, $z = -1.987$, $p = .047$.

Last but not the least, a Mann-Whitney U test was conducted between the Social Sciences and the Arts. Like the two previous tests, there was no statistically significant difference, at $\alpha = .017$, in the number of research collaboration between the Social Sciences and the Arts: Social Sciences ($Md = 5$, $n = 41$), Arts ($Md = 3.50$, $n = 10$), $U = 147.500$, $z = -1.378$, $p = .168$. The outcome of the analysis led to acceptance of the null hypothesis (H_0), that there is no statistically significant difference in the number of research collaboration by the STEM, Social Sciences and the Arts. The finding contradicts that by Grimpe and Fier (2010) which indicated that academics from the Sciences were more likely to engage in informal technology transfer compared to the Social Sciences and Humanities.

A possible reason for the contrasting results is that whereas this study analysed several forms of collaboration, such as knowledge generation projects and technology transfer projects, that by Grimpe and Fier (2010) focused on informal technology transfer mechanisms such as patents, licenses and royalty, which are often associated with the STEM (Chang et al., 2011; Hughes & Kitson, 2012). However, the findings support arguments by Hughes et al. (2011) and Bakhshi et al. (2008) that all academic disciplines are relevant in knowledge exchange. The implication is that the Arts and the Social Sciences are as important as the STEM in general knowledge exchange, hence, should be supported in research collaboration, as demonstrated in the conceptual framework of the study which presents the dynamics of research collaboration without emphasis on any particular academic discipline (Figure 4).

Essentials of Research Collaboration

The network theory of social capital (Lin, 1999; 2008) posits that collective assets, such as trust and norms, and structural and positional variations such as availability of support services and funding, are important to social interactions. Consequently as part of examination of the dynamics of research collaboration, as depicted in the conceptual framework of the study (Figure 4), the study sought to establish factors that were critical to research collaboration. In order to establish the essentials of research collaboration, fourteen factors were subjected to factor analysis (Table 22). Prior to the factor analysis, normality of the data on essentials of research collaboration was assessed through inspection of the skewness and kurtosis of the data, presented in Table 22. The assessment revealed that the values were within tolerable limits of below ±2 skewness and below ±7 kurtosis (Curran et al., 1996; Kim, 2013).

Table 22: Essentials of Research Collaboration

Factors	N*	M-M	Mean	SD	Skew.	Kurt.
Trust	129	3-7	6.11	.978	-1.086	.925
Common values	129	2-7	5.82	1.086	-1.051	1.483
Common goal	131	3-7	6.05	.931	-1.095	1.343
Timely information flow	130	2-7	5.78	1.241	-1.199	1.229
Availability of time	131	1-7	5.70	1.207	-.979	1.093
Access to information	133	2-7	5.87	1.111	-1.124	1.362
Availability of funding	126	1-7	5.35	1.684	-.924	-.130
Availability of requisite infrastructure	116	1-7	5.29	1.486	-.890	.261
Willingness of user to use findings for intended purpose	119	1-7	5.57	1.338	-1.225	1.337
Ability of user to use findings for intended purpose	122	1-7	5.61	1.256	-1.015	1.123
Prompt delivery of support services by own institution	121	1-7	5.06	1.445	-.844	.305
Own capability to manage relationships	120	2-7	5.66	1.111	-.707	.104
Prompt delivery of support by partner institution or individual	121	2-7	5.63	1.170	-.950	.922
Availability of EIPR	107	1-7	4.49	1.782	-.389	-.807
Opportunity to publish findings	127	2-7	6.04	1.191	-1.393	1.620

Source: Field survey (2015)
*Multiple responses; M-M means minimum and maximum scores; Skew. stands for skewness; Kurt. stands for kurtosis.

Examination of the correlation matrix (See Table 56 in Appendix I) of the data showed the presence of several coefficients of .3 and above which, according to Pallant (2011), is an indication of the suitability of the data for factor analysis. However, the correlation matrix revealed the presence of a high correlation coefficient of .829 between willingness of user to use research findings and capability of user to use research findings on one hand, and a coefficient of .761 between availability of funding and availability of requisite infrastructure, on the other. According to Pallant (2011), correlation coefficient above .7 is high and is an indication that the correlated items tend to measure the same concept. As a result Pallant (2011) recommends that only one item is maintained for analysis or the two items should be averaged to form a composite variable.

Consequently, willingness of user to use research findings and capability of user to use research findings were merged into a composite variable captioned as "willingness and capability of user to use findings". However, no action was taken on availability of funding and availability of requisite infrastructure since theoretically, and practically, the two items capture different and important concepts. Nonetheless, the high correlation between the two items suggests that respondents might have secured funding to finance the acquisition of requisite infrastructure.

Eventually, the principal component analysis (PCA) showed that the Kaiser-Meyer-Oklin value of sampling adequacy (Pallant, 2011) was .837, exceeding the recommended value of .6. Moreover, the Bartlett's Test of Sphericity (Pallant, 2011) reached statistical significance, supporting the factorability of the correlation matrix (see Table 57 in Appendix I). Furthermore, the PCA showed the presence of four components with eigenvalues exceeding 1, explaining 41.723 percent, 11.633 percent, 8.260 percent and 7.404 percent of the variance, respectively.

Assessment of the scree plot (see Figure 7 in Appendix I) indicated a clear break after the second component. Although the undulating nature of the plot, after the third and fourth components, appeared interesting to explore, the structure matrix of the PCA did not support a four factor solution since very few items loaded on components three and four (Pallant, 2011). According to Pallant (2011), there should be more than three factor loadings above the .4 mark, under each component in the component matrix, to permit the inclusion of the component in PCA. Therefore, using Catell's (1966, as cited in Pallant, 2011) scree test, two components were retained for further analysis. The decision was supported by the results of parallel analysis, which showed only two components with eigenvalues exceeding the corresponding criterion values for a randomly generated data matrix of the same size (14 variables x 118 participants on average x 100 replications).

The Kaiser-Meyer-Oklin value of sampling adequacy for the two-component solution was .847 while the Bartlett's Test of Sphericity reached statistical significance. The two-component solution explained a total of 54.379 percent of the variance, with component one contributing 41.999 percent and component two contributing 12.380 percent. Results of Oblimin rotation showed that the correlation between the two components was .414, confirming some association between the two factors, as well as supporting the use of the Oblimin rotation (Pallant, 2011). Moreover, the rotated solution showed the presence of simple structure, with the two components demonstrating a number of strong loadings (.4 and above) and all variables loading substantially on only one component (Table 23).

Table 23: Factor Loadings of the Essentials of Research Collaboration

	Component	
	1	2
Availability of EIPR	.848	
Availability of requisite infrastructure	.776	
Availability of funding	.772	
Prompt delivery of support services by own institution	.768	
Prompt delivery of support by partner institution or individual	.691	
Own capability to manage relationships	.503	.333
Common goal		.862
Common values		.739
Trust		.733
Access to information		.642
Timely information flow		.634
Opportunity to publish findings		.557
Availability of time	.315	.440
Willingness and capability of user to use findings	.379	.393
Eigenvalues	5.880	1.733
Total variance explained (%)	41.999	12.380
Cumulative variance explained	41.999	54.379

Source: Field survey (2015)

Inspection of the factor loadings for the two component solution, as shown in Table 23, indicated that component 1 consisted mainly of factors on the structure and position of research collaboration, as illustrated by the network theory of social capital (Lin. 1999; 2008). Following Cheung and Vogel (2013), the cut-off point of .5 was used in the identification of items with high loadings.

Consequently, with the exception of the importance of time availability, and importance of user capability and willingness to use findings, all variables under component 1 loaded highly between .503 and .848. Component 2 had strong factor loadings (.557 to .862) from all collective assets, followed by some structural and positional factors.

Overall, the essentials of research collaboration, in order of importance under Component 1 in Table 23, were availability of enforceable intellectual property rights (IPR), infrastructure, funding, support by own institution and support by partner institution. These essentials of research collaboration conform to structural and positional factors which, the network theory of social capital (Lin, 2008) illustrates as critical to the pursuit of individual and collective goals in social interactions. The importance of funding to research collaboration was also established in related studies by Bozeman and Gaughan (2007) and Hughes et al. (2011). In the knowledge spillover theory of entrepreneurship (Acs et al., 2009) and Schumpeterian growth models (Zachariadis, 2003), the five essentials of research collaboration constitute investment in research and development at both the national and institutional levels.

Other essentials of research collaboration, from Component 2, included the need for the collaborating parties to have a common goal, common values, trust in each other, access to requisite information, timely information flow and opportunity to publish research findings of the collaboration. The relevance of common goal, values and trust to research collaboration was stressed by several interviewees who indicated the importance of commitment and a sense of ownership of the interaction. An answer to a follow-up question on what an individual researcher would look for in potential collaborators was: "my research interest will be the first factor I will consider and the second thing will be how reliable the person will be."

Trust as an essential of research collaboration is consistent with Perkmann and Walsh's (2009) finding, in a similar study in the UK, that secrecy was critical, particularly for technology development projects. Common goals, common values and trust are collective assets (Coleman, 1988) described by the network theory of social capital (Lin, 1999) as sources of solidarity or binding relations that bring network actors into a collectivity to achieve shared goals (Kwon & Adler, 2014). Yang et al. (2014) emphasise that trust and norms are critical to collaborations involving intensive exchange of tacit knowledge and they, particularly, prove useful when rights and obligations are not well outlined.

Summary

In this Chapter, the involvement of academics in research collaboration was analysed as part of the dynamics of research collaboration, depicted in the conceptual framework of the study (Figure 4). Overall, a little over fifty percent of academics had engaged in research collaboration within the past ten years, with more of the collaborations taking place with the third sector. The percentage of academics who sought after instrumental purpose was slightly higher than those who aimed at expressive purpose of collaboration. The leading academic-related purpose of research collaboration was the quest to advance research work. It was also established that the number of engagement in various types of research collaboration was low, particularly, for technology transfer projects.

The Sciences, Technology, Engineering and Mathematics (STEM) had the highest number of collaborations, although significant differences were not established across academic discipline. Research expertise emerged the most provided input to research collaboration while the least provided input was equipment. The essentials of research collaboration comprised structural and positional factors such as intellectual property rights and funding, and collective assets, including common goal, common values and trust. The next Chapter of the thesis presents and discusses findings on the use of collaborative research findings in innovation in addition to the research orientation of academics.

CHAPTER SEVEN

USE OF COLLABORATIVE RESEARCH FINDINGS IN INNOVATION AND ANALYSIS OF RESEARCH ORIENTATION

Introduction

Research and innovation constitute an integral and interrelated component of the knowledge-based economy (Etzkowitz, 2003; Leydesdorff, 2010). The interplay between research and innovation is explicated by Schumpeterian growth models (Zachariadis, 2003) and the knowledge spillover theory of entrepreneurship (Acs et al., 2009) which illustrate that research output positively influences innovation while innovation positively influences economic growth and development, via entrepreneurship (Leydesdorff, 2010; Schumpeter, 1934/1983; Zachariadis, 2003). However, an important feature of the knowledge-based economy is that research and innovation are able to have the most impact on economic growth and development through well-directed recursive interactions between knowledge producers and users, as confirmed in empirical studies by Robin and Schubert (2010), and Mueller (2005).

Consequently, this Chapter of the thesis addresses the third and fourth objectives of the study, which sought to explore the use of collaborative research findings in innovation and to examine the research orientation of academic researchers, respectively. Exploration of the use of collaborative research findings in innovation was informed by the knowledge spillover theory of entrepreneurship (Acs et al., 2009; 2013) and Schumpeterian growth models (Zachariadis, 2003) which indicate the need for knowledge to flow from incumbents to users, for innovation (Mueller, 2005; Robin & Schubert, 2010).

The knowledge flow expectation has several implications including the necessity for academic researchers to possess versatile research orientation that could be tapped for innovation (Chang et al., 2011; Hughes & Kitson, 2012).

In line with the conceptual framework of the study (Figure 4) which proposes that research collaboration can be useful in generating innovation, type of collaborative research was examined on the basis of Perkmann and Walsh's (2009) typology of collaborative research. This was followed by an assessment of the use of collaborative research findings in innovation according to Schumpeter's (1934/1983), Gunday et al.'s (2011) and Abdi and Ali's (2013) conceptualisation of innovation. Research orientation was studied within the framework of the quadrant model of scientific research (Stokes, 1997) and was preceded by an assessment of the research interest of respondents (Mathews & Hu, 2007).

Upon the preceding theoretical background, survey and interview data were analysed to explore the use of collaborative research findings in innovation and to examine the research orientation of academic researchers. Firstly, type of collaborative research project was analysed with minimum and maximum data points of 26 and 100 multiple responses, respectively. Secondly, with a minimum of 40 and a maximum of 108 multiple responses, the extent to which research findings contributed to various types of innovation and problem solving, was assessed.

The assessment was followed by a Kruskal-Wallis test of difference in the extent to which collaborative research findings from the Sciences, Technology, Engineering and Mathematics (STEM), Social Sciences and Arts, were beneficial to innovation by collaborating parties. Thirdly, frequency distribution of the research interest of respondents was examined followed by analysis of research orientation, based on a maximum of 265 valid responses. Thereafter, a Kruskal-Wallis test was conducted to assess whether academic researchers from the STEM, Social Sciences and Arts differ in their research orientation.

Use of Collaborative Research Findings in Innovation

From the perspective of the knowledge spillover theory of entrepreneurship (Acs et al., 2009; Johnson et al., 2002), research collaboration is deemed as an essential medium for the spillover or transfer of tacit knowledge for innovation, hence, a vital means of overcoming the Swedish paradox (Braunerhjelm et al., 2010; Ejermo & Kander, 2006). Therefore, the conceptual framework of the study (Figure 4) illustrates that, in the knowledge-based economy, knowledge produced through research collaboration is useful for innovation. The use of collaborative research findings for innovation was explored in three main ways.

Firstly, there was a description of the types of collaborative research project which respondents had engaged in within the reference period of past ten years. Secondly, the extent to which collaborative research findings contributed to innovation and problem solving was examined. Thirdly, a Kruskal-Wallis test was conducted to analyse possible differences among the Sciences, Technology, Engineering and Mathematics (STEM), Social Sciences and Arts, in the extent to which their collaborative research findings contributed to innovation.

Therefore, using a typology by Perkmann and Walsh (2009), five types of collaborative research projects were examined, and further compared on the basis of engagement in collaborative research projects. The research projects were problem solving projects, idea testing projects, technology development projects, knowledge generation projects and technology transfer projects. Table 24 provides an overview of the number of collaborative research projects which respondents had engaged in within the past ten years.

Table 24: Number of Collaborative Research Projects

Research Project	N	Min	Max	Mean	Median	Interquar-tile Range	Skewness	Kurtosis
Problem solving projects	100	1	15	2.80	2.00	3	2.440	10.099
Idea testing projects	52	1	12	2.29	2.00	1	3.111	11.056
Technology development projects	52	1	10	1.96	2.00	1	3.325	15.165
Knowledge generation projects	86	1	14	3.29	2.00	2	1.796	3.085
Technology transfer projects	26	1	6	2.19	2.00	1	1.261	1.445

Source: Field survey (2015)

Inspection of Table 24 revealed that except technology transfer projects, scores for all the other types of collaborative research project were highly skewed (above ±2) and or highly peaked with kurtosis above ±7, signifying substantial departure from normal distribution of data (Curran et al., 1996; Kim, 2013). As a result, the median was reported as the measure of central tendency for all types of collaborative research projects apart from technology transfer project whose mean was reported in addition to the median. Further assessment of the descriptive statistics, presented in Table 24, showed that problem solving projects and technology transfer projects ($M = 2.04$, $SD = 1.453$) received the highest (N = 100) and lowest (N = 26) number of responses, respectively.

In addition, each collaborative research project had a median score of 2.00 (Table 24) which is an indication that, on average, two each of the various types of collaborative research project were carried out within the past ten years. According to Perkmann and Walsh (2009), problem solving projects and knowledge generation projects are less applied in nature, hence, less innovation-oriented whereas idea testing, technology development and technology transfer projects are more applied in nature, hence more innovation-oriented. It can, therefore, be inferred from the median scores that there were as much less innovation-oriented research projects as the more innovation-oriented research projects. However, the variance and skewness values indicate wide dispersion of scores around the median with most of the scores clustering to the lower end of the distribution (Lind et al., 2005; Pallant, 2011).

The preceding findings, in relation to the conceptual framework of the study (Figure 4), suggest less use of collaborative research findings in innovation and problem solving. The results also provide evidence for the generalisability of the typology by Perkmann and Walsh (2009) to other study settings. Perkmann and Walsh (2009), through a qualitative study, developed the typology in a developed country setting. Therefore, the applicability of the typology in a developing country setting is an indication of the feasibility of universal usage of the typology, particularly, in discussions on collaborative research projects. In addition to the assessment of collaborative research types, the extent to which collaborative research findings contributed to innovation and problem solving was examined.

The definition of innovation type was informed by Schumpeter's (1934/1983), Gunday et al.'s (2011), and Abdi and Ali's (2013) characterisation, and comprised product innovation, service innovation, technological innovation, process innovation, administrative innovation and opportunity-related innovation. The extent to which collaborative research findings aided external collaborating parties in problem solving and in developing or improving upon the various types of innovation were scored on a scale of 1, representing least beneficial to 7, representing very beneficial. The respective descriptive statistics, presented in Table 25, revealed some key findings based on scores below the tolerable limits of skewness (±2) and kurtosis (±7) (Kim, 2013; Schmider et al. 2010).

First and foremost, the extent to which collaborative research findings contributed to problem solving had the highest mean score of 5.73 followed by service innovation with a mean score of 5.53 (Table 25). Except for service innovation and process innovation which had mean scores of 5.53 and 5.39, respectively, the remaining innovation types recorded relatively lower mean scores with technological innovation recording the least mean score of 4.17.

Table 25: Extent to which Collaborative Research Findings Contributed to Innovation and Problem Solving

	N	Min.	Max.	Mean	SD	Skewness	Kurtosis
Innovation:							
Product innovation	46	1	7	4.73	1.328	-1.069	.606
Service innovation	94	1	7	5.53	1.250	-1.372	2.330
Technological innovation	40	1	6	4.17	1.430	-.891	-.144
Process innovation	89	2	7	5.39	1.174	-.945	.581
Administrative innovation	52	1	7	4.45	1.412	-.453	.510
opportunity-related innovation	61	1	7	4.53	1.557	-.525	.620
Problem solving	108	1	7	5.73	1.212	-1.295	2.043

Source: Field survey (2015)

Thus, from the conceptual framework of the study (Figure 4), it can be said that collaborative research output were beneficial to service innovation and process innovation, while the output were quite beneficial to product innovation, opportunity-related innovation, administrative innovation and technological innovation. The findings, partly, conform to those of Robin and Schubert (2010) that collaboration with public research institutions had a significant positive effect on process and product innovation intensity.

However, the mean scores on the extent to which collaborative research findings were beneficial to the various types of innovation, together with lower median scores on number of collaborative research projects, imply that collaborative research findings make less contribution to the knowledge-based economy, hence the presence of a wider knowledge filter and pronounced Swedish paradox (Acs et al., 2013; Braunerhjelm et al., 2010; Ejermo & Kander, 2006). Kruskal-Wallis tests were conducted to examine whether academic researchers from the Sciences, Technology, Engineering and Mathematics (STEM), Social Sciences and Arts, differ in the extent to which their collaborative research findings were beneficial to innovation, within the past ten years.

The Kruskal-Wallis tests were necessitated by emerging debates such as those by Bakhshi et al. (2008) and Hughes et al. (2011), in the literature on university interaction with external entities, which argue for policy attention for all academic disciplines besides the STEM, which hitherto had been the focus of most policy interventions. The STEM has been the priority of policy interventions due to the perception that this discipline, by its nature, is relatively more useful for innovation (Bakhshi et al., 2008; Chang et al., 2011). The Kruskal-Wallis tests were performed on six types of innovation. Firstly, the extent to which collaborative research findings contributed to product innovation was analysed with a total of 45 responses (Table 26).

Table 26: Contribution of Collaborative Research Findings to Product Innovation across Academic Discipline

Academic Discipline	N	Mean Rank
STEM	25	25.16
Social Sciences	14	19.14
Arts	6	23.00
Total	45	

Chi-square = 1.938, Asymp. Sig. = .379
Source: Field survey (2015)

Inspection of Table 26 shows that the STEM recorded the highest mean rank (25.16) while the Arts had the lowest mean rank (23.00). However assessment of the median scores, as presented in Table 27, revealed that collaborative research findings from the Social Sciences (*M* = 4.75) made the least contribution to product innovation whilst the highest contribution came from the STEM (*M* = 5.50). That is, collaborative research findings from the Social Sciences were somehow beneficial to product innovation while that from the STEM made quite high contribution to product innovation.

Table 27: Median Scores on Use of Collaborative Research Findings in Product Innovation across Academic Discipline

Discipline	N	Median
STEM	25	5.50
Social Sciences	14	4.75
Arts	6	5.00
Total	45	5.00

Source: Field survey (2015)

Nevertheless, results of the Kruskal-Wallis test indicated the absence of statistically significant difference in the extent to which collaborative research findings from the three academic disciplines were beneficial to product innovation [(Group 1, n = 25: STEM, Group 2, n = 14: Social Sciences, Group 3, n = 6: Arts), x^2 (2, n = 25) = 1.938, p = .379]. Thus, academic researchers from the STEM, Social Sciences and Arts did not differ, significantly, in the extent to which they perceived their collaborative research findings to be beneficial to product innovation.

Secondly, the contribution of collaborative research findings to service innovation was assessed. The assessment was based on a total of 91 responses (Table 28). Results of the assessment showed that the STEM recorded the highest mean rank (51.47) followed by the Arts (40.50) and Social Sciences (36.95), respectively.

Table 28: Contribution of Collaborative Research Findings to Service Innovation across Academic Discipline

Academic Discipline	N	Mean Rank
STEM	55	51.47
Social Sciences	29	36.95
Arts	7	40.50
Total	91	

Chi-square = 6.778, $p = .034$
Source: Field survey (2015)

In addition, the STEM and the Arts recorded higher median scores of 6 each, than the Social Sciences which had a median score of 5 (Table 29). Results of the Kruskal-Wallis test revealed statistically significant differences in the extent to which collaborative research findings from the three academic disciplines were beneficial to service innovation [(Group 1, n = 55: STEM, Group 2, n = 29: Social Sciences, Group 3, n = 7: Arts), χ^2 (2, n = 55) = 6.778, $p = .034$]. Assessment of the median scores (Table 29) showed that the STEM and the Arts recorded higher median scores ($M = 6$) than the Social Sciences which recorded a median score of 5. In order to control for Type 1 error, post-hoc analysis was done with the Mann-Whitney U test with an Alpha level of .017 (Pallant, 2011).

Table 29: Median Scores on Use of Collaborative Research Findings in Service Innovation across Academic Discipline

Discipline	N	Median
STEM	55	6.00
Social Sciences	29	5.00
Arts	7	6.00
Total	91	6.00

Source: Field survey (2015)

The first Mann-Whitney U test was between the STEM and the Social Sciences. The test revealed a statistically significant difference, at $\alpha = .017$, in the extent to which collaborative research findings from the STEM (*Md* = 6, n = 55) and the Social Sciences (*Md* = 5, n = 29), U = 545, z = -2.504, $p = .012$, $r = .273$, contributed to service innovation. The effect size, $r = .273$, was computed with the formula $r = z \div \sqrt{N}$ (Pallant, 2011). Using Cohen's criteria (.1 = small; .25 = medium; .40 = large) for effect size interpretation (Cohen, 1992; Pallant, 2011), it can be concluded that a medium, statistically significant difference existed between the STEM and the Social Sciences in the extent to which their collaborative research findings contributed to service innovation.

The second and third Mann-Whitney U tests were between the STEM and the Arts, on one hand, and the Social Sciences and the Arts, on the other. The test between the STEM and the Arts showed insignificant difference, at $\alpha = .017$, in the extent to which collaborative research findings from the STEM (*Md* = 6, n = 55) and the Arts (*Md* = 6, n = 7), U = 144.000, z = -1.138, $p = .225$, contributed to service innovation. There was also no statistically significant difference between the Social Sciences and the Arts in the extent to which their collaborative research findings contributed to service innovation ($\alpha = .017$:

Social Sciences (*Md* = 5, n = 29), Arts (*Md* = 6, n = 7), U = 91.500, z = -.433, *p* = .696).

Thirdly, with a total of 39 responses, the extent to which collaborative research findings were beneficial to technological innovation was analysed (Table 30). The analysis showed close mean ranks with the Arts and the STEM recording similar mean ranks of 20.88 and 20.00, respectively, while the Social Sciences recorded a lower mean rank of 19.71. Nonetheless, as presented in Table 31, the Social Sciences and the Arts recorded the same median score (*M* = 4.50) whilst the STEM had a higher median score of 5.00. The median scores indicate that collaborative research findings from the Social Sciences and the Arts were somehow beneficial to technological innovation whilst that from the STEM made quite high contribution to technological innovation.

Table 30: Contribution of Collaborative Research Findings to Technological Innovation across Academic Discipline

Discipline	N	Mean Rank
STEM	23	20.00
Social Sciences	12	19.71
Arts	4	20.88
Total	39	

Chi-square = .032, Asymp. Sig. = .984
Source: Field survey (2015)

However, Kruskal-Wallis test results revealed the absence of statistically significant difference in the extent to which collaborative research findings were beneficial to technological innovation, across the three academic disciplines[(Group 1, n = 23: STEM, Group 2, n = 12: Social Sciences, Group 3, n = 4: Arts), χ^2 (2, n = 39) = .032, *p* = .984]. In other words, academic researchers from the STEM, Social Sciences and Arts did not differ, significantly, in the extent to which they perceived their collaborative research findings were used in technological innovation (Table 31).

Table 31: Median Scores on Use of Collaborative Research Findings in Technological Innovation across Academic Discipline

Discipline	N	Median
STEM	23	5.00
Social Sciences	12	4.50
Arts	4	4.50
Total	39	4.50

Source: Field survey (2015)

Fourthly, the contribution of collaborative research findings to process innovation was examined with a total of 86 responses (Table 32). Inspection of the descriptive statistics, presented in Table 32, revealed that the Arts (48.57) had the highest mean rank followed by the STEM (44.17) and the Social Sciences with the lowest mean rank (41.22).

Table 32: Contribution of Collaborative Research Findings to Process Innovation across Academic Discipline

Discipline	N	Mean Rank
STEM	49	44.17
Social Sciences	30	41.22
Arts	7	48.57
Total	86	

Chi-square = .0647, Asymp. Sig. = .724
Source: Field survey (2015)

However, as illustrated in Table 33, the three academic disciplines recorded the same median score (M = 6.00), which is an indication that respondents considered the use of their collaborative research findings in process innovation, as high. Kruskal-Wallis test confirmed the absence of statistically significant differences in the extent to which collaborative research findings from the three academic disciplines were beneficial to process innovation [(Group 1, n = 49: STEM, Group 2, n = 30: Social Sciences, Group 3, n = 7: Arts), χ^2 (2, n = 86) = .0647, p = .724]. Thus, academic researchers from the STEM, Social Sciences and Arts did not differ, significantly, in the extent to which they perceived the use of their collaborative research findings in process innovation (Table 33).

Table 33: Median Scores on Use of Collaborative Research Findings in Process Innovation across Academic Discipline

Discipline	N	Median
STEM	49	6.00
Social Sciences	30	6.00
Arts	7	6.00
Total	86	6.00

Source: Field survey (2015)

Fifthly, with a total of 51 responses, the extent to which collaborative research findings from the three academic disciplines contributed to administrative innovation was assessed (Table 34). The assessment showed that the Arts recorded the highest mean rank of 29.17 whereas the STEM recorded the lowest mean rank (119.94).

Table 34: Contribution of Collaborative Research Findings to Administrative Innovation across Academic Discipline

Discipline	N	Mean Rank
STEM	29	25.10
Social Sciences	19	26.87
Arts	3	29.17
Total	51	

Chi-square = .311, Asymp. Sig. = .856
Source: Field survey (2015)

Median scores, presented in Table 35, indicated that collaborative research findings from the Social Sciences (M = 5.00) and the Arts (M = 5.00) were quite highly beneficial to administrative innovation while that from the STEM were somehow beneficial to administrative innovation. Nevertheless, Kruskal-Wallis test revealed the absence of statistically significant difference in the extent to which collaborative research findings were beneficial to administrative innovation, across the three academic disciplines [(Group 1, n = 29: STEM, Group 2, n = 19: Social Sciences, Group 3, n = 3: Arts), χ^2 (2, n = 51) = .311, p = .856]. The test results indicate academic researchers from the STEM, Social Sciences and Arts did not differ, significantly, in the extent to which they perceived their collaborative research findings to be beneficial to administrative innovation (Table 35).

Table 35: Median Scores on Use of Collaborative Research Findings in Administrative Innovation across Academic Discipline

Discipline	N	Median
STEM	29	4.50
Social Sciences	19	5.00
Arts	3	5.00
Total	51	4.50

Source: Field survey (2015)

Sixthly, the contribution of collaborative research findings to opportunity-related innovation was analysed with a total of 59 responses (Table 36). Inspection of Table 36 shows that the STEM recorded the highest mean rank (32.93). The lowest mean rank was recorded by the Arts (17.10).

Table 36: Contribution of Collaborative Research Findings to Opportunity-related Innovation across Academic Discipline

Discipline	N	Mean Rank
STEM	35	32.93
Social Sciences	19	28.00
Arts	5	17.10
Total	59	

Chi-square = 4.188, Asymp. Sig. = .123
Source: Field survey (2015)

In the same way, median scores presented in Table 37 indicates that collaborative research findings from the STEM (M = 5.00) were quite highly beneficial to opportunity-related innovation while that from the Social Sciences (M = 4.50) were somehow beneficial to the innovation. The benefits derived from collaborative research findings from the Arts was quite low (M = 3.00)

Nonetheless, results of the Kruskal-Wallis test showed the absence of statistically significant difference in the extent to which collaborative research findings were beneficial to opportunity-related innovation, across the three academic disciplines [(Group 1, n = 35: STEM, Group 2, n = 19: Social Sciences, Group 3, n = 5: Arts), χ^2 (2, n = 59) = 4.188, p = .123]. Thus, academic researchers from the STEM, Social Sciences and Arts did not differ, significantly, in the extent to which they perceived their collaborative research findings to have been beneficial to opportunity-related innovation (Table 37).

Table 37: Median Scores on Use of Collaborative Research Findings in Opportunity-related Innovation across Academic Discipline

Discipline	N	Median
STEM	35	5.00
Social Sciences	19	4.50
Arts	5	3.00
Total	59	5.00

Source: Field survey (2015)

In sum, the Kruskal-Wallis tests resulted in statistically insignificant differences, across the three academic disciplines, in the extent to which collaborative research findings contributed to product innovation, technological innovation, process innovation, administrative innovation, and opportunity-related innovation. These findings corroborate the capacity of the Arts and Social Sciences to contribute towards innovation in the knowledge-based economy, as put forward by Bakhshi et al. (2008) and Hughes et al. (2011) contrary to arguments by Chang et al. (2011) that indicate otherwise. However, a statistically significant difference was found in the extent to which collaborative research findings from the three academic disciplines contributed to service innovation.

Results of the preceding analysis led to acceptance of five out of the six sub null-hypotheses (H_0) that were presented in the third hypothesis of the study. Thus, it was concluded that there were no statistically significant differences among academic researchers from the STEM, Social Sciences and Arts, in the extent to which their collaborative research findings contributed to product innovation, technological innovation, process innovation, administrative innovation and opportunity-related innovation.

Nevertheless, there was rejection of the sub-null hypothesis (H_0) which stated that there was no statistically significant difference among academic researchers from the STEM, Social Sciences and Arts, in the extent to which their collaborative research findings contributed to service innovation. Although a statistically significant difference existed between the STEM and the Social Sciences, it should be noted that the difference was small.

To an extent, interview results confirmed the findings of the survey. Interviewees from the various academic disciplines indicated use of their collaborative research findings in almost all the types of innovation. However, interview results from the Liberal Arts revealed that use of collaborative research findings, by relevant bodies, resulted more in the improvement of processes and service delivery by the users, while collaborative research findings from the Creative Arts yielded, relatively, more product innovations such as jewelry, furniture and other items for interior decoration.

The Kruskal-Wallis test results and corresponding interview results contradict debates, such as those by Chang et al. (2011) that place the STEM above the other academic disciplines in terms of capacity to contribute to innovation and economic development. The results, however, agree with Hughes et al.'s (2011) and Bakhshi et al.'s (2008) position that the Arts and the Social Sciences are also important in advancing the knowledge base of an economy. The findings, therefore, confirm the relevance of all academic disciplines in building the knowledge-based economy, through the contribution of their research findings to innovation, as generalised in the conceptual framework of the study (Figure 4).

Research Orientation

The knowledge-based economy thrives on versatile knowledge types with the implication on knowledge producers to meet the diverse knowledge requirements of the economy (Baba et al., 2009; Grimpe & Fier, 2010). Therefore, as part of examining the dynamics of research collaboration in accordance with the conceptual framework of the study (Figure 4), the research focus and research orientation of academics were analysed. The research focus of respondents was analysed on the basis of recommendations in development literature, including discussions by Mathews and Hu (2007) that least developed and developing countries should engage less in new-to-the-world innovations and more in new-to-the-country and reverse innovations as well as focus more on outward-oriented industrialisation (Lucas, 1988; UNCTAD, 2011).

The rationale behind the recommendation by Mathews and Hu (2007) is that new-to-the-world innovations consist of commercialisation of inventions, usually by lead countries, which developing countries can hardly match up to. Alternatively, an empirical study by Ang and Madsen (2009) supports the recommendation for developing countries to aim at reverse innovation. The implication is that academic researchers should focus more on new-to-the-country research since such research offers opportunities for new-to-the-country or reverse innovation, and export of products to already established markets (Lazonick 2004; Govindarajan & Ramamurti, 2011; Zedtwitz et al., 2015).

Assessment of the research focus of respondents, through frequency distribution of multiple responses (Table 38), revealed more responses (43.5 percent) from academics that most of the research they conducted throughout their professional career was country-specific research. However, 39.2 percent of responses specified new-to-the-country research as the primary research focus, while a lower percentage (17.3) of responses focused on new-to-the-world research.

Table 38: Research Interest of Respondents

Research interest	Frequency	%
New-to-the-country research	165	39.2
New-to-the-world research	73	17.3
Country-specific research	183	43.5
Total	421	100.0

Source: Field survey (2015)

Interview results also showed that almost an equal percentage of interviewees were into country-specific research, such as inquiry into economic, technological and health-related issues peculiar to Ghana, and new-to-the-country research, which involved exploration of the feasibility of upgrading, adopting and or adapting innovations from elsewhere to suit local conditions. New-to-the-world research, hardly came up as research focus of interviewees.

Although the survey and interview results indicated relatively higher focus on country-specific research, the findings appear consistent, to an extent, with recommendations by Mathews and Hu (2007), who advise developing countries to focus less on new-to-the-world innovation and, rather on new-to-the-country innovation and, hence, new-to-the-country research. Nonetheless, the relatively fewer engagement in new-to-the-country research coupled with lower engagement with the private sector as established in Chapter six, could limit the capability of Ghana in the pursuit of effective outward-oriented industrialisation (Lucas, 1988; Rodrik, 2001) which thrives on reverse innovation (Lazonick, 2004; Zedtwitz et al., 2015).

In addition to assessment of research focus, the primary research orientation of respondents, and research requests by collaborating partners, were analysed. The analysis was informed by the quadrant model of scientific research (Hughes & Kitson, 2012; Stokes, 1997) which categorises research into basic, applied and use-inspired basic research. Each type of research was scored on a scale of 1 to 7, representing very weak agreement to very strong agreement that most of the research that respondents conducted throughout their career was basic, applied or use-inspired basic research.

The results of the analysis, as shown in Table 39, indicated skewness and kurtosis values below ±2 and ±7, respectively. The values do not signify substantial departure from normality (Curran et al., 1996; Kim, 2013), hence, the mean was reported as the measure of central tendency. Assessment of the descriptive statistics, presented in Table 39, showed closer mean scores of 5.63 for basic research and applied research, and 5.62 for use-inspired basic research.

Thus respondents highly agreed that, throughout their career, most of the research they conducted were either basic, applied or use-inspired basic research. Similarly, respondents who had engaged in research collaboration, within the past ten years, indicated that requirements for basic research (M = 5.45, SD = 1.315), applied research (M = 5.49, SD = 1.384) and use-inspired basic research (M = 5.41, SD = 1.405) were quite high (Table 39).

Table 39: Research Orientation of Respondents and Research Request by Collaborating Partner(s)

	N	Min.	Max.	Mean	SD	Skewness	Kurtosis
Research orientation:							
Basic research	265	1	7	5.63	1.299	-1.436	-1.436
Applied research	262	1	7	5.63	1.183	-1.237	-1.237
Use-inspired basic research	261	1	7	5.62	.954	-1.777	-.777
Partner's research request:							
Basic research	120	1	7	5.45	1.315	-1.153	-1.153
Applied research	114	1	7	5.49	1.384	-1.102	-1.102
Use-inspired basic research	119	1	7	5.41	1.405	1.365	-1.365

Source: Field survey (2015)

The results point to an almost equal distribution of Edison, Pasteur and Bohrian researchers (Stokes, 1997) among the academics surveyed. Interview results revealed that out of the two to three interviewees from each academic discipline, at least, one cited use-inspired basic research as the primary research orientation while a respondent indicated that "you can't do the applied without the basic..." The results, interpreted within the conceptual framework of the study (Figure 4), imply that use-inspired basic research is critical to the attainment of a knowledge-based economy. The findings are quite similar to those of Baba et al. (2009) and Chang et al. (2011) who established that use-inspired basic research was the leading research orientation of scientists studied in Japan and the UK, respectively.

Research orientation was also assessed from the perspective of respondents who had engaged in research collaboration within the past ten years. Specifically, respondents were asked to rate on a scale of 1, representing least requirement, to 7 representing major requirement, the purpose for which collaborating partners requested for the research. Descriptive statistics (Table 39) showed closer mean scores, from 5.41 to 5.49, for use-inspired basic research, basic research and applied research, meaning that research requests by collaborating partners were either use-inspired, basic or applied in nature. The results show a close match between research orientation and the knowledge requirements of users. The implication is that use of collaborative research output in innovation, as illustrated in the conceptual framework of the study (Figure 4), is an outcome of the interplay between research demand and supply.

Furthermore, the findings indicate versatility in the research demands of knowledge users contrary to Baba et al.'s (2009) and Grimpe and Fier's (2010) findings which showed use-inspired basic research and applied research as the most demanded research types. The difference could be attributed to differences in study design. That is, whereas this study was designed for respondents to indicate knowledge requirements from users, irrespective of their sector of operation, the studies by Baba et al. (2009) and Grimpe and Fier (2010) focused on firms, which according to literature, often require applied knowledge.

In line with the fourth hypothesis of the study, Kruskal-Wallis tests were conducted to assess whether respondents from the STEM, Social Sciences and Arts differ in their research orientation. In spite of fulfilling the assumption of normality and large sample size of 25 participants per condition (Pallant, 2011; Schmider et al., 2010), Kruskal-Wallis tests were performed instead of ANOVA due to violation of the assumption of homogeneity of variance. With the exception of basic research which had an insignificant Levene statistic (p = .400), applied research and use-inspired basic research recorded significant Levene statistics of p = .04 and p = .05, respectively. Basic research, that is research aimed at creating understanding, was analysed with a total of 254 responses (Table 40). The analysis showed, the Social Sciences recorded the highest mean rank (133.62) while the Arts had the lowest mean rank (119.94).

Table 40: Basic Research across Academic Discipline

Academic Discipline	N	Mean Rank
STEM	157	126.6
Social Sciences	64	133.62
Arts	33	119.94
Total	254	

Source: Field survey (2015)

However, as presented in Table 41, the three academic disciplines recorded the same median score (6.00), which is an indication that the respondents highly agreed that most of the research they conducted, throughout their career, was basic research. According to the Kruskal-Wallis results, there were no statistically significant differences in basic research orientation across the three academic disciplines [(Group 1, n = 157: STEM, Group 2, n = 64: Social Sciences, Group 3, n = 33: Arts), χ^2 (2, n = 254) = .889, p = .641]. On the basis of the findings, it is agreed that academic researchers from the STEM, Social Sciences and Arts did not differ, significantly, in their research orientation as basic researchers.

Table 41: Median Scores for Basic Research across Academic Discipline

Academic Discipline	N	Median
STEM	157	6.00
Social Sciences	64	6.00
Arts	33	6.00
Total	254	6.00

Source: Field survey (2015)

Applied research was assessed based on 251 responses (Table 42). Applied research was operationalised as research aimed at applying the findings to problem solving or in innovation. Mean ranks, as presented in Table 42, indicate that the STEM had the highest score (132.10) followed by the Arts with a score of 121.76. The Social Sciences recorded the lowest mean rank (113.19).

Table 42: Applied Research by Academic Discipline

Academic Discipline	N	Mean Rank
STEM	156	132.10
Social Sciences	64	113.19
Arts	31	121.76
Total	251	

Source: Field survey (2015)

Nevertheless, the three disciplines recorded the same median score (6.00), as shown in Table 43, meaning that respondents highly agreed that most of the research they conducted, throughout their career, was applied research in nature. Results of the Kruskal-Wallis test confirmed the absence of statistically significant difference in applied research orientation across the three academic disciplines [(Group 1, n = 156: STEM, Group 2, n = 64: Social Sciences, Group 3, n = 31: Arts), χ^2 (2, n = 251) = 3.510, p = .173]. Thus, academic researchers from the STEM, Social Sciences and Arts did not differ, significantly, in their research orientation as basic researchers.

Table 43: Median Scores for Applied Research across Academic Discipline

Academic Discipline	N	Median
STEM	156	6.00
Social Sciences	64	6.00
Arts	31	6.00
Total	251	6.00

Source: Field survey (2015)

The third research orientation was use-inspired basic research which aims at creating knowledge for both understanding and application. Analysis of use-inspired basic research was based on 250 responses (Table 44). Assessment of the mean ranks revealed that the STEM and the Arts recorded the highest (129.19) and lowest (113.58) mean ranks, respectively.

Table 44: Use-inspired Basic Research by Academic Discipline

Academic Discipline	N	Mean Rank
STEM	155	129.19
Social Sciences	64	122.34
Arts	31	113.58
Total	250	

Source: Field survey (2015)

However, the three disciplines recorded the same median scores (5.50), as shown in Table 45. The Kruskal-Wallis test on use-inspired research orientation showed no statistically significant difference across the three academic disciplines [(Group 1, n = 155: STEM, Group 2, n = 64: Social Sciences, Group 3, n = 31: Arts), χ^2 (2, n = 250) = 1.416, p = .493]. These findings show that the STEM, Social Sciences and Arts did not differ, significantly, in their research orientation as use-inspired basic researchers.

Table 45: Median Scores for Use-inspired Basic Research across Academic Discipline

Academic Discipline	N	Median
STEM	155	5.50
Social Sciences	64	5.50
Arts	31	5.50
Total	250	5.50

Source: Field survey (2015)

The preceding findings led to acceptance of each of the sub-null hypothesis (H_{0s}) contained in the fourth hypothesis of the study that there are no statistically significant differences among academic researchers from the STEM, Social Sciences and the Arts, in their research orientation as basic researchers, applied researchers and use-inspired basic researchers. Thus, there were as many Bohr scientists as there were Edison and Pasteurian scientists. The findings contradict those of Chang et al. (2011) and Hughes et al. (2011).

Chang et al. (2011), in a study of how university departments respond to the rise of academic entrepreneurship, found that academics from the STEM were more of use-inspired basic researchers. Hughes et al. (2011) in an exploration of hidden connections established that, except academics from the Creative Arts and Media, academics in the Arts and Humanities were much more likely to describe their research as basic research. Even though the quadrant model of scientific research (Stokes 1997) and empirical studies including those of Baba et al. (2010) and Chang et al. (2011) point to the supremacy of use-inspired basic research as the ideal alternative that meets knowledge requirements of both knowledge producers and knowledge users, the findings of this study show versatility in orientation, of the academics surveyed, for meeting various knowledge needs of the economy.

Summary

One of the objectives of this Chapter was to assess the contribution(s) of research collaboration to innovation, which is the immediate goal of research collaboration as illustrated in the conceptual framework of the study (Figure 4). On the basis of Perkmann and Walsh's (2009) typology of collaborative research types, it was found that academic researchers engaged in all the types of collaborative research, within the past ten years. However, there was relatively more engagement in less innovation-oriented projects, such as problem solving projects and knowledge generation projects, than in more innovation-oriented projects such as idea testing and technology development projects.

Academics perceived their collaboration to be quite beneficial to service and process innovation while they considered the collaboration to be somehow beneficial to product, technological, administrative and opportunity-related innovation. Except for service innovation, there was no statistically significant difference in the extent to which academics perceived their collaborative research findings to be beneficial to the various types of innovation. It was further established that there were as many basic researchers as applied and use-inspired basic researchers with no statistically significant difference across academic discipline.

Although the findings of this Chapter establish the availability of academics with versatile research orientation in support of the knowledge-based economy, there are a number of issues, from previous results Chapters and this Chapter, which raise questions with respect to payoffs of research collaboration and the challenges of research collaboration. The issues include the relatively fewer interactions with the private sector and limited engagement of academic researchers in various types of collaborative research projects. In order to further understand these issues, the next Chapter of the thesis presents and discusses findings on the impact and challenges of research collaboration.

CHAPTER EIGHT

IMPACT AND CHALLENGES OF RESEARCH COLLABORATION

Introduction

As part of examining the dynamics of research collaboration, illustrated in the conceptual framework of the study (Figure 4), this Chapter of the thesis presents findings, and related discussions, on the fifth and sixth objectives of the study. The fifth objective was to examine the professional and welfare-related impact of research collaboration while the sixth objective was to analyse the challenges of research collaboration. The study was designed to address these objectives because the impact and challenges of research collaboration have the tendency to encourage, facilitate or discourage future collaborations, as implied in the theory of planned behaviour (Ajzen, 1991; 2011b) which postulates that perceived environmental possibility, among other factors, influence intention to engage in a given behaviour, at a future date.

The impact of research collaboration was examined in accordance with welfare-related effects of social interactions, categorised into instrumental and expressive returns, by the network theory of social capital (Lin, 1999; 2008). In addition, the impact of research collaboration on the academic duties and career advancement of respondents were assessed on the basis of related empirical works, such as that by Hughes and Kitson (2012). The network theory of social capital (Lin, 1999; 2008) further illustrates the capacity of collective assets and structural and positional factors to either facilitate or constrain access to and use of social capital, and in turn affect the returns to social capital. As a result, challenges of research collaboration were analysed through assessment of the extent to which collective assets and structural and positional factors were considered constraints to research collaboration.

Analysis of the impact and challenges of research collaboration was done with 136 valid survey responses on impact of research collaboration and a maximum of 127 on challenges of research collaboration. The skewness and kurtosis values of the data, presented in various sections of the Chapter, were below ±2 and ±7, respectively, which means that they were within tolerable limits to permit the use of the mean as the measure of central tendency as well as the conduct of parametric analysis (Curran et al., 1996; Kim, 2013). The Cronbach's Alpha coefficient for the challenges of research collaboration scale was 0.870. The impact of research collaboration was examined through descriptive statistics while the challenges of collaboration were analysed through principal component analysis (PCA). The survey results were supported with interview results from 11 key informants.

Welfare and Professional Impact of Research Collaboration

The network theory of social capital (Lin, 1999; 2008) illustrates that the effects of social interactions could either be instrumental returns, such as effect on the reputation of network actors, or expressive returns, for example effect on the physical health of actors (Wasko & Faraj, 2005). As a result, the study sought to analyse the instrumental and expressive returns of research collaboration, which were labelled as welfare-related impact since, by their nature, they relate to the personal welfare of network actors. The study also examined the extent to which the collaboration(s) had a positive or negative impact on respondent's professional duties of teaching and research, and career advancement. Table 46 contains results of descriptive analysis of the extent to which research collaboration had positive or negative impact on the welfare of respondents, scored on a scale of 1 representing slight increase or decrease, to 7 representing very high increase or decrease.

Table 46: Impact of Research Collaboration on Personal Welfare of Respondents

Impact	N	Min.	Max.	Mean	SD	Skewness	Kurtosis
Positive instrumental effect:							
Increase in wealth	106	1	7	3.40	1.700	.010	-1.131
Increase in power	116	1	7	4.23	1.517	-.236	-.598
Increase in reputation	126	1	7	5.05	1.469	-.853	.074
Positive expressive effect:							
Increase in physical health	92	1	7	3.41	1.876	.124	-1.243
Increase in mental health	129	1	7	5.59	1.170	-1.497	3.374
Increase in general life satisfaction	120	1	7	5.47	1.236	-1.035	1.084
Negative instrumental effect:							
Decrease in wealth	65	1	6	2.37	1.547	.815	-.631
Decrease in power	55	1	5	2.25	1.350	.687	-.870
Decrease in reputation	51	1	6	1.98	1.407	1.247	.424
Negative expressive effect:							
Decrease in physical health	62	1	7	2.58	1.615	.864	.025
Decrease in mental health	53	1	7	2.23	1.601	1.309	.983
Decrease in general life satisfaction	54	1	7	2.28	1.687	1.405	1.118

Source: Field survey (2015)

The results, as presented in Table 46, showed increase in mental health, that is the psychological well-being of respondents, as the leading positive welfare-related impact of research collaboration, with a mean score of 5.59 and a standard deviation of 1.70. This was closely followed by increase in general life satisfaction with a mean score of 5.47 and a standard deviation of 1.236. The least welfare-related positive impact was on the wealth of respondents. Further inspection of Table 46 indicated that expressive returns to research collaboration had relatively higher mean scores than instrumental returns to research collaboration.

On the other hand, descriptive analysis of the negative welfare-related impact of research collaboration, scored on a scale of, 1 representing slight decrease, to 7 representing very high decrease, suggests that research collaboration could have adverse effect on the welfare of collaborating parties (Table 46). However, assessment of the descriptive statistics showed that, comparatively, the mean scores on the negative welfare-related impact of research collaboration were lower than the mean scores on the positive welfare-related impact of research collaboration. Nonetheless, the survey and interview results produced issues that are of relevance to the promotion of fruitful research collaboration.

Firstly, decrease in physical health emerged as the leading negative welfare-related impact of research collaboration, with the mean score of 2.58 and a standard deviation of 1.615, suggesting quite slight decrease in the physical health of respondents. The finding was buttressed by a number of interviewees who expressed the stressful nature of research collaboration. For example, one respondent stated that research collaboration usually involves sleepless nights to meet deadlines for preparations and report writing. Two interviewees, however, cautioned that deterioration in one's health could be attributed to aging and life's demands in general and that proper diet, enough rest and physical upkeep were indispensable to maintaining one's physical well-being.

Secondly, the next highest negative impact on personal welfare was decrease in wealth ($M = 2.37$, $SD = 1.547$). Interviewees who had experienced this phenomenon interpreted decrease in wealth in relation to personal finances lost in the course of research collaboration. According to the interviewees, the finances were lost due to unfavourable terms on the disbursement of funds for research collaboration that received funding from international organisations. The interviewees noted that, in most instances, funding entities requested for evidence of payments before funds were released.

Moreover, the interviewees enumerated a number of stressful experiences associated with this practice. The experiences included search for funds to pre-finance research projects, efforts to secure receipts for payments made in a culture where issuing of receipt was often not practiced on the general market, and loss of financial gains due to low conversion rates applied to the reimbursement of funds secured to pre-finance projects. An interviewee's explanation to a request for interpretation of decrease in wealth was that "I buy things and send them invoices and they also want VAT invoices and nothing else...even I had to pre-finance...It's very hurting, it's hurting a lot because sometimes the inflation, Cedi depreciation and appreciation will cause you to lose...."

The preceding findings demonstrate that research collaboration has the potential of having both positive and negative impact on the welfare of collaborating parties, as postulated by the network theory of social capital (Lin, 1999; 2008). Therefore, the impact of research collaboration on the welfare of collaborating parties constitute an essential dynamic of research collaboration, as implied in the conceptual framework of the study (Figure 4). The findings also show the importance of studying welfare-related impact of research collaboration, which appeared absent in the reviewed empirical studies on research collaboration, including those by Moore et al. (2010) and Hughes et al. (2011), which rather focused on academic-related impact of collaboration.

In addition to the examination of the welfare-related impact of research collaboration, the impact of research collaboration on the profession of respondents was analysed through assessment of the extent to which the collaboration had a positive and or negative impact on teaching, research and promotion. The results of the analysis are presented in Table 47.

Table 47: Impact of Research Collaboration on the Profession of Respondents

Impact	N	Min.	Max.	Mean	SD	Skewness	Kurtosis
Positive impact:							
Positive impact on teaching	131	2	7	5.78	1.242	-1.012	.462
Positive impact on research	136	4	7	6.30	.819	-1.103	.742
Positive impact on promotion	131	1	7	5.76	1.265	-1.101	1.246
Negative impact:							
Negative impact on teaching	94	1	7	2.02	1.665	1.79	2.198
Negative impact on research	95	1	7	1.85	1.557	2.064	3.356
Negative impact on promotion	92	1	7	2.07	1.683	1.565	1.232

Source: Field survey (2015)

Assessment of the positive impact of research collaboration on teaching, research and promotion revealed mean scores of 5.78 (*SD* = 1.242), 6.30 (*SD* = .819) and 5.76 (*SD* = 1.265), respectively (Table 47). Thus, on a scale of 1, representing least positive impact, to 7 representing very high positive impact, it can be inferred that on average, the research collaborations by the academics surveyed had high positive impact on their research work on one hand, and quite high positive impact on their teaching and promotion, on the other. A number of interviewees expressed their satisfaction with the positive impact of research collaboration on their professional duties and career advancement. For example some respondents indicated that through research collaboration, they identified other dimensions to their research and were able to develop new demand-driven Masters and PhD programmes.

In relation to impact on teaching, one interviewee exclaimed to a question on impact on teaching that "sure! It exposed me to the practical side of what I teach". These findings agree with Hughes and Kitson's (2012) and Moore et al.'s (2010) findings in related studies, that the academics surveyed benefited most in terms of new insights and new contacts in their field of research. The findings also corroborate the desire of the respondents to advance their research work, as the overriding purpose of research collaboration, which was established in the Chapter six of the thesis.

Further inspection of Table 47 revealed that research collaboration had negative impact on the profession of respondents, although to a lesser extent in comparison to the positive impact. The leading profession-related negative impact of research collaboration was on promotion which recorded a mean score of 2.07 and a standard deviation of 1.683, while the area with the least negative impact was research ($M = 1.85$, $SD = 1.557$; $Md = 1.00$, *Interquartile Range* = 1).

Probing of interviewees on the preceding findings revealed that although research collaboration may yield publications in support of one's promotion, it could also delay it when so much time is spent on collaborations without having the opportunity to publish. Other interviewees indicated that research collaboration could delay one's work when collaborating parties do not keep to deadlines. The interview results imply that the opportunity to publish findings and the ability of collaborating parties to respect deadlines are critical to achieving positive impact of research collaboration in the form of promotion or career advancement. In relation to teaching, the negative impact was interpreted as rescheduling of lectures to suit appointments for activities on research collaboration.

The findings show the relevance of understanding the positive and negative impact of research collaboration which was studied as part of the dynamics of research collaboration, in the conceptual framework of the thesis (Figure 4). The findings also support the postulate by the network theory of social capital that network activity could produce negative returns to social capital (Lin, 1999; 2008) and vice-versa (Levien, 2014). According to Portes (1998) and Portes and Landolt (2000), although social capital can produce negative returns, literature tends to be highly skewed towards positive returns to social capital and network activity. The findings of this study, therefore, affirm the argument that network activity could produce negative returns to social capital, including personal and profession-related impact.

Challenges of Research Collaboration

Challenges of research collaboration were analysed as part of the dynamics of research collaboration, as shown in the conceptual framework of the study (Figure 4). Examination of the challenges of research collaboration involved analysis of factors whose non-existence or limited availability hindered fruitful research collaboration. The investigation was done in accordance with the network theory of social capital by Lin (1999; 2008).

The network theory of social capital illustrates that collective assets and structural and positional factors could facilitate or constrain access to and use of social capital which, in turn affects the returns to social capital (Lin, 1999). Collective assets that were examined included trust, common values and common goal or expectation. Structural and positional factors comprised access to requisite resources and support such as information, funding and administrative support by own institution (Table 48).

Descriptive statistics, presented in Table 48, on the extent to which collective assets and structural and positional factors were a challenge indicated mean scores from 2.76 to 4.80, scored on a scale of 1, representing least challenge, to 7, representing major challenge. The mean scores suggest that collective assets and structural and positional factors were not major challenges to the collaborations by respondents. The fifteen items on the challenges of research collaboration scale were subjected to principal component analysis (PCA) to ascertain the primary challenges of research collaboration.

Table 48: Challenges of Research Collaboration

Challenge	N	M-M	Mean	SD	Skewness	Kurtosis
Trust	117	1-7	2.85	1.760	.634	-.658
Common values	112	1-7	2.84	1.685	.660	-.423
Common goal	110	1-7	2.94	1.793	.622	-.760
Inadequate information	119	1-7	3.67	1.771	-.057	-1.003
Timely information flow	123	1-7	3.76	1.799	-.108	-.986
Availability of time	127	1-7	4.20	1.856	-.422	-.892
Availability of funding	122	1-7	4.80	1.969	-.585	-.911
Availability of infrastructure	113	1-7	4.52	1.871	-.360	-.941
Willingness of user to use findings	110	1-7	3.02	1.724	.376	-.995
Ability of user to use findings	111	1-7	2.89	1.811	.566	-.811
Prompt delivery of support services by own institution	106	1-7	4.24	1.829	-.243	-.967
Prompt delivery of support services by partner institution/individual	110	1-7	3.22	1.731	.358	.827
Own capability to manage relationships	102	1-7	2.76	1.642	.606	-.691
Enforceable intellectual property rights	94	1-7	3.11	1.852	.474	-.921
Delay in publication	121	1-7	3.60	2.096	.225	-1.293

Source: Field survey (2015)
Note: M-M means minimum and maximum scores

However, the correlation matrix of the PCA (Table 58 in Appendix I) revealed high coefficients, of .7 and above, between three pairs of items. The pairs of items were trust and common values, inadequate information and timely information flow, and willingness of intended user to use research findings and capability of intended user to use the findings. Following recommendations by

Pallant (2011), each pair of items were aggregated and averaged resulting in three variables, namely, trust and common values, information flow, and willingness and ability of user to use findings for intended purpose.

Subsequent PCA indicated high correlations between willingness and ability of user to use findings for intended purpose and own capability to manage relationships, as well as between prompt delivery of support services by partner institution and willingness and ability of user to use findings for intended purpose. On the basis of the recommendations by Pallant (2011), own capability to manage relationships and prompt delivery of support services by partner institution, were excluded from the final analysis. Eventually, ten items were subjected to PCA.

Examination of the correlation matrix of the data (Table 59 in Appendix I) showed the presence of several coefficients between .3 and .7 which, according to Pallant (2011), is an indication of the suitability of the data for factor analysis. The results showed that the Kaiser-Meyer-Oklin value of sampling adequacy (.778) exceeded the recommended value of .6. In addition, the Bartlett's Test of Sphericity reached statistical significance in support of the factorability of the correlation matrix. Moreover, the principal component analysis (PCA) contained three components with eigenvalues greater than 1.

Assessment of the scree plot (see Figure 8 in Appendix I) indicated a clear break after the second component. Although the steep falling nature of the plot after the third and fourth components appeared interesting to explore, the structure matrix of the PCA did not support a four factor solution since it contained fewer factors with low loadings. According to Pallant (2011), there should be more than three factor loadings above the .4 mark under each component in the component matrix, to permit the inclusion of the component in PCA. Using Catell's (1966 as cited in Pallant, 2011) scree test, two components were retained for further analysis.

The decision to retain two components was supported by the results of parallel analysis, which showed only two components with eigenvalues exceeding the corresponding criterion values for a randomly generated data matrix of the same size (10 variables x 110 participants on average x 100 replications). The two-component solution explained a total of 60.234 percent of the variance, with component 1 contributing 45.755 percent and component 2 contributing 14.790 percent (Table 49). To aid in the interpretation of the two components, Oblimin rotation was conducted.

The results of the rotation showed correlation coefficients of .409, which is an indication of some association between the two factors, and a justification for the use of the Oblimin rotation (Pallant, 2011). Moreover, the rotated solution revealed the presence of simple structure, with the two components demonstrating a number of strong loadings (.4 and above) and all variables loading substantially on only one component, as presented in Table 49. Scrutiny of the outcome of the PCA was necessary in understanding the factors that constituted the leading challenges of research collaboration captioned, in the conceptual framework of the study (Figure 4), as part of the dynamics of research collaboration.

Table 49: Factor Loadings of the Challenges of Research Collaboration

	Component	
	1	2
Trust and common values	.912	
Enforceable intellectual property rights	.789	
Common goal	.726	
Willingness and ability of user to use findings for intended purpose	.714	
Delay in publication	.591	
Information flow	.552	.422
Availability of time	.536	
Availability of funding		.890
Availability of requisite infrastructure		.824
Prompt delivery of support services by own institution		.736
Eigenvalues	4.575	1.448
Total variance explained (%)	45.755	14.79
Cumulative variance explained	45.755	60.234

Source: Field survey (2015)

Inspection of the factor loadings, presented in Table 49, showed that all items under component 1 consisted of high loadings of .5 and above. In reference to the network theory of social capital (Lin, 1999; 2008), two latent variables can be identified under component 1, namely, collective assets and structural and positional factors. The collective assets were challenge of common goal, and challenge of trust and common values while the remaining factors consisted of structural and positional factors. The structural and positional factors included the availability of enforceable intellectual property rights, willingness and ability of user(s) to use the collaborative research findings for intended purpose, delay in publication, information flow and availability of time for collaboration. Four of the items under component 1 have been a subject of debate.

Firstly, challenge of trust and common values emerged with the highest factor loading of .912, as shown under component 1 in Table 49. The emergence of trust and common values as a key challenge of research collaboration, contradicts Hughes and Kitson's (2012) finding that problems concerning cultural differences between academics and business were not a key constraint. The finding, however, supports the universal claim that there is a clash of values between academia and external parties, as argued by Rinne and Koivula (2005) and Lorenz (2012). The finding also points to the apparent existence of an ivory tower between academia and users of knowledge, as presented in Chapter six, in the analysis of the involvement of academics in research collaboration.

Secondly, the challenge of the availability of enforceable intellectual property rights had the second highest factor loading, under component 1 of Table 49. Interview results confirmed the absence of enforceable intellectual property rights laws. The study institutions, at the time of data collection, were in the process of developing institutional intellectual property rights laws. In the absence of intellectual property rights laws, trust and common values were indispensable to research collaboration (Yang et al., 2014) since, according to Coleman (1988), trustworthiness implies that obligations will be repaid.

Consequently, the emergence of trust and common values and availability of enforceable intellectual property rights as key challenges of research collaboration imply the limited presence of the much needed assurance for network actors to actively participate in collaborative research projects. According to Perkmann and Walsh (2009), collaborative research projects, particularly technology development projects, often require secrecy and, hence, trust.

As a result, in situations where trust and enforceable intellectual property rights are challenges, the resultant effect could be fewer research collaboration and the prevalence of the Swedish paradox whereby entrepreneurial opportunities, produced through investment in knowledge production, remain under-exploited or are exploited outside the economic system (Acs et al., 2013; Braunerhjelm et al., 2010; Ejermo & Kander, 2006). An answer to an interview question on the availability of intellectual property rights in Ghana, signals how absence of enforceable intellectual property rights could lead to the Swedish paradox. The interviewee stated that "We have applied for patent rights…in Europe…Ghana you won't get it".

Thirdly, willingness and ability of users to use collaborative research findings for innovation was a key challenge to research collaboration. Literature indicates the importance of industry and other knowledge users to have the requisite absorptive capacity for the use of research output in innovation (Henrekson & Rosenberg, 2001; Kostopoulos, Papalexandris, Papachroni & Ioannou, 2010). Further questioning of interviewees revealed that the target industrial players, sometimes, lacked the requisite capacity for large-scale commercial uptake of the research output.

Interview results also showed that respondents who sought to collaborate with industry, after the conduct of collaborative research often with support from an international funding agency or the institution of affiliation, faced this challenge the most. An interviewee expressed the frustration that goes with this challenge by stating that "If we have our own place, we could produce…as much as possible." The challenge of limited absorptive capacity of intended users has several implications.

Notable among them are the under-utilisation of academic research results for innovation and the associated widening of the knowledge filter as well as the deepening of the Swedish paradox (Acs et al., 2013; Braunerhjelm et al., 2010; Ejermo & Kander, 2006). These conditions worsen the national innovation deficit and competitiveness, with negative repercussions on economic growth and development (Leydesdorff, 2010; UNCTAD, 2011). They become accentuated in an economy with weak industrial research and innovation, such as that of Ghana (Brundenius & Göransson, 2011; Robson & Obeng, 2008).

Fourthly, lack of time was a key challenge under component 1 with factor loading of .536. An interviewee who collaborated, several times, with institutions commented that:

> "Sometimes the institutions we collaborate with …their expectations are really very … high. They expect that you work at the same pace as they do and often that's very difficult for us to keep up; you are teaching, you are supervising and then you have to do research…and their demands with regards to timeliness can be very difficult."

Lack of time, as a key constraint, is consistent with Moore et al.'s (2010) and Hughes and Kitson's (2012) findings that lack of time was the leading challenge to knowledge exchange interactions in the UK. Nevertheless, a disparity between the findings of this study and that by Moore et al. (2010) and Hughes and Kitson (2012) is that whereas lack of time was the major challenge in the two studies, trust and common values was the leading challenge in this study. The disparity could be attributed to differences in collective assets and structural and positional situations in the countries where the studies were conducted.

Thus, whereas this study was conducted in a developing country setting beset with institutional challenges, that by Moore et al. (2010) and Hughes and Kitson (2012) were conducted in a developed country setting where structural and positional conditions, such as availability of enforceable intellectual property rights, are relatively advanced and serve as a buffer against mistrust and a deterrent to the contradiction of set goals and values of collaboration. The next analysis was examination of factor loadings under component 2 of Table 49.

Assessment of factor loadings under component 2 (Table 49) revealed that all items under this component consisted of structural and positional factors in conformity with the network theory of social capital (Lin, 1999; 2008). Remarkably, challenges of availability of funding, availability of requisite infrastructure and support by own institution explained a significant variation in the latent construct of structural and positional factors. Interview results indicated that all interviewees bemoaned limited funding availability and limited infrastructure at both the institutional and national levels and cited international sources of funding as the main target for academics who wished to collaborate.

An interviewee summarised the challenges by stating that "the challenges...are challenges of the university and challenges of the nation." Another interviewee noted, in an explanation of how difficult it was to commercialise inventions, that: "One of the main problems is getting this commercialised...due to lack of funds...At the moment we don't have a permanent laboratory for the production...sometimes you want to produce something and...somebody is also using the facility...". In reference to the conceptual framework of the study (Figure 4), the challenges and the infrequent engagement of academics in research collaboration, as established in Chapter six of the thesis, would imply that collaborative research output, and academic research in general, would contribute less to innovation.

The preceding findings are consistent with arguments by Schumpeter (1934/1983) and Acs et al. (2009) that, resource availability including credit, budget support and funding for research are indispensable to economic development, particularly, innovation-driven development (Leydesdorff, 2010; Rinne & Koivula, 2005). Moreover Henrekson and Rosenberg (2001), in a comparative study of Sweden and the US, established the development of the venture capital industry, in the US, as a vital means of facilitating access to risk capital for growth-oriented initiatives such as research collaboration for innovation (Mansfield, 1995).

Summary

The objectives of this Chapter consisted of assessing the positive and negative impact of research collaboration on the welfare and profession of academics as well as examining the challenges of research collaboration. On the whole, research collaboration produced higher positive impact and lower negative impact. In relation to the welfare of respondents, the highest positive impact of research collaboration was a quite high increase in the mental health or psychological satisfaction of respondents (M = 5.59) while the leading negative impact was a slight decrease in the physical health of respondents (M =2.58). The highest profession-related positive impact of research collaboration was a high increase in the research activities of respondents while the leading negative impact was decrease in the chances for promotion or career advancement of respondents (M = 2.07)

In conformity with the network theory of social capital (Lin, 1999; 2008), the leading challenges of research collaboration comprised two latent variables under component 1, and one latent variable under component 2 of the pattern matrix of the PCA. The latent variables under component 1 included collective assets and structural and positional factors. The collective assets were the challenge of common goal, and the challenge of trust and common values. The structural and positional factors included the unavailability of enforceable intellectual property rights, limited willingness and ability of user(s) to use the collaborative research findings for intended purpose, delay in publication, limited information flow and unavailability of time for collaboration. Component 2 consisted, mainly, of structural and positional factors including limited funding, limited infrastructure and limited support by own institution.

CHAPTER NINE

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

Introduction

This Chapter of the thesis consists of presentation of key findings, conclusions and some recommendations, made on the basis of the conclusions drawn, as well as contributions of the study to knowledge. On the basis of the limitations and some critical findings of the study, a number of suggestions are made for future inquiry on research collaboration for attainment of a knowledge-based economy.

Summary

The primary objective of the thesis was to analyse research collaboration for attainment of a knowledge-based economy in Ghana by examining, for example, the intention of academic researchers to collaborate and the involvement of academics in research collaboration. The study was prompted by the apparent limited innovation within the Ghanaian economy coupled with weak industrial research and development activities, and the fact that these two lapses in the economy could be addressed, to a larger extent, through the promotion of fruitful research collaboration between academic researchers and knowledge users, particularly industry.

Through a sequential mixed methods approach and a descriptive-causal research design, a proportionate stratified sample of 511 academic researchers was surveyed while 11 purposively selected academics were interviewed. The study institutions were the University of Cape Coast (UCC) and the Kwame

Nkrumah University of Science and Technology (KNUST). Data collection spanned a period of seven months and commenced with questionnaire administration from November, 2014 to March, 2015 and ended with interviews which took place in May and June, 2015.

Maximum data point of 266 survey responses were analysed using the IBM Statistical Product and Service Solutions (SPSS) while interview results were transcribed for identification of relevant themes for interpretation. Analysis of the quantitative data involved generation of frequencies and descriptive statistics such as the mean, median, skewness and kurtosis as well as inferential statistics including ANOVA, Kruskal-Wallis test, principal component analysis (PCA) and regression analysis. All quantitative variables were measured on scales of 1, representing the least score, to 7, representing the highest score.

The following were the key findings of the study.

The first objective of the study was to establish the determinants of the intentions of academic researchers to collaborate.

1. First and foremost, it was established that intention of academic researchers to engage in research collaboration was quite high with the mean score of 5.74.
2. Analysis of intention to collaborate, across academic discipline, showed that the Sciences, Technology, Engineering and Mathematics (STEM) had the highest intention to collaborate ($M = 5.78$), followed by the Social Sciences ($M = 5.78$). The Arts recorded the lowest intention to collaborate ($M = 5.36$).

3. However, no statistically significant difference was found in the intentions, to collaborate, of academic researchers from the Sciences, Technology, Engineering and Mathematics (STEM), Social Sciences, and Arts.
4. Out of nineteen items that constituted the determinants of intention to collaborate scale, eleven were fundamental to respondents' intention to collaborate in the future.
    a. The eleven items included three items under attitude towards research collaboration, for example, academics' conviction and the relevance attached to the conviction that research collaboration will advance their research work.
    b. Two of the eleven items constituted perceived behavioural control over research collaboration, for example, the importance and ability of academic researchers to conduct various types of research.
    c. Three items emerged under subjective norm, for instance, the expectations of the university and readiness of respondents to comply with the expectation.
    d. The remaining three items related to environmental possibility for research collaboration and comprised availability and importance of rewards, funding and administrative support for research collaboration.
5. Attitude towards research collaboration, perceived behavioural control over research collaboration, subjective norm on research collaboration and environmental possibility for research collaboration were quite high (M = 5.02 to 5.82). Comparatively, attitude towards research collaboration had the highest mean score of 5.82 (SD =.954) while

3. However, no statistically significant difference was found in the intentions, to collaborate, of academic researchers from the Sciences, Technology, Engineering and Mathematics (STEM), Social Sciences, and Arts.
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   d. The remaining three items related to environmental possibility for research collaboration and comprised availability and importance of rewards, funding and administrative support for research collaboration.
5. Attitude towards research collaboration, perceived behavioural control over research collaboration, subjective norm on research collaboration and environmental possibility for research collaboration were quite high (M = 5.02 to 5.82). Comparatively, attitude towards research collaboration had the highest mean score of 5.82 (SD =.954) while

perceived environmental possibility for research collaboration recorded the lowest mean score of 5.02 (SD =.936).

6. Attitude towards research collaboration, perceived behavioural control over research collaboration and perceived environmental possibility for research collaboration significantly influenced intention to collaborate. Subjective norm did not significantly influence intention to collaborate. Attitude towards research collaboration made the highest contribution by explaining 38 percent ($beta$ = .380, p = .000) of the variance in intention to collaborate.
7. There were no statistically significant differences in attitude towards research collaboration, perceived behavioural control over research collaboration and perceived environmental possibility for research collaboration, among academic researchers from the Sciences, Technology, Engineering and Mathematics (STEM), Social Sciences, and Arts.

Involvement in research collaboration was examined as the second objective of the study. The major findings were multifaceted.

1. A greater percentage of 52.8 of the respondents had engaged in research collaboration. The academics consented that, throughout their professional career, they did research with or for another individual or entity and that the research findings were used for purposes other than acquiring an academic degree or promotion.

2. There was an almost equal percentage of 49.4 percent initiation of research collaboration by academic researchers and 50.6 percent initiation by collaborating partners.
3. Fifty two percent of the collaborations were with the third sector while the least collaboration was with the private sector (22.6 percent).
4. The leading purpose of research collaboration was the quest to obtain additional resources to advance one's research work followed by the desire to help others.
5. Assessment of the number of engagement in various types of research collaboration, within the past ten years, showed contract research recording the highest mean number of engagement ($M = 2.92$; $SD = 2.08$; $Md = 2.00$, *Interquartile Range* = 3) and technology transfer recording the lowest number of engagement ($M = 1.10$, $SD = .316$; $Md = 1.00$, *Interquartile Range* = 0).
6. The number of research collaboration, within the past ten years, stood at a median score of 5 with an interquartile range of 7.
7. There was no statistically significant difference, at $\alpha = .05$, in the number of research collaboration across the three academic disciplines of STEM, Social Sciences and Arts.
8. A two-component solution of the essentials of research collaboration revealed that the first component, consisting of the structure and position of network actors, explained 41.999 percent of the total variance while the second component, made up of collective assets followed by some structural and positional factors, explained 12.380 percent of the total variance of 54.379 percent.

9. The leading essentials of research collaboration, in order of importance under Component 1, were availability of enforceable intellectual property rights (IPR), infrastructure, funding, support by own institution and support by partner institution.
10. Other essentials of research collaboration, from Component 2, included the need for the collaborating parties to have a common goal, common values, trust in each other, access to requisite information, timely information flow and opportunity to publish research findings of the collaboration.

Use of collaborative research findings in innovation was explored as the third objective of the study and it was established that:

1. Research collaboration was beneficial to problem solving and innovation, although the highest contribution was made to problem solving, followed by service innovation, while the least contribution was to technological innovation.
2. There was no statistically significant difference in the extent to which collaborative research output from the STEM, Social Sciences and the Arts were beneficial to product innovation, process innovation, opportunity-related innovation, administrative innovation and technological innovation.
3. However, a statistically significant difference ($p = .012$) was found between the STEM ($Md = 6$, n = 55) and the Social Sciences ($Md = 5$, n = 29), at $\alpha = .017$, in the extent to which their collaborative research output were beneficial to service innovation. The effect size was medium ($r = .273$). No statistically significant difference existed between the STEM and the Arts, and the Arts and the Social Sciences.

The fourth objective of the study examined the research orientation of academic researchers. The following were the key findings:

1. There were as many academic researchers with basic research orientation as there were applied and use-inspired basic researchers.
2. User knowledge requirements for basic research, applied research and use-inspired basic research, were quite high.
3. There were no statistically significant differences among academic researchers from the STEM, Social Sciences and the Arts in their research orientation as basic researchers, applied researchers and use-inspired basic researchers.

The fifth objective focused on the positive and negative welfare and academic-related impact of research collaboration. Key findings that emerged were as follows:

1. The leading positive welfare-related impact of research collaboration was quite high increase in the psychological satisfaction of respondents with a mean score of 5.59, while the least positive welfare-related impact was quite low increase in the wealth of respondents with a mean score of 3.40.
2. It was also established that research collaboration could have negative impact on the welfare of respondents, although to a relatively lesser extent. Decrease in physical health emerged as the leading negative impact of research collaboration, with a mean score of 2.58 followed by decrease in reputation, with a mean score of 1.98.

3. On the other hand, the leading academic-related positive impact of research collaboration was a high increase in the research activities of respondents (M = 6.30) while the most negative academic-related impact was slight decrease in opportunities for career advancement or promotion of respondents (M = 2.07).

The sixth objective was to analyse the challenges of research collaboration, and it was established that:

1. The main challenges of research collaboration, that emerged under the first component of a two-factor solution, were collective assets and structural and positional factors, which accounted for 45.755 percent of 60.234 percent of the total variance explained. The collective assets comprised the challenge of trust and common values, and difficulty in having common goals.
2. The structural and positional factors, under component 1, were absence of enforceable intellectual property rights, unwillingness and limited ability of user(s) to use the collaborative research findings for intended purpose, delay in publication, limited information flow and inadequate time for collaboration.
3. Other challenges of research collaboration, which emerged under component 2 of the two-factor solution , entirely consisted of structural and positional factors, namely, limited funding, inadequate infrastructure and limited support by own institution, explaining 14.790 percent of the total variance of 60.234 percent.

Conclusions

The intention of academic researchers to engage in research collaboration was quite high, irrespective of the academic discipline to which respondents belonged. That is, academic researchers from the STEM, Social Sciences and the Arts agreed, to a larger extent, that they will or plan to engage in research collaboration within the next four years.

The determinants of research collaboration were attitude towards research collaboration, perceived behavioural control over research collaboration and perceived environmental possibility for research collaboration, regardless of academic discipline. Comparatively, attitude towards research collaboration was the leading determinant of intention to collaborate. It explained more than twice, the variance that was explained by perceived behavioural control over research collaboration as well as that which was explained by perceived environmental possibility for research collaboration. Subjective norm was not a major predictor of intention to collaborate.

Involvement of academics in research collaboration was generally low, across academic discipline. Nearly half of academic researchers had not engaged in research collaboration throughout their professional career. Moreover relatively fewer collaborations were with the private sector, which constitutes the larger industrial and innovation hub of Ghana. The low involvement of academics in research collaboration culminates into limited research collaboration and, in the face of continuous academic research, serves as a signal to the existence of a wider knowledge filter and, possibly, a looming Swedish paradox.

The essentials of research collaboration were multifaceted and included, in order of importance, the need for enforceable intellectual property rights (IPR), infrastructure, funding, support by own institution and support by partner institution. Other essentials of research collaboration were the need for the collaborating parties to have common goal, common values, trust in each other, access to requisite information, timely information flow and opportunity to publish research findings of the collaboration.

Collaborative research findings from all academic disciplines were used in various types of innovation except for service innovation which involved a relatively higher use of research findings from the STEM than the Social Sciences. There were also few collaborative research projects that involved the use of research output in innovation as compared to problem solving.

Academic researchers were oriented towards use-inspired basic research. Other research orientations were basic research and applied research. The versatility in research orientation of academics, is necessary for meeting the diverse knowledge requirements of the Ghanaian economy, for instance, in the exploration and development of lead industries.

Research collaboration had positive and negative impact on the profession and welfare of academics. In order of magnitude, research collaboration had positive impact on research, teaching and career advancement of academics. The leading positive welfare-related impact included increase in psychological satisfaction, increase in general life satisfaction and increase in the reputation of academics. Although research collaboration had negative impact on the profession and welfare of academics, the impact was relatively minimal, led by decrease in the physical health of academics.

A number of factors constituted challenges of research collaboration. The leading challenge of research collaboration was the inability of the collaborating parties to have trust in each other and to share common values. Other challenges, in order of importance, were limited funding, inadequate infrastructure, absence of enforceable intellectual property rights, inadequate support by own institution and difficulty of collaborating parties to have common goals. Unwillingness and limited ability of some knowledge users to use the collaborative research findings for intended purpose, delay in publication, limited information flow and limited time for collaboration, were also established as challenges of research collaboration.

Overall, this study shows that research collaboration, by the academics surveyed, was limited in a number of ways. For example, the involvement of academics in research collaboration was low while academics who engaged in research collaboration encountered several challenges. Nevertheless, research collaboration contributed to the knowledge-based economy through the use of collaborative research findings in innovation and problem solving, while collaborating academics made personal gains in their profession and welfare. In the face of quite high intention to collaborate, versatile research orientation, and the usefulness of collaborative research findings in innovation, research collaboration can produce competitive innovations for the advancement of the knowledge-based economy in Ghana, if the challenges of collaboration are addressed.

Recommendations

This study shows that research collaboration is important for innovation. However, the study provides evidence that research collaboration is limited in the Ghanaian economy, and that there are a number of challenges of research collaboration. It is, therefore, imperative that the challenges are, appropriately, addressed for effective and efficient outcomes that will drive national innovation and competitiveness. On the basis of the key findings and conclusions of the study, the following recommendations are made:

1. In order to address the challenges of limited funding, infrastructure and administrative support, academics are advised to advocate for a national research and innovation council that will promote research collaboration for attainment of a knowledge-based economy in Ghana. The academics can impress upon the offices responsible for research and innovation in their universities to liaise with the management of the universities, the government, the National Council for Tertiary Education (NCTE), the CSIR and the Association of Ghana Industries (AGI) to initiate discussions on the need for a national research and innovation council.

   The discussions are necessary to garner rich and diverse experiences from participants, particularly, on the composition and mandate of the council. The discussions could take several forms including meetings, public lectures and symposia.

2. The challenges of limited funding and infrastructure can also be addressed through the establishment of a national research and innovation fund, besides the STREFund, to be managed possibly by the national research and innovation council that is being proposed in this study. Acknowledging the

Recommendations

This study shows that research collaboration is important for innovation. However, the study provides evidence that research collaboration is limited in the Ghanaian economy, and that there are a number of challenges of research collaboration. It is, therefore, imperative that the challenges are, appropriately, addressed for effective and efficient outcomes that will drive national innovation and competitiveness. On the basis of the key findings and conclusions of the study, the following recommendations are made:

1. In order to address the challenges of limited funding, infrastructure and administrative support, academics are advised to advocate for a national research and innovation council that will promote research collaboration for attainment of a knowledge-based economy in Ghana. The academics can impress upon the offices responsible for research and innovation in their universities to liaise with the management of the universities, the government, the National Council for Tertiary Education (NCTE), the CSIR and the Association of Ghana Industries (AGI) to initiate discussions on the need for a national research and innovation council.

   The discussions are necessary to garner rich and diverse experiences from participants, particularly, on the composition and mandate of the council. The discussions could take several forms including meetings, public lectures and symposia.

2. The challenges of limited funding and infrastructure can also be addressed through the establishment of a national research and innovation fund, besides the STREFund, to be managed possibly by the national research and innovation council that is being proposed in this study. Acknowledging the

importance of the book and research allowance to the conduct of teaching and research by academics, it is recommended that besides the allowance, the fund should be established to cater for the conduct of innovation-driven research that will advance the knowledge-base of the Ghanaian economy towards the desired growth and development.

The establishment of the fund could be done in two main ways. Firstly, in conjunction with the research and innovation directorates of their institutions, academics should identify sectors in the Ghanaian economy that will benefit from collaborative research findings and lobby government for a percentage of annual royalties, from the sectors, to be paid into the fund. Secondly, academics can encourage corporate entities to contribute to the establishment of the fund as part of their corporate social responsibilities.

3. Moreover, through dialogue, academics should ensure that the above intervention policies aim at enhancing the attitude of academics towards research collaboration, which was established in the study as the leading factor that influences academics to collaborate, followed by perceived behavioural control and perceived environmental possibility for research collaboration. Thus, the interventions should focus on making research collaboration relevant, firstly, to the profession of academics in advancing their research, teaching and promotion. This could be achieved by imploring the relevant stakeholders to ensure that promotion policies duly recognise collaborating academics, by making their engagement in research collaboration count, prominently, towards their career advancement.

   The proposed intervention will serve as a means of making up for the extra time and effort expended on research collaboration. The recognition importance of the book and research allowance to the conduct of teaching and research by academics, it is recommended that besides the allowance, the fund should be established to cater for the conduct of innovation-driven research that will advance the knowledge-base of the Ghanaian economy towards the desired growth and development.

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   The proposed intervention will serve as a means of making up for the extra time and effort expended on research collaboration. The recognition could also take the form of national awards on research collaboration which could be administered by the national research and innovation council, which is being proposed in this study, or by the Ghana Academy of Arts and Sciences. The various forms of recognition are expected to urge on collaborating academics to greater heights and serve as a source of motivation for non-collaborating academics to do same.

Secondly, academics are advised to avail themselves more to the services offered by the directorates responsible for research and innovation in their institutions to ensure that they constantly enhance their efficacy at research collaboration. Academics may also liaise with the directorates to design more demand-driven services that will enable the academics to step up their engagement in research collaboration that will advance the knowledge-base of the Ghanaian economy towards the desired growth and development.

4. Academics are entreated to promote, through the national dialogue, a national research agenda involving knowledge users, particularly the private sector, on their willingness and readiness to engage in research collaboration that advances the knowledge-based economy of Ghana. The dialogue and the research agenda are important means of learning about the willingness and ability of knowledge users to use collaborative research findings for intended purpose, which was established, in this study, as a challenge to research collaboration. The outcome of the dialogue and research is expected to provide guidance to the enactment of appropriate measures aimed at addressing the challenge.

5. Academics should entreat the offices responsible for research and innovation in their universities, to step up commitment to outreach as a third university mission, especially research collaboration with the private sector or industry, which is critical to bridging the knowledge filter. This could be achieved through several means such as committing more internally-generated funds to research and outreach, refurbishment of laboratories and demonstration facilities in support of research collaboration, and prompt delivery of diverse administrative support to academic researchers in the pursuit of research collaboration.
6. In order to address the inability of the collaborating parties to have complete trust in each other and to share common values, academics are advised to impress upon the research and innovation directorates of their universities to intensify interactions between academia and knowledge users for the appreciation and assimilation of the goals, norms and values of science and the business world. Academics should request that the directorates frequently organise, and motivate the relevant stakeholders to actively participate in, university open days, industry fairs and university-industry conferences.
7. Academics are encouraged to implore relevant stakeholders in their universities to speed up consultations on the finalisation and or approval of policies on intellectual property rights, since enforceable intellectual property rights were critical to research collaboration, but were unavailable.
8. Last but not the least, before the start of every collaboration, academics are entreated to liaise with their collaborating partners to develop guidelines for working towards common goal and agenda. The guidelines should also

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specify agreements on deadlines, publication of research findings, accessibility to requisite information and persons responsible for the timely release of information. Appropriate sanctions for the various guidelines should be clearly spelt out, and if necessary with legal backing, to ensure that collaborating parties do not unduly flout the guidelines. These recommendations are also expected to address the challenge of trust among collaborating parties.

Contributions to Knowledge

The thesis makes contribution towards the closure of a number of gaps that were identified in literature. The gaps included a strong skewness of research in the field towards advanced country experiences and limited studies with rigorous theoretical foundation. Other lapses were methodological in nature and included the near absence of test of significant differences in the perceptions of academics on their research orientation and failure to assess the negative impact of research collaboration on the welfare and profession of academic researchers. Insights into these methodological issues are important in informing policy on, for instance, academic groups that need sensitisation towards effective research collaboration.

Consequently this study adds a developing country perspective to the existing literature on university interaction with external entities. In addition, the study demonstrates the feasibility of examining university interactions with external entities, within a theoretical framework in order to give much focus and rigour to the research process. For example, the theory of planned behaviour (Ajzen, 1991; 2011b) has proven to be a useful theory in studying intention to collaborate and associated determinants, while the network theory of social capital (Lin, 1999; 2008) was instrumental in the study of the dynamics of research collaboration.

Furthermore, the thesis makes three key contributions to literature. Firstly, the conceptual framework of the study could serve as a guide to future studies on research collaboration for attainment of a knowledge-based economy. Secondly, the study proves that environmental possibility as a construct variable, made up of availability and relevance of administrative support, funding and rewards, could significantly influence intention to perform a particular behaviour.

The reviewed related literature showed that, in the extended version of the theory of planned behaviour, factors such as availability of resources and infrastructure could only significantly influence intention to engage in a particular behaviour when the factors were individually regressed on intention, contrary to the principle of constructing a composite variable out of the factors for the regression analysis, as stipulated by the theory. However, in line with the principles of the theory of planned behaviour (Ajzen, 1991; 2011a; 2011b), this study has demonstrated the feasibility of a construct variable, of environmental possibility, as a predictor of intention.

Thirdly, the study demonstrates the applicability of the model of collaborative research types, by Perkmann and Walsh (2009), to a developing country setting, suggesting the universal application of the model to studying types of collaborative research. The study also illustrates the relevance of conducting inferential analysis, in addition to descriptive analysis, of the research orientation of academics. Specifically, such analysis provides insights into the preparedness of academics in meeting user knowledge requirements, which often appear to be applied or partly applied in nature.

Last but not the least, the study shows that research collaboration could have negative impact on the welfare and profession of academic researchers, a finding that suggests the necessity for future studies to assess, in addition to positive impact, the negative impact of interactions between academics and external parties.

Limitations

The limitations of the study relate to scope and methodology. A number of the reviewed related studies involved large-scale national surveys which spanned several universities. Comparatively, the scope of this study is narrow due to the use of two universities as the study institutions. In addition, the study focused on only one group of key actors in the knowledge-based economy and, as a result, misses out on the perspectives of other key actors, such as knowledge users. Therefore, the findings of this study should be interpreted within its scope until studies of a broader nature confirm them.

Furthermore, the categorisation of sectors with which academic researchers collaborated was broader for the sector of primary interest, that is, industry. Although, in Ghana, industry is largely in the domain of the private sector, operationalising it as part of the private sector may not give an exact reflection of collaborations with industry, considering the fact that the public sector of Ghana still has a number of industries, although few in number.

Suggestions for Further Research

The following suggestions may be useful for future studies on research collaboration for attainment of a knowledge-based economy:

1. Future studies may have a wider scope. For instance, a national survey of academic researchers will be essential to the building of a comprehensive body of knowledge that generally reflects the views and practices of academic researchers in Ghana. In addition, user-side research is highly crucial in learning about the perspectives of knowledge users, particularly industry.
2. Research may be conducted to inform stakeholders on the feasibility of setting up a national research and innovation council of Ghana. The feasibility study is critical to informing the establishment processes, composition and the mandate of the council.
3. It may also be necessary for future studies to specifically assess collaborations with industry and avoid placing it under broader sectors to ensure that actual engagement with industry is appropriately captured.
4. Assessment of the existence of an ivory tower between academia and industry may be a promising and relevant research agenda to confirm or disprove the findings of the study which point to a possible existence of the ivory tower.
5. The conceptual framework of the thesis illustrates a relationship between intention to collaborate and actual engagement in research collaboration. However, the relationship was not tested due to the cross-sectional data used for this study. It is, therefore, suggested that future research takes a look at

the relationship. The conceptual framework also showed possible feedback loops which were not tested; this may be a promising area of research.

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APPENDICES

APPENDIX A

Table 50: Categorisation of Departments/Centres/Institutes into Academic Disciplines

Academic Discipline	UCC	KNUST
Science, Technology, Engineering & Mathematics (STEM)	Molecular Biology & Biotechnology Environmental sciences Biochemistry Entomology & Wildlife Biomedical & Forensics Fisheries & Aquatic Sciences Nursing Chemistry Physics Mathematics &Statistics Optometry Computer Science & Information Technology Laboratory Technology Agriculture Economics & Extension Animal Science Crop Science Soil Science Engineering Aquatic Science Medical Sciences Anatomy Microbiology Medical Biochemistry Community Medicine Medical & Mental Health Behavioural Sciences Physiology Medical Education & Information Technology Surgery Obstetrics & Gynaecology Internal Medicine Pediatrics Pharmacology Chemical Pathology Pharmacology Chemical Pathology	Theoretical & Applied Biology Biochemistry Physics Biochemistry & Biotechnology Surgery Veterinary Pathobiology Molecular Medicine Pathology Physiology Radiology Herbal Medicine Anesthesia & Intensive Care Adult Oral Health Sonography Dental Microbiology Eye, Ear, Nose & Throat Child Health Clinical & Social Pharmacy Veterinary Medicine Anatomy Pharmaceutics Community Health Nursing Medicine Behavioural Sciences Clinical Microbiology Medical Laboratory Technology Pharmacology Pharmaceutical Chemistry Community Dentistry Obstetrics & Gynaecology Sports & Exercise Science Optometry & Visual Science Agroforestry BIRD Diary Beef & Cattle Crop Science & Soil Sciences Wildlife & Range Management Fisheries & Watershed Management Animal Science

Table 50 cntd.: Categorisation of Departments/Centres/Institutes into Academic Disciplines

Academic Discipline	UCC	KNUST
Science, Technology, Engineering & Mathematics (STEM)		Agriculture Economics FFRT Horticulture Sivilculture & Forest Management Agroforestry Wood Science & Technology FRNR Wood Processing & Marketing Agribusiness & Extension Food Science & Technology Environmental Science Computer Science Geological Chemical Engineering Petroleum Engineering Aerospace Engineering Agricultural Engineering Computer Engineering Civil Engineering Mechanical Engineering Materials Engineering Geomatric Engineering Electrical Engineering Technology Consultancy Building Technology, Architecture Mathematics
Social Sciences	Economics Development studies Geography & Regional Planning Sociology & Anthropology Population & Health Hospitality & Tourism Management Education Foundation Science & Mathematics Education Vocational & Technical Education Education Basic Education Counselling Arts & Social Science Education	Information Systems & Decision Sciences Marketing & Corporate Strategy Managerial Sciences Service Management Accounting & Finance Planning Centre for Settlement Studies Land Economy Geography & Rural Development Public Law Commercial Law Private Law Land Studies Sociology & Social Work Economics Distance Learning

Table 50 cntd.: Categorisation of Departments/Centres/Institutes into Academic Disciplines

Academic Discipline	UCC	KNUST
Social Sciences	Health, Physical Education & Recreation Educational Planning & Administration Management studies Accounting & Finance Continuing Education Law	
Arts	Classics & Philosophy English Ghanaian Languages & Linguistics French Music & Dance Religious & Human Values Theatre Studies Communication Studies African Studies	History & Political Studies Industrial Art Communication Design Modern Languages Religious Studies Integrated Rural Art & Industry Painting & Sculpture Publishing Studies Cultural Studies English General & African Studies General Art Studies

Source: Author's construct (2014)

APPENDIX B

SAMPLE LETTER OF REQUEST FOR KEY INFORMANTS

Department of Management Studies
School of Business
University of Cape Coast
Cape Coast

19th April, 2015

The Co-ordinator
Office of Grants & Research (OGR)
Office of the Vice Chancellor
Kwame Nkrumah University of Science & Technology
Kumasi

Dear Sir/Madam,

REQUEST FOR KEY INFORMANTS ON COLLABORATIVE RESEARCH

I am a third-year Ph.D. student at the Institute for Development Studies, University of Cape Coast, Cape Coast. As part of my research work titled "Research collaboration for attainment of a knowledge-driven economy of Ghana", I will be conducting interviews of heads of research and technology transfer Units of your august University as well as academic senior members who actively engage in collaborative research and whose research findings have become useful to society.

I will, therefore, be grateful if your outfit could assist me in the identification academic senior members who will serve as key informants in the following academic disciplines:

a) Four (4) persons from the Sciences, Engineering, Technology and Mathematics-related disciplines.
b) Three persons from the Social Sciences and related disciplines.
c) Three persons from Arts-related disciplines.

I plan to visit KNUST from the 27th of April, 2015, to follow up on the request and possibly begin the interviews. Before then, I shall contact the OGR via phone to confirm the visit. Please find attached official documents in support of my study.

I look forward to your kind consideration of my request.
Thank you.

Yours faithfully,

Mavis Serwah Benneh Mensah (Ms.)
(0245093600; mmensah@ucc.edu.gh/mbenneh@yahoo.com)

APPENDIX C

SURVEY QUESTIONNAIRE

The questionnaire contains items that solicit for information on research-related activities of academic senior members. The survey is part of a study on the theme **"research collaboration for attainment of a knowledge-driven economy of Ghana"**. The answers you provide shall be treated with utmost confidentiality and anonymity is as well assured. Thank you for taking part in the survey.

SECTION A: BACKGROUND INFORMATION

Please answer all the questions in this section by ticking (√) or stating the appropriate response.

1. Please indicate your gender.
   ☐ Male ☐ Female

2. Which of the following ranks do you belong?
   ☐ Assistant lecturer/Assistant research fellow
   ☐ Lecturer/research fellow
   ☐ Senior Lecturer/senior research fellow
   ☐ Associate Professor
   ☐ Professor
   ☐ Other (please specify):
   ____

3. Please state your academic discipline:
   ____

4. How many years have you worked as a senior member at the university level?
   ____

SECTION B: RESEARCH ORIENTATION (Please answer all questions in this section)

5. Please **indicate the extent to which you agree** with the following statements, "a" and "b". **Circle the number beneath the dashes** that best reflects the extent of your agreement. The **preamble** to statements "a" and "b" is in bold.

   Most of the research I conduct is *mainly*

   (a) in pursuit of *understanding* a phenomenon e.g. in my discipline, industry or society in general.

   Weak agreement: ___ : ___ : ___ : ___ : ___ : ___ : ___ : strong agreement
   1 2 3 4 5 6 7

(b) intended for *applying* the research findings e.g. in any of the following ways: developing or producing or offering or improving upon a process or procedure, policy, law, alternative source of livelihood, service, a good , machine, organisational form.

Weak agreement:____:____:____:____:____:____:____:____: strong agreement
1 2 3 4 5 6 7

6. Please tick (√) **any or as many** of the following that **best describe most of the research** that you conduct.
   - ☐ Research on issues that are known elsewhere but new to Ghana
   - ☐ Research on issues that are completely new to the world
   - ☐ Research about issues known in Ghana but need attention
   - Other (please specify): ______________________________

7(a). For the years that you have worked as an academic, have you ever **done research with OR for** an individual, a group, a community or an institution?

☐ Yes ☐ No

7(b). Did you or the partner with whom or for whom you did the research *use the research findings* for a purpose(s) **APART FROM** the sole purpose of acquiring an academic degree or promotion?

☐ Yes ☐ No

- ➢ **If** you answered **YES to question** 7, please complete **Sections C, D and E**.
- ➢ **If** you answered **NO to question** 7, please complete **Section C only**.

SECTION C: FUTURE RESEARCH COLLABORATION

This section of the questionnaire assesses your "beliefs" about **future** research collaboration. *Research collaboration* is defined as doing research with or for another person, group, community or institution that provides input, such as problem definition, research expertise and/or resources, to the research process and/or that party or you may use the research findings for a particular purpose besides the acquisition of a degree or promotion.

Instruction: Please **respond to all items in this Section** by **circling the number** beneath the dashes that best describes your opinion.

8. I *intend to* do research, *in the next four years*, with inputs from others interested in the research findings.

   Least likely:____:____:____:____:____:____:____:____: very likely
   1 2 3 4 5 6 7

9. I *will try to* do research, *in the next four years*, with inputs from others interested in the research findings.

   Least likely:____:____:____:____:____:____:____:____: very likely
   1 2 3 4 5 6 7

10. I *plan to* do research, *in the next four years*, with inputs from others interested in the research findings.

Weak agreement :____:____:____:____:____:____:____:____: strong agreement
1 2 3 4 5 6 7

- ➢ **Please note that the rest of the items** in this Section consist of **two opinions each.**

11. The **preamble** to items 11(a) to 11(e) is:
Doing research, *in the next four years,* **with inputs from others interested in the research findings, will enable me**

11(a) advance my academic research work.
Least likely:____: ____:____:____:____:____:____: very likely
1 2 3 4 5 6 7

→Advancing my research work is
least desirable ____: ____:____:____:____:____:____: very desirable
1 2 3 4 5 6 7

11(b) improve my teaching.
Least likely:____: ____:____:____:____:____:____: very likely
1 2 3 4 5 6 7

→Improving my teaching is

least important____: ____:____:____:____:____:____: very important
1 2 3 4 5 6 7

11(c) fast track my promotion to the next rank or obtain a higher status.
Least likely:____: ____:____:____:____:____:____: very likely
1 2 3 4 5 6 7

→Fast tracking my promotion or obtaining a higher status is

least desirable____: ____:____:____:____:____:____: very desirable
1 2 3 4 5 6 7

11(d) earn extra income/gain wealth.
Least likely:____: ____:____:____:____:____:____: very likely
1 2 3 4 5 6 7

→Earning extra income/gaining wealth is
least desirable:____: ____:____:____:____:____:____: very desirable
1 2 3 4 5 6 7

11(e) improve my reputation in society.
Least likely:____: ____:____:____:____:____:____: very likely
1 2 3 4 5 6 7

→Improving my reputation in society is

least important____: ____:____:____:____:____:____: very important
1 2 3 4 5 6 7

12. I am sure that I can
least relate:____: ____:____:____:____:____:____: very much relate
1 2 3 4 5 6 7

with interested others who decide to provide input to my research *in the next four years*.

→ My ability to relate with interested others would make it
less easy:____: ____:____:____:____:____:____: very easy
1 2 3 4 5 6 7

to do research with the interested others who are likely to provide input to my research work, *in the next four years*.

13. I am very sure that I will be

less able:____: ____:____:____:____:____:____: more able
1 2 3 4 5 6 7

to do whatever research type, whether for understanding, application or both, that I am required to do *in the next four years.*

→ My ability to do whatever research type would make it

less easy:____: ____:____:____:____:____:____: very easy
1 2 3 4 5 6 7

to do research, *in the next four years*, with others who will provide inputs to the research and are interested in my research findings.

14. My institution expects

less:____: ____:____:____:____:____:____: very much
1 2 3 4 5 6 7

that I do research, *in the next four years*, with inputs from others interested in the research findings.

→ Generally speaking, how much do you want to do what your institution expects you to do?

Least concerned:____: ____:____:____:____:____:____: very much concerned
1 2 3 4 5 6 7

15. My close fellow academics will

least approve:____: ____:____:____:____:____:____: very much approve
1 2 3 4 5 6 7

that I do research, *in the next four years*, with inputs from others interested in the research findings.

→ Generally speaking, how much do you want to do what your fellow academics will approve that you do?

Least concerned:____: ____:____:____:____:____:____: very much concerned
1 2 3 4 5 6 7

16. My Head of Department or Dean or Provost is

least likely:____: ____:____:____:____:____:____: very likely
1 2 3 4 5 6 7

to support my quest to do research, *in the next four years*, with inputs from others interested in the research findings.

→ Generally speaking, how much do you want to do what your Head approves that you should do?

Least concerned:____: ____:____:____:____:____:____: very much concerned
1 2 3 4 5 6 7

17. My community leader(s) expects

less:____: ____:____:____:____:____:____: very much
1 2 3 4 5 6 7

that I do research, *in the next four years*, with inputs from others interested in the research findings.

→ Generally speaking, how much do you want to do what the community leader(s) expects you should do?

Least concerned:____: ____:____:____:____:____:____: very much concerned
1 2 3 4 5 6 7

18. I expect that my work will place high demands on my time *in the next four years.*

Least likely:____:____:____:____:____:____:____: very likely
1 2 3 4 5 6 7

→ My work placing high demands on my time, *in the next four years*, would make it

less difficult:____:____:____:____:____:____:____: very difficult
1 2 3 4 5 6 7

to do research with or for others who are interested in my research and want to provide input to the research.

19. I am confident that I will get funding, *in the next four years*, from the university or government to do research with others who are interested in my research findings.

Least agreement:____:____:____:____:____:____:____: strong agreement
1 2 3 4 5 6 7

→ Getting funding from the university or government would make it

less easy:____:____:____:____:____:____:____: very easy
1 2 3 4 5 6 7

to do research, *in the next four years*, with inputs from others interested in the research findings.

20. I am sure that the university or government will offer me monetary or non-monetary reward if I decide to do research, *in the next four years*, with others who are interested in the research findings.

Least agreement:____:____:____:____:____:____:____: strong agreement
1 2 3 4 5 6 7

→ An assurance of a reward from the university or government would make it

less easy:____:____:____:____:____:____:____: very easy
1 2 3 4 5 6 7

to do research, *in the next four years*, with inputs from others interested in the research findings.

21. I am confident that I will legally get my intellectual property rights well enforced, if the need arises, when I do research *in the next four years* with others interested in the research findings.

Least agreement:____:____:____:____:____:____:____: strong agreement
1 2 3 4 5 6 7

→ Having my intellectual property rights well enforced would make it

less easy:____:____:____:____:____:____:____: very easy
1 2 3 4 5 6 7

to do research, *in the next four years*, with inputs from others interested in the research findings.

22. I am sure that I will get the necessary support infrastructure like software or equipment or laboratory facilities at my workplace when I do research, *in the next four years*, with others interested in the research findings.

Least agreement:____:____:____:____:____:____:____: strong agreement
1 2 3 4 5 6 7

→ Having access to the necessary support infrastructure would make it

less easy:____:____:____:____:____:____:____: very easy
1 2 3 4 5 6 7

to do research, *in the next four years*, with inputs from others interested in the research findings.

23. I am confident that I will get the necessary administrative support from my university/other relevant institutions when I decide to do research, *in the next four years*, with others interested in the research findings.

Least agreement:____:____:____:____:____:____:____: strong agreement
1 2 3 4 5 6 7

→ Receiving the necessary administrative support from my university/other relevant institutions would make it

less easy:____:____:____:____:____:____:____: very easy
1 2 3 4 5 6 7

to do research, *in the next four years*, with inputs from others interested in the research findings.

24. I am confident that I will find an individual or group or institution, *in the next four years*, that is willing to provide some input and/or is interested in the research findings.

Least agreement:____:____:____:____:____:____:____: strong agreement
1 2 3 4 5 6 7

→ Finding others who are willing to provide input and/or are interested in my research findings would make it

less easy:____:____:____:____:____:____:____: very easy
1 2 3 4 5 6 7

to do research, in the next four years, with such interested others.

25. I am sure that I will find an interested individual or group or institution that has the capacity to use the research findings when I decide to do research, *in the next four years*.

Least agreement:____:____:____:____:____:____:____: strong agreement
1 2 3 4 5 6 7

→ Being certain of the availability of others who have the capacity to use the research findings would make it

less easy:____:____:____:____:____:____:____:very easy
1 2 3 4 5 6 7

to do research, *in the next four years*, with support from others.

SECTION D: INVOLVEMENT IN RESEARCH COLLABORATION

This section of the questionnaire assesses your **involvement** in research collaboration. *Research collaboration* is defined as doing research with or for another person, group, community or institution that provides input such as problem definition, research expertise and/or resources and that party or you may use the research findings for a particular purpose **other than solely for pursuing a degree or promotion.**

26. In your **entire career** as an academic, how many of your research work have you done with or for others? Please **state number**____________
27. Please **state the number** of research work that you have done with or for others within the **past one to ten years?** ____________________
28. Please **indicate the number** of research, stated in question 27 above, that was your own initiative and the number that was the initiative of others such as the individual or organisation with whom or for whom you did the research.

    (a) ____________ due to own initiative

    (b) ____________due to initiative of others

29. Please **state the number of collaboration(s)** that you have had with the following sectors within the *past one to ten years*:

Sector	Number of Collaboration per Sector	Not applicable (N/A) (please tick)
(a) Private sector *in Ghana* e.g. entrepreneurs, industry, colleagues in a private institution..............................	____________________	☐
(b) Public sector *in Ghana* e.g. state-owned enterprise, Ministry, District Assembly, public university	____________________	☐
(c) Third sector *in Ghana* e.g. NGO, local community council.......................	____________________	☐
(d) An individual, group, institution or government *outside* Ghana.........	____________________	☐

30. The following statements describe some *types of research project*. Please **state the number of** each project type that you have engaged in *within the past one to ten years.*

Type of research project	Number of research Project per type	N/A (please tick)
(a) Seeking solutions to problems encountered by an individual/institution/society.............	____________________	☐
(b) Exploring potentially useful/ commercially feasible ideas....................	____________________	☐
(c) Improving or developing an idea, or process, good, service, equipment, machine, etc. for commercial application.........................	____________________	☐
(d) Conducting research informed by gaps at the frontiers of academic research but of interest to another individual or entity.................	____________________	☐

Type of research project	Number of research Project per type	N/A (please tick)
(e) Research that is part of transferring a particular technology, developed by you or others, for commercial application	______	☐

Other (please specify):...

31. In relation to the *past one to ten years*, which of the following best describes **your main resource-related purpose**, if any, of collaborating with an individual or institution? Please **tick all that apply**.

☐ To obtain additional resources e.g. expertise of other researchers, funding, equipment, etc.

☐ To share/use existing resources e.g. jointly-won research grant, public research laboratory, etc.

☐ Other(s) (please specify):

____

____

____

32. The following statements describe some *types of research collaboration*. Please **state the number of** each type of collaboration that you have engaged in *within the past one to ten years*.

Type of Collaboration	Number per type	N/A (please tick)
(a) The research was requested by an individual/entity but was entirely conducted by you or with other academic researchers....................	______	☐
(b) The research was conducted by you and a researcher(s) who work for the individual/entity that requested for the research..................................	______	☐
(c) You provided advisory service(s) with a research component to another person/entity that requested for the service................................	______	☐
(d) You formed a business, based on your research findings with another person or entity.........................	______	☐
(e) You granted a person or entity the right to use your intellectual property like a patent which was an outcome of your research work....................	______	☐

Other(s) please specify____

33. The following statements describe some *purposes of collaborative research*. If you sought after any of the purposes in your collaborative research, *within the past one*

to ten years, then please **state the number** of collaborative research for each purpose that you pursued.

Purpose	**Number of research project for each purpose**	**Not a purpose (please tick)**
(a) Advance my research work......	______	...... ☐
(b) Advance my teaching...........	______	...... ☐
(c) Help the individual, entity or society e.g. in solving problems..	______	...... ☐
(d) Make monetary gains.................	______	...... ☐

34. Please **place a tick** (√) on any of the seven dashes in front of each statement that is true about the **purpose of the partner(s)** with or for whom you did the research within the *past one to ten years*. The scale seeks to measure the extent to which the partner(s) sought after any of these purposes.

Least requirement	**1**	**2**	**3**	**4**	**5**	**6 High requirement**	**7**	**N/A (tick)**
(a) For understanding of an issue/phenomenon...	___	___	___	___	___	___	___	.... ☐
(b)For application of the research findings.......	___	___	___	___	___	___	___	.... ☐
(c) For understanding and application..........	___	___	___	___	___	___	___	.... ☐

35. Please **place a tick** (√) on any one of the 7 dashes in front of each under-listed item **to indicate the extent to which you provided any of the items** in your research with or for others, within the *past one to ten years*.

Least provided	**1**	**2**	**3**	**4**	**5**	**6 Most provided**	**7**	**N/A (tick)**
Research expertise...........	___	___	___	___	___	___	___	..... ☐
Information..................	___	___	___	___	___	___	___	.... ☐
Time..........................	___	___	___	___	___	___	___	... ☐
Own funding..................	___	___	___	___	___	___	___	... ☐
Personally secured funding.	___	___	___	___	___	___	___	... ☐
Jointly secured funding......	___	___	___	___	___	___	___	... ☐
Infrastructure e.g. your own lab, software or that of your institution...........	___	___	___	___	___	___	___	... ☐
Transfer of								

(please tick & rate):	**Least provided** 1	2	3	4	5	6	**Most provided** 7	**N/A (tick)**
☐ self-developed ideas......	___	___	___	___	___	___	___	☐
☐ good/service	___	___	___	___	___	___	___	☐
☐ process....................	___	___	___	___	___	___	___	☐
☐ machines/tools/ equipment....................	___	___	___	___	___	___	___	☐

(Others, please specify):
....

36. Please **place a tick** (√) on any of the 7 dashes in front of each under-listed item to indicate the extent to which your collaboration experience, within the *past one to ten years*, was **beneficial to the collaborating partner(s) or entity (entities)**.

Developing/improving/ producing/offering:	**Least beneficial** 1	2	3	4	5	6	**Very beneficial** 7	**N/A (tick)**
A good/product.........	___	___	___	___	___	___	___	☐
A service.................	___	___	___	___	___	___	___	☐
Components/parts.......	___	___	___	___	___	___	___	☐
Software..................	___	___	___	___	___	___	___	☐
Process, method.........	___	___	___	___	___	___	___	☐
Tool(s)/equipment/ machine......................	___	___	___	___	___	___	___	☐
Policies, laws............	___	___	___	___	___	___	___	☐
Opportunity, market....	___	___	___	___	___	___	___	☐
Alternative source(s) of livelihood..............	___	___	___	___	___	___	___	☐
Organisational structure	___	___	___	___	___	___	___	☐
Problem solving..........	___	___	___	___	___	___	___	☐

Other benefits (please specify): ....

37. Please **place a tick** (√) on any one of the 7 dashes in front of each under-listed item to indicate **how important each item** was in **your collaboration** experience, within the *past one to ten years.*

Less important **Very important**

	1	2	3	4	5	6	7	(N/A (tick)
Trust.....................	___	___	___	___	___	___	___	....☐
Common values.........	___	___	___	___	___	___	___	....☐
Common expectations /goals....................	___	___	___	___	___	___	___	....☐
Timely information flow	___	___	___	___	___	___	___	...☐
Availability of time......	___	___	___	___	___	___	___	...☐
Access to information...	___	___	___	___	___	___	___	...☐
Availability of funding..	___	___	___	___	___	___	___	....☐
Availability of requisite infrastructure...........	___	___	___	___	___	___	___	...☐
Willingness of user to use research findings for intended purpose	___	___	___	___	___	___	___	...☐
Ability of user to use Research findings for intended purpose.........	___	___	___	___	___	___	___	...☐
Prompt delivery of support services by own institution..................	___	___	___	___	___	___	___	...☐
Own capability to manage relationships......	___	___	___	___	___	___	___	...☐
Prompt delivery of support by partner institution/individual......	___	___	___	___	___	___	___	...☐
Availability of enforceable intellectual property rights...........	___	___	___	___	___	___	___	...☐
Opportunity to publish findings.........	___	___	___	___	___	___	___	.....☐

Please specify other factors...

38. Please **place a tick** (√) on any one of the 7 dashes in front of each under-listed item to indicate any **positive impact** that your collaboration experience, within the *past one to ten years*, had **on each item.**

Least positive impact	**1**	**2**	**3**	**4**	**5**	**6**	**7** (**Very high positive impact**)	**N/A (please tick)**
Teaching........	___	___	___	___	___	___	___	.... □
Research........	___	___	___	___	___	___	___	.... □
Promotion or career advancement...	___	___	___	___	___	___	___	.... □

39. Please **place a tick** (√) on any one of the 7 dashes in front of each under-listed item to indicate any **negative impact** that your collaboration experience, within the *past one to ten years*, had **on each item.**

Least negative impact	**1**	**2**	**3**	**4**	**5**	**6**	**7** (**Very high negative impact**)	**N/A (tick)**
Teaching........	___	___	___	___	___	___	___	.... □
Research........	___	___	___	___	___	___	___	.... □
Promotion or career advancement....	___	___	___	___	___	___	___	.... □

40. Please **place a tick** (√) on any one of the 7 dashes in front of each under-listed item to indicate the extent to which your collaboration experience, within the *past one to ten years*, **resulted in an increase in any of the items** in relation to your personal welfare.

Slight increase	**1**	**2**	**3**	**4**	**5** (**Very high increase**)	**6**	**7**	**N/A (tick)**
Wealth..............	___	___	___	___	___	___	___	.... □
Power/influence e.g. at work, in society.......	___	___	___	___	___	___	___	..... □
Reputation..............	___	___	___	___	___	___	___	..... □
Physical health.........	___	___	___	___	___	___	___	..... □
Psychological satisfaction...........	___	___	___	___	___	___	___	..... □
General life Satisfaction...........	___	___	___	___	___	___	___	..... □

41. Please **place a tick (√)** on any one of the 7 dashes in front of each under-listed item to indicate the extent to which your collaboration experience, within the *past one to ten years*, **resulted in a decrease** in any of the items in relation to your personal welfare.

Slight decrease

	1	2	3	4	**Very high decrease** 5	6	7	**N/A (tick)**
Wealth..................	___	___	___	___	___	___	___	☐
Power/influence e.g. at work, in society......	___	___	___	___	___	___	___	☐
Reputation...............	___	___	___	___	___	___	___	☐
Physical health.........	___	___	___	___	___	___	___	☐
Psychological satisfaction...............	___	___	___	___	___	___	___	☐
General life satisfaction	___	___	___	___	___	___	___	☐

SECTION E: CHALLENGES OF RESEARCH COLLABORATION

42. Please **place a tick (√)** on any one of the 7 dashes in front of each under-listed item **to indicate the extent to which an item was a challenge** in your collaboration experience within the *past one to ten years.*

Least challenge

	1	2	3	4	**Major challenge** 5	6	7	**N/A (tick)**
Trust.....................	___	___	___	___	___	___	___	☐
Common values.........	___	___	___	___	___	___	___	☐
Common expectations/ goals.....................	___	___	___	___	___	___	___	☐
Access to adequate information..............	___	___	___	___	___	___	___	☐
Timely information flow...	___	___	___	___	___	___	___	☐
Availability of time.........	___	___	___	___	___	___	___	☐
Availability of requisite funding.........................	___	___	___	___	___	___	___	☐
Availability of requisite infrastructure...	___	___	___	___	___	___	___	☐
Willingness of user to use research findings for intended purpose	___	___	___	___	___	___	___	☐

Least challenge

	1	2	3	4	5	6	7	N/A (tick)
Ability of user to use research findings for intended purpose..........	___	___	___	___	___	___	___	☐
Prompt delivery of support services by own institution	___	___	___	___	___	___	___	☐
Prompt delivery of support services by partner institution or individual..................	___	___	___	___	___	___	___	☐
Own capability to manage relationships......	___	___	___	___	___	___	___	☐
Enforceable intellectual property rights...........	___	___	___	___	___	___	___	☐
Delay in publication of findings................	___	___	___	___	___	___	___	☐

Major challenge (7)

Other challenges (please specify)..

Thank you for completing the questionnaire. Please provide any further comment(s) or suggestion(s):

____

____

____

____

____

____

____

APPENDIX D

LETTER OF INTRODUCTION

INSTITUTE FOR DEVELOPMENT STUDIES
FACULTY OF SOCIAL SCIENCES
UNIVERSITY OF CAPE COAST

Telephone: *03321-32983/35410/37105*
Fax: *03321-32983*
Website: www.eds-ucc.edu.gh

Post Office Box 01
University of Cape Coast
Cape Coast

Our Ref: IDS/40/Vol. 4/169

Your Ref:

Date: 9th September, 2014.

TO WHOM IT MAY CONCERN

LETTER OF INTRODUCTION

We write to introduce to you **Ms Mavis Serwah Benneh Mesah**, a student pursuing **Ph.D (Development Studies)** programme with Registration Number SS/DSD/12/0007 at the Institute for Development Studies, University of Cape Coast.

She is writing her thesis on the topic: **"RESEARCH COLLABORATION FOR ATTAINMENT OF THE KNOWLEDGE-DRIVEN ECONOMY OF GHANA".**

We shall be grateful if you can accord her all the necessary assistance that she requires for her thesis.

Thank you.

Yours faithfully,

For:

Betty K. Addo-Nkrumah (Mrs.)
Assistant Registrar
For: Director

Assistant Registrar
INSTITUTE FOR DEVELOPMENT STUDIES
UNIVERSITY OF CAPE COAST
CAPE COAST

cc: Director, IDS, UCC

APPENDIX E

SAMPLE COVER LETTER

Department of Management Studies
University of Cape Coast
Cape Coast

29th October, 2014

Dear Sir/Madam,

COVER LETTER

The enclosed questionnaire is designed to solicit for information on research-related activities of academic staff, of selected Universities in Ghana. The findings of the study shall be useful in the identification of the concerns, challenges and, possibly, contributions of academic staff towards the attainment of a knowledge-driven economy of Ghana. The researcher is a Ph.D. student at the Institute for Development Studies, University of Cape Coast, Cape Coast, Ghana.

Your participation in the study is very much needed and appreciated. Your responses shall, duly, be kept confidential and anonymous. The questionnaire is in five sections. The first and second sections consist of items on background information and research orientation respectively. The third section looks at the feasibility of academics doing research with and/or for others in future. In addition the last two sections are designed for academics, who have done research with and/or for others *aside the sole* purposes of pursuing a degree or promotion, to share their experiences. It shall take between 15 to 25 minutes to complete the questionnaire. You may reach the researcher on 0245093600 or via email at mmensah@ucc.edu.gh or mbenne@yahoo.com.

Thank you for participating in the study.

Yours faithfully,

Mavis Serwah Benneh Mensah (Ms.)
Researcher

APPENDIX F

Table 51: Constructs and Measures

Construct/variables	Indicators	Scale of measurement	Cronbach alpha (α)	Method(s) of data analysis
Intention to collaborate (Objective 1, Hypothesis 1(a))	Extent to which one 1. intends, 2. will try, and 3. plans to engage in RC in the next 4 years	Interval rating scale	.876	Mean Standard deviation Skewness Kurtosis ANOVA
Determinants of intention to collaborate: (Objective 1, Hypotheses 1(b) and 1(c))				
1. Attitude towards research collaboration (RC) (*belief strength & outcome evaluation*)	1. RC in next 4 years will advance one's a. research b. teaching c. promotion d. financial gains e. reputation in society	Interval rating scale	.877	Mean Standard deviation Skewness Kurtosis Principal component analysis Standard multiple regression ANOVA

Table 51 cntd.: Constructs and Measures

Construct/variables	Indicators	Scale of measurement	Cronbach alpha (α)	Method(s) of data analysis
2. Perceived behavioural control over RC (*belief strength & control belief power*)	2. Extent to which one is capable of a. Conducting various types of research b. Relating with collaborating partner(s)	Interval rating scale	.724	
3. Subjective norms on RC (*normative belief strength & motivation to comply*)	3. The following (ff) significant others will approve of RC… c. one's institution d. colleagues e. head or dean or provost f. community leader	Interval rating scale	.893	
4. Perceived environmental possibility for RC (*belief strength & control belief power*)	4. Extent to which one is certain of the availability of the ff for RC: a. time b. funding c. rewards or incentives d. infrastructure e. administrative support f. enforceable intellectual property rights g. willing collaborating partner(s) h. capable collaborating partner(s)	Interval rating scale	.954	

Table 51 cntd.: Constructs and Measures

Construct/variables	Indicators	Scale of measurement	Method(s) of data analysis
Involvement in RC (Objective 2, Hypothesis 2)	1. Engagement in RC within past ten years	1. Nominal scale	1. Percentages
	2. Source of initiation: number of RC initiated in past ten years a. by respondent b. others, e.g. collaborating partner	2. Nominal & ratio scales	2. Percentages
	3. Sector of collaborating partner(s) & number of collaborations per sector in past ten years a. Private sector b. Public sector c. Third sector d. International partner(s)	3. Nominal & ratio scales	3. Percentages
	4. Purpose of RC in past ten years a. Academic-related purpose: b. Resource-related purpose - extent to which one sought after the ff in RC: • additional resources • joint resources	4. Nominal scale	4. Percentages

Table 51 cntd.: Constructs and Measures

Construct/variables	Indicators	Scale of measurement	Method(s) of data analysis
Involvement in RC (Objective 2)	5. Number of engagement in various types of RC in past ten years a. Contract research b. Joint research c. Consulting d. Commercialisation e. Technology transfer	5. Ratio scale	5. Mean Standard deviation Skewness Kurtosis Median Variance
	6. Total number of engagement in RC within past ten years	6. Ratio scale	6. Median Variance Kruskal-Wallis test
Essentials of RC & challenges of RC (objectives 2 & 6)	Extent to which the following were important and or challenge(s) to RC in past ten years: 1. Trust 2. Common values 3. Common goals 4. Timely information flow 5. Availability of time 6. Access to requisite information 7. Availability of funding 8. Availability of requisite infrastructure 9. Willingness of user to use research findings for intended purpose	Interval rating scales	Mean Standard deviation Skewness Kurtosis Principal component analysis

Table 51 cntd.: Constructs and Measures

Construct/variables	Indicators	Scale of measurement	Method(s) of data analysis
	10. Ability of user to use research findings for intended purpose 11. Prompt delivery of support services by own institution 12. Prompt delivery of support service by partner entity 13. Own capability to manage relationships 14. Availability of enforceable intellectual property rights 15. Opportunity to publish research findings		
Innovation (objective 3, Hypothesis 3)	Extent to which the collaboration aided in developing, improving, producing, offering or identifying: 1. Good or product 2. Service 3. Process or method 4. Technology: components, software, tools, equipment… 5. Market opportunity, alternative source of livelihood 6. Administrative: policies, laws, organisational structure 7. Problem solving*	Interval rating scales	Mean Standard deviation Skewness Kurtosis Median Kruskal-Wallis test Mann-Whitney U test

Table 51 cntd.: Constructs and Measures

Construct/variables	Indicators	Scale of measurement	Method(s) of data analysis
Research orientation (objective 4, Hypothesis 4) 1. Basic research 2. Applied research 3. Use-inspired basic research	(A) Extent to which one's research work is aimed at seeking: 1. understanding 2. application 3. understanding & application	Interval rating scale	Mean Standard deviation Skewness Kurtosis Median Kruskal-Wallis test
	(B) Extent to which collaborating partner sought after 1. understanding 2. application of the findings 3. understanding & application	Interval rating scale	
Research interest	Description of one's research as focusing on: 1. country-specific issues 2. new-to the country issues 3. new-to-the-world issues	Nominal scale	Percentages
Impact of RC (objective 5) 1. Personal welfare	1. Extent of increase or decrease in the ff as a result of the RC: a. Wealth b. Power or influence at work or in society c. Reputation d. Physical health e. Psychological satisfaction f. General life satisfaction	Interval rating scales	Mean Standard deviation Skewness Kurtosis Median Variance

Table 51 cntd.: Constructs and Measures

Construct/variables	Indicators	Scale of measurement	Method(s) of data analysis
2. Academic	2. Extent of positive and/or negative impact of RC on the ff: a. Teaching b. Research c. Promotion or career advancement	Interval rating scales	

Source: Author's construct (2014)

APPENDIX G

INTERVIEW GUIDE FOR SELECTED RESPONDENTS WITH RESEARCH COLLABORATION EXPERIENCE

A. Self-introduction (Seek interviewee's consent to record interview).

B. Presentation of research theme and purpose to interviewee.

C. How many years have you worked as an academic researcher at the university level?

D. Academic discipline/specialisation:

E. Sex:

F. Rank:

G. Could you tell me a little about your research work within the past ten years?

H. Current research interests:

I. Questions and prompts on research collaboration within the past ten years:

1. Please share your experiences on your research work, with other individuals or entities in and outside the University?
   - i. Which of the projects took place within the past 10 years, that is, 2005 to 2015?
   - ii. For the various research projects who were *the collaborating parties*? (if no collaborations with private sector entrepreneurs, find out why)
   - iii. Who initiated the collaborations?
   - iv. What was the purpose of the collaboration?
   - v. What was your role in the collaboration?
   - vi. What role did the collaborating party or parties play?
   - vii. What was your major reason for getting involved in the collaboration?

viii. What was the source of funding?

ix. Apart from research expertise and time, did you provide any other thing in support of the collaboration? If YES, what were they?

x. What was/were the outcome(s) of the collaboration (Identify contributions to innovation)?

xi. Of all the collaborations which one(s) would you consider a success and why?

xii. What were the most important things that made the collaboration(s) a success (Essentials)?

xiii. Which of the collaborations would you consider less successful and why were they not successful (Challenges)?

xiv. What would you consider major challenge(s) of the collaborative research experience?

2. Did the collaborations have any positive impact on your academic duties and advancement particularly, research, teaching and promotion?

3. Did the collaborations have any negative impact on your academic duties and advancement, particularly, research, teaching and promotion?

4. Did the collaborations have any positive impact on your welfare, for example, increase in your wealth, status in society and physical health?

5. Did the collaborations have any negative impact on your welfare, for example, decrease in your wealth, status in society and physical health?

6. Are you currently engaged in collaborative research?

7. If you were to collaborate in the next three years, what factors would you consider before engaging in the collaboration (Determinants)? Which of the factors is/are most important to you (In order of importance)?

8. In general, how would you describe most of the research work you conduct: mainly seeking understanding or results for application such as policy enactment and product development, or both understanding and application?

i. In what way(s) was your research orientation helpful in your collaborative research project(s)?

9. In terms of geographical consideration, how would you describe your main research focus? For example, issues that are known elsewhere but of interest to Ghana or issues that are entirely new to the world?

APPENDIX H

INTERVIEW GUIDE FOR INTERVIEW OF HEADS OF RESEARCH DIRECTORATES/RELATED OFFICES

A. Self-introduction (Seek interviewee's consent to record interview).

B. Presentation of research theme and purpose to interviewee.

C. Could you tell me a little about the history and mandate of your office (mention name of office)?

D. Questions and prompts on research collaboration:

1. What is the University's position on collaborative research, especially, that which is aimed at producing results for the benefit of an external party such as industry or society in general?
    i. Does the University encourage this form of collaborative research? If yes in what ways?
    ii. Are academics mandated to formally channel their collaborative research through the University? If YES, which outfit is responsible for this exercise?
2. What support does the office (mention name of office) offer academics who engage in collaborative research?
3. Are academics who engage in collaborative research with persons or entities outside the University eligible for support from your outfit?
4. Within a month, how often do academics approach your outfit for support for collaborative research?

    Note: In case of infrequent use of support, what are some of the possible reasons for academics not seeking the support?

5. Which of the various forms of support provided by your office is/are most demanded by academics?

6. Are there other forms of support that the University provides besides what your office (or mention name of office) is mandated to offer?

Follow-up questions (if not addressed earlier):

i. Does your outfit or any other entity within the University offer information on opportunities for research-based outreach such as collaborative research?

ii. Are academics allowed to use University research facilities, such as laboratories, for research work that is formally or informally pursued with another individual or entity outside the University?

If YES, what are the conditions for use of the facilities?

iii. Does the University offer financial support for collaborative research?

a. How adequate is it (if there is support)?

b. Is there differentiation in the allocation of funds among academics from various academic disciplines or faculties?

c. If YES, how is the financial support apportioned among academic disciplines -Science, Technology, Engineering and Mathematics; Arts; and Social Science?

iv. Does your office handle issues on intellectual property rights?

a. If YES, are there specific provisions for collaborative research?

b. What kind(s) of support is/are available to academics who want to acquire intellectual property rights?

c. What kind(s) of support is/are available to academics who want to enforce their intellectual property rights?

d. If NO, is there a Unit responsible for handling intellectual property-related matters?

v. Does the University reward academics whose collaborative research work produces outstanding benefits to society? If yes, what kinds of rewards exist?

vi. What time provisions, if any, does the University policy make for academics to devote part of their schedule to research-based outreach?

7. Is there any other thing you may want to share in support of this research?

D. Exchange of contact information for possible future clarification of issues.

APPENDIX I

TABLES AND FIGURES

Table 52: Double Measures of the Determinants of Intention to Collaborate

	N	Min.	Max.	Mean	SD
Attitude towards research collaboration					
Collaboration will advance research	264	1	7	5.87	1.160
Desire to advance research	263	1	7	6.03	1.001
Collaboration will improve teaching	266	2	7	5.92	1.061
Desire to improve teaching	262	1	7	5.85	1.086
Collaboration will speed promotion	262	1	7	5.71	1.350
Desire to speed promotion	261	1	7	5.62	1.361
Collaboration will bring extra income	266	1	7	5.21	1.592
Desire to earn extra income	265	1	7	5.02	1.450
Collab will improve reputation	264	1	7	5.68	1.239
Desire to improve reputation	263	1	7	5.50	1.284
Perceived behavioural control over research Collaboration					
Ability to relate	262	1	7	5.88	.950
Influence of ability to relate on collaboration	264	2	7	5.86	.989
Ability to conduct various types of research	264	1	7	5.71	.979
Influence of ability to research on collaboration	261	1	7	5.58	.999
Subjective norms on research collaboration					
Institutional expectation (IE) to collaborate	263	1	7	5.57	1.317
Motivation to comply with IE	261	1	7	5.92	1.144

Table 52 cntd.: Double Measures of the Determinants of Intention to Collaborate

	N	Min.	Max.	Mean	SD
Peers approval of collaboration	258	1	7	5.71	1.058
Motivation to comply with peers	254	1	7	5.41	1.297
Head's support for collaboration	260	1	7	5.37	1.354
Motivation to comply with head's expectations	262	1	7	5.55	1.360
Community leader's (CL) expectation to collaborate	259	1	7	4.59	1.593
Motivation to comply with expectation of CL	260	1	7	5.01	1.538
Environmental possibilities for research Collaboration					
Time availability	265	1	7	3.72	1.086
Availability of time for collaboration	264	1	7	3.05	1.491
Availability of funding (FA) for collaboration	265	1	7	4.42	1.814
Importance of FA to collaboration	265	1	7	5.60	1.389
Availability of reward (RA) for collaboration	266	1	7	4.31	1.884
Importance of RA to collaboration	263	1	7	5.08	1.469
Availability of EIPR for collaboration	263	1	7	5.08	1.486
Importance of EIPR to collaboration	261	1	7	5.36	1.256
Availability of infrastructure for collaboration	264	1	7	4.83	1.570
Importance of infrastructure to collaboration	260	1	7	5.75	1.181
Availability of AS for collaboration	262	1	7	4.94	1.526
Importance of AS for collaboration	260	1	7	5.70	1.106
Availability of potential collaborating partner(s)	262	1	7	5.23	1.261
Importance of partner availability to collaboration	261	1	7	5.72	1.082

Table 52 cntd.: Double Measures of the Determinants of Intention to Collaborate

	N	Min.	Max.	Mean	SD
Availability of capable user of research output	262	1	7	5.29	1.274
Importance of user availability to collaboration	260	1	7	5.57	1.162

Source: Field survey (2015)

Table 53: Correlation Matrix of the Measures of the Determinants of Intention to Collaborate

		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
Correlation	1 Advance research	1.000	.554	.533	.214	.202	.493	.350	.339	.280	.341	.106	.127	.049	.244	250	.276	.346	.263	-.036
	2 Improve teaching	.554	1.000	.374	204	235	.355	.359	.302	.313	.276	.159	.118	.052	.198	.278	.225	.288	.246	.025
	3 Fast track promotion	.533	.374	1.000	.533	.221	.293	283	.296	.267	.258	.120	.109	.111	209	.225	.257	.227	.263	-.169
	4 Bring extra income	.214	.204	.533	1.000	.414	.278	.382	.361	.385	.274	.391	287	.340	.334	.357	.446	.361	.450	-.099
	5 Improve reputation	.202	.235	.221	.414	1.000	.359	.329	.387	.441	.365	.241	.192	216	.307	.344	.360	.329	297	-.081
	6 Ability to relate	.493	.355	.293	.278	.359	1.000	.567	.427	.416	.342	.254	.216	.139	.295	.350	.373	.436	.417	-.154
	7 Ability to research	.350	.359	.283	.382	.329	.567	1.000	.508	.466	.440	.305	.262	.194	.366	.430	.400	.494	.412	-.082
	8 Institutional expectation	339	.302	.296	.361	.387	.427	.508	1.000	.648	.516	.440	.389	.289	.476	.330	.536	.510	.450	-.133
	9 Peers approval	.280	.313	.267	.385	.441	.416	.466	.648	1.000	.604	.448	335	.362	.522	.463	.483	.425	.424	-.153
	10 Head's support	.341	.276	.258	.274	.365	.342	.440	.516	.604	1.000	.321	.286	.231	.373	.434	.425	.408	.391	-.153
	11 *CLE	.106	.159	.120	.391	.241	.254	.305	.440	.448	.321	1.000	.320	.455	.409	.366	.481	.335	.432	-.074
	12 Funding availability	.127	.118	109	.287	.192	.216	.262	.389	.335	.286	.320	1.000	.522	.396	.329	.470	.367	.400	-.111
	13 Reward availability	.049	.052	.111	340	.216	.139	194	.289	.362	.231	.455	.522	1.000	.446	.460	.428	.315	.419	-.165
	14 *EIPR availability	.244	.198	.209	334	.307	.295	.366	.476	.522	.373	.409	.396	.446	1.000	.357	.459	.411	.426	-.150
	15 Infrastructure availability	.250	.278	.225	.357	.344	.350	.430	.330	.463	.434	.366	.329	.460	.357	1.000	.568	.481	.452	-.206
	16 Administrative support	.276	.225	.257	.446	.360	.373	.400	.536	.483	.425	.481	.470	.428	.459	.568	1.000	.639	.622	-.100
	17 Partner availability	.346	.288	.227	361	.329	.436	.494	.510	.425	.408	.335	.367	.315	.411	.481	.639	1.000	.571	-.103
	18 User availability	.263	.246	.263	.450	.297	.417	.412	.450	.424	.391	.432	.400	.419	.426	.452	.622	.571	1.000	-.183
	19 Availability of time	-.036	.025	.013	-.169	-.099	-.081	-.154	-.082	-.133	-.153	-.074	-.111	-.165	-.150	-.206	-.100	-.103	-.183	1.000
Sig. (1-tailed)	1 Advance research		.000	.000	.000	.001	.000	.000	.000	.000	.000	.046	.021	.216	.000	.000	.000	.000	.000	281
	2 Improve teaching	.000		.000	.000	.000	.000	.000	.000	.000	000	.006	.029	.201	.001	.000	000	.000	.000	.347
	3 Fast track promotion	000	.000		.000	.000	.000	.000	.000	.000	.000	029	.040	.038	000	.000	.000	.000	.000	.415
	4 Bring extra income	000	.000	.000		.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.003
	5 Improve reputation	.001	.000	.000	.000		.000	.000	.000	.000	.000	.000	.001	.000	.000	.000	.000	.000	.000	.055
	6 Ability to relate	000	.000	.000	.000	000		.000	.000	.000	.000	.000	.000	.013	.000	.000	.000	.000	.000	096
	7 Ability to research	.000	.000	.000	.000	.000	.000		.000	.000	.000	.000	.000	.001	.000	.000	.000	000	.000	.007
	8 Institutional expectation	.000	.000	.000	.000	.000	000	.000		.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.093
	9 Peers approval	.000	.000	.000	.000	.000	.000	.000	.000		.000	.000	.000	.000	.000	.000	.000	000	.000	.018
	10 Head's support	.000	.000	.000	.000	.000	.000	.000	.000	.000		.000	.000	.000	.000	.000	.000	.000	.000	.007
	11 *CLE	.046	.006	.029	.000	.000	.000	.000	.000	.000	.000		.000	.000	.000	.000	.000	.000	.000	.118
	12 Funding availability	.021	.029	.040	.000	.001	.000	.000	.000	.000	.000	.000		.000	.000	.000	000	.000	.000	.037
	13 Reward availability	.216	.201	.038	.000	.000	.013	.001	.000	.000	000	.000	.000		.000	.000	.000	.000	.000	.004
	14 *EIPR availability	.000	.001	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000		.000	.000	.000	.000	.008
	15 Infrastructure availability	000	.000	.000	.000	.000	.000	000	.000	.000	.000	.000	.000	.000	.000		.000	.000	.000	.000
	16 Administrative support	.000	.000	.000	.000	.000	.000	000	.000	.000	.000	.000	.000	.000	.000	.000		.000	.000	.055
	17 Partner availability	.000	.000	.000	.000	.000	.000	000	.000	.000	.000	.000	.000	.000	.000	.000	000		.000	.048
	18 User availability	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000		002
	19 Availability of time	.281	.347	.415	.003	.055	.096	.007	.093	.018	.007	.118	.037	.004	.008	.000	.055	.048	.002	

Source: Field survey (2015)

*Note: 11 *CLE means community leader's expectation

14 *EIPR means enforceable intellectual property rights

Table 54: Component Correlation Matrix of the Measures of the Determinants of Intention to Collaborate

Component	1	2	3
1	1.000	-.397	.382
2	-.397	1.000	-.079
3	.382	-.079	1.000

Extraction Method: Principal Component Analysis.

Rotation Method: Oblimin with Kaiser Normalization.

Source: Field survey (2015)

Table 55: Correlations Matrix of Intention to Collaborate and its Determinants

		INT	ATT	PBC	PEP	SN
Pearson Correlation	INT	1.000	.466	.355	.274	.272
	ATT	.466	1.000	.429	.229	.400
	PBC	.355	.429	1.000	.364	.562
	PEP	.274	.229	.364	1.000	.509
	SN	.272	.400	.562	.509	1.000
Sig. (1-tailed)	INT	.	.000	.000	.000	.000
	ATT	.000	.	.000	.000	.000
	PBC	.000	.000	.	.000	.000
	PEP	.000	.000	.000	.	.000
	SN	.000	.000	.000	.000	.
N	INT	262	253	253	254	243
	ATT	253	255	249	248	240
	PBC	253	249	257	251	244
	PEP	254	248	251	258	242
	SN	243	240	244	242	247

Source: Field survey (2015)

Table 56: Initial Correlation Matrix of the Essentials of Research Collaboration

		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Correlation	1 Trust	1.000	.490	.573	.531	.420	.555	.385	.414	.305	.318	.175	.459	.278	.222	.203
	2 Common values	.490	1.000	.510	.507	.300	.468	.300	.213	.298	.369	.281	.363	.207	.186	.280
	3 Common goal	.573	.510	1.000	.438	.336	.443	.205	.234	.282	.409	.191	.339	.222	.123	.448
	4 Timely information flow	.531	.507	.438	1.000	.527	.632	.491	.434	.451	.522	.324	.424	.366	.269	.227
	5 Time availability	.420	.300	.336	.527	1.000	.538	.372	.456	.246	.364	.267	.411	.317	.243	.104
	6 Access to information	.555	.468	.443	.632	.538	1.000	.446	.447	.385	.457	.250	.528	.373	.342	.271
	7 Funding availability	.385	.300	.205	.491	.372	.446	1.000	.761	.379	.321	.509	.367	.403	.480	.040
	8 Infrastructure availability	.414	.213	.234	.434	.456	.447	.761	1.000	.439	.368	.411	.429	.405	.536	.059
	9 Willingness to use findings	.305	.298	.282	.451	.246	.385	.379	.439	1.000	.829	.229	.372	.350	.465	.201
	10 Capability to use findings	.318	.369	.409	.522	.364	.457	.321	.368	.829	1.000	.246	.342	.401	.407	.309
	11 Support by own institution	.175	.281	.191	.324	.267	.250	.509	.411	.229	.246	1.000	.443	.528	.578	.213
	12 Capability to manage relationships	.459	.363	.339	.424	.411	.528	.367	.429	.372	.342	.443	1.000	.591	.377	.170
	13 Support by partner	.278	.207	.222	.366	.317	.373	.403	.405	.350	.401	.528	.591	1.000	.502	.250
	14 EIPR availability	.222	.186	.123	.269	.243	.342	.480	.536	.465	.407	.578	.377	.502	1.000	.132
	15 Opportunity to publish findings	.203	.280	.448	.227	.104	.271	.040	.059	.201	.309	.213	.170	.250	.132	1.000

Source: Field survey (2015)

*Note: 11 *CLE means community leader's expectation
14 *EIPR means enforceable intellectual property rights

Table 57: Final Correlation Matrix of the Essentials of Research Collaboration

		1	2	3	4	5	6	7	8	9	10	11	12	13	14
Correlation	1 Trust	1.000	.490	.573	.531	.420	.555	.385	.414	.335	.175	.459	.278	.222	.203
	2 Common values	.490	1.000	.510	.507	.300	.468	.300	.213	.353	.281	.363	.207	.186	.280
	3 Common goal	.573	.510	1.000	.438	.336	.443	.205	.234	.364	.191	.339	.222	.123	.448
	4 Timely information flow	.531	.507	.438	1.000	.527	.632	.491	.434	.524	.324	.424	.366	.269	.227
	5 Time availability	.420	.300	.336	.527	1.000	.538	.372	.456	.305	.267	.411	.317	.243	.104
	6 Access to information	.555	.468	.443	.632	.538	1.000	.446	.447	.445	.250	.528	.373	.342	.271
	7 Funding availability	.385	.300	.205	.491	.372	.446	1.000	.761	.372	.509	.367	.403	.480	.040
	8 Infrastructure availability	.414	.213	.234	.434	.456	.447	.761	1.000	.417	.411	.429	.405	.536	.059
	9 Willingness and capability of user to use findings	.335	.353	.364	.524	.305	.445	.372	.417	1.000	.244	.363	.387	.469	.276
	10 Support service from own institution	.175	.281	.191	.324	.267	.250	.509	.411	.244	1.000	.443	.528	.578	.213
	11 Capability to manage relationships	.459	.363	.339	.424	.411	.528	.367	.429	.363	.443	1.000	.591	.377	.170
	12 Support services from partner	.278	.207	.222	.366	.317	.373	.403	.405	.387	.528	.591	1.000	.502	.250
	13 EIPR availability	.222	.186	.123	.269	.243	.342	.480	.536	.469	.578	.377	.502	1.000	.132
	14 Opportunity to publish	.203	.280	.448	.227	.104	.271	.040	.059	.276	.213	.170	.250	.132	1.000

Source: Field survey (2015)

Table 58: Initial Correlation Matrix of the Challenges of Research Collaboration

		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Correlation	1 Trust	1.000	.710	.610	.468	.612	.394	.081	.318	.487	.429	.190	.499	.519	.476	.388
	2 Common values	.710	1.000	.675	.438	.612	.416	.116	.254	.606	.587	.254	.444	.545	.499	.250
	3 Common goal	.610	.675	1.000	.465	.459	.443	.175	.351	.606	.612	.374	.458	.568	.322	.181
	4 Inadequate information	.468	.438	.465	1.000	.701	.585	.471	.483	.347	.466	.462	.416	.505	.335	.231
	5 Timely information flow	.612	.612	.459	.701	1.000	.566	.326	.472	.381	.529	.431	.479	.572	.390	.407
	6 Availability of time	.394	.416	.443	.585	.566	1.000	.389	.379	.320	.418	.257	.293	.385	.352	.454
	7 Availability of funding	.081	.116	.175	.471	.326	.389	1.000	.618	.281	.388	.438	.248	.158	.130	.257
	8 Availability of infrastructure	.318	.254	.351	.483	.472	.379	.618	1.000	.249	.368	.596	.354	.244	.291	.272
	9 Willingness of user to use findings for intended purpose	.487	.606	.606	.347	.381	.320	.281	.249	1.000	.883	.370	.462	.658	.411	.369
	10 Capability of user to use findings for intended purpose	.429	.587	.612	.466	.529	.418	.388	.368	.883	1.000	.468	.574	.749	.457	.415
	11 Prompt delivery of support service by own institution	.190	.254	.374	.462	.431	.257	.438	.596	.370	.468	1.000	.560	.393	.165	.240
	12 Prompt delivery of support service by partner institution	.499	.444	.458	.416	.479	.293	.248	.354	.462	.574	.560	1.000	.566	.302	.388
	13 Own capability to manage relationships	.519	.545	.568	.505	.572	.385	.158	.244	.658	.749	.393	.566	1.000	.465	.416
	14 Availability of EIPR	.476	.499	.322	.335	.390	.352	.130	.291	.411	.457	.165	.302	.465	1.000	.546
	15 Delay in publication	.388	.250	.181	.231	.407	.454	.257	.272	.369	.415	.240	.388	.416	.546	1.000

Table 59: Final Correlation Matrix of the Challenges of Research Collaboration

		1	2	3	4	5	6	7	8	9	10
Correlation	1 Trust and common values	1.000	.683	.618	.442	.103	.323	.560	.251	.523	.356
	2 Common goal	.683	1.000	.498	.443	.175	.351	.590	.374	.322	.181
	3 Information flow	.618	.498	1.000	.625	.433	.524	.452	.492	.399	.367
	4 Time availability	.442	.443	.625	1.000	.389	.379	.343	.257	.352	.454
	5 Funding availability	.103	.175	.433	.389	1.000	.618	.290	.438	.130	.257
	6 Infrastructure availability	.323	.351	.524	.379	.618	1.000	.274	.596	.291	.272
	7 Willingness and capability of user to use findings	.560	.590	.452	.343	.290	.274	1.000	.422	.434	.397
	8 Institutional support	.251	.374	.492	.257	.438	.596	.422	1.000	.165	.240
	9 EIPR availability	.523	.322	.399	.352	.130	.291	.434	.165	1.000	.546
	10 Delay in publication	.356	.181	.367	.454	.257	.272	.397	.240	.546	1.000
Sig. (1-tailed)	1 Trust and common values		.000	.000	.000	.149	.001	000	.006	.000	.000
	2 Common goal	.000		.000	.000	.039	.000	.000	.000	.001	.034
	3 Information flow	.000	.000		.000	.000	.000	.000	.000	.000	.000
	4 Time availability	.000	.000	.000		.000	.000	.000	.005	.000	.000
	5 Funding availability	.149	039	.000	.000		.000	.002	.000	.112	.003
	6 Infrastructure availability	.001	.000	.000	.000	.000		.004	.000	.004	.002
	7 Willingness and capability of user to use findings	.000	.000	.000	.000	.002	.004		.000	.000	.000
	8 Institutional support	.006	.000	000	.005	.000	.000	.000		.065	.008
	9 EIPR availability	.000	.001	.000	.000	.112	.004	.000	.065		.000
	10 Delay in publication	000	.034	.000	.000	.003	.002	.000	.008	.000	

a. Determinant = .007

Source: Field survey (2016)

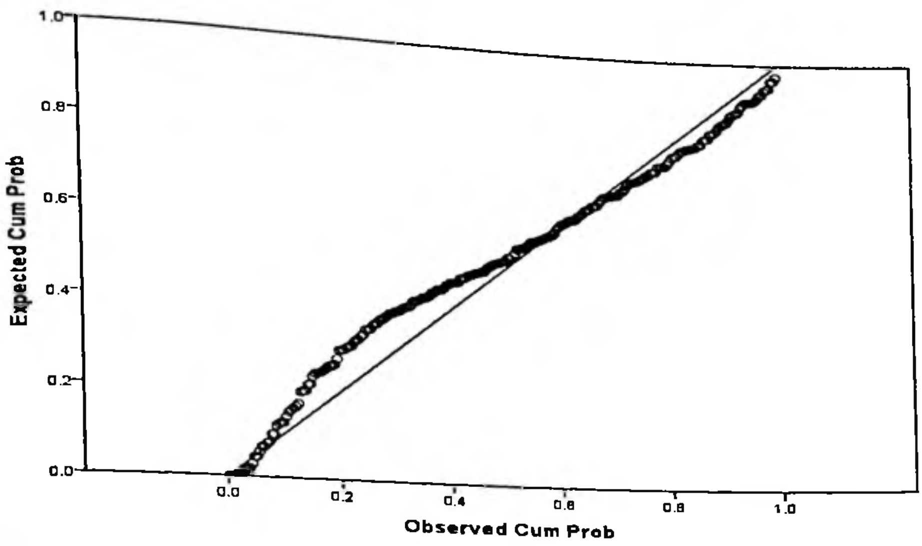

Figure 6: **Normal P-P plot of regression standardised residual of intention to collaborate and its determinants**

Dependent variable: intention to collaborate (INT)

Source: Field survey (2015)

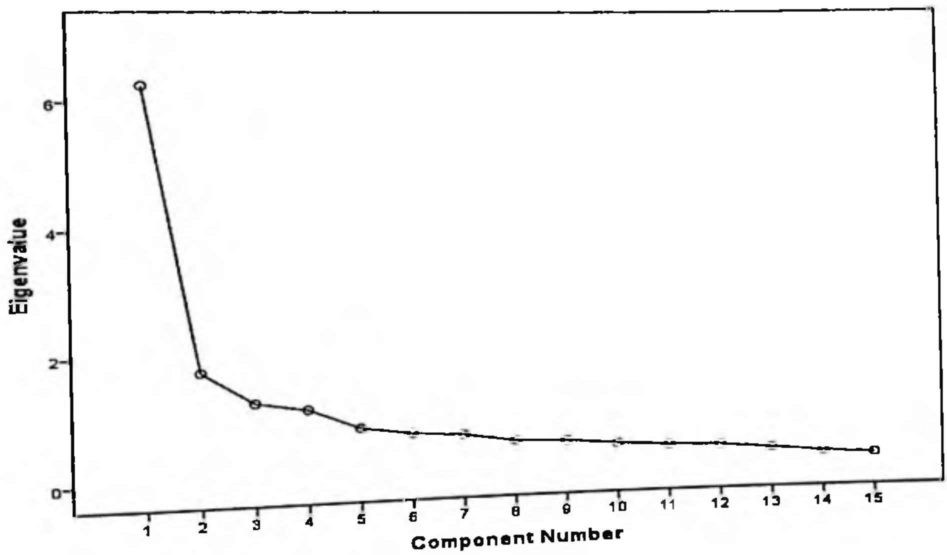

Figure 7: **Scree plot of components on essentials of research collaboration**

Source: Field survey (2015)

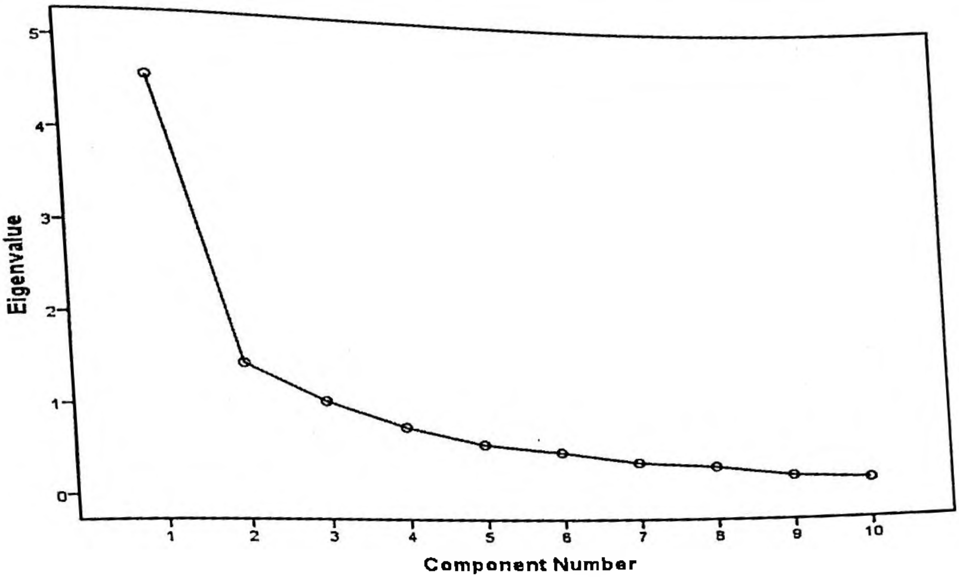

Figure 8: **Scree plot of the components of challenges of research collaboration**

Source: Field survey (2015)

APPENDIX J
ETHICAL CLEARANCE

UNIVERSITY OF CAPE COAST
Institutional Review Board
School of Graduate Studies and Research

TELEPHONE: +233 42 32440-9 & 32480-9 Ext. 237
DIRECT: +233 42 35351 & 028 9670793(4)

TELEGRAM: UNIVERSITY, CAPE COAST.

C/O UNIVERSITY POST OFFICE
CAPE COAST, GHANA

Our Ref: UCC/IRB/4^
Your Ref:

26th September, 2014

Ms. Mavis Benneh Mensah
Department of Management Studies
School of Business
U.C.C

ETHICAL CLEARANCE –ID NO: UCCIRB: 26/9/2014

The University of Cape Coast Institutional Review Board (UCCIRB) has granted **Provisional Approval** for implementation of your research protocol titled:

"Research Collaboration for Attainment of a Knowledge-driven Economy of Ghana"

This approval requires that you submit periodic review of the protocol to the Board and a final full review to the UCCIRB on completion of the research. The UCCIRB may observe or cause to be observed procedures and records of the research during and after implementation.

Please note that any modification of the project must be submitted to the UCCIRB for review and approval before its implementation.

You are also required to report all serious adverse events related to this study to the UCCIRB within seven days verbally and fourteen days in writing.

Always quote the protocol identification number in all future correspondence with us in relation to this protocol

....

For: Joseph C. Sefenu
ADMINISTRATOR

cc: The Chairman, UCCIRB

APPENDIX K
SAMPLE LETTER OF REQUEST FOR INTERVIEW

Department of Management Studies
School of Business
University of Cape Coast
Cape Coast

28th May, 2015

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

Dear Sir,

REQUEST FOR INTERVIEW

The request for interview is being made upon recommendation of the Directorate of Research, Innovation and Consultancy (DRIC), University of Cape Coast.

I am a third-year Ph.D. student at the Institute for Development Studies, University of Cape Coast, Cape Coast. As part of my research work titled "Research collaboration for attainment of a knowledge-driven economy of Ghana", I will be conducting interviews of academic senior members who actively engage in collaborative research and whose research findings have become useful to society.

The interview shall focus on your collaborative research experiences including institutional support and challenges of collaboration. It shall take between 30 to 45 minutes to conduct the interview.

Please find attached ethical clearance from the Institutional Review Board of the University of Cape Coast and introductory letter from the Institute for Development Studies, University of Cape Coast.

I look forward to your kind consideration of my request.

Thank you.

Yours faithfully,

Mavis Serwah Benneh Mensah (Ms.)
Tel: 0245093600
Email: mmensah@ucc.edu.gh and mbenneh@yahoo.com

APPENDIX L

SAMPLE TEMPLATE FOR RECORDS KEEPING DURING DATA COLLECTION

UCC RANDOM SAMPLE FOR Arts = 35						
No.	Surnam e	First Name	Department	To be collected on: Date/Time	Collected? (√)	Remarks
1.						
2.						
3.						
4.						
5.						
6.						
7.						
8.						
9.						
10.						
11.						
12.						
13.						

VITA

Mavis Serwah Benneh Mensah (Mrs.)

Address

Centre for Entrepreneurship and Small Enterprise Development (CESED)

School of Business

College of Humanities and Legal Studies

University of Cape Coast

Cape Coast

Ghana

Contact Information

Email: mmensah@ucc.edu.gh

Telephone: 00233 24 5093600

Date of Birth: 14th August, 1978

Research Interests: Knowledge-based economy, entrepreneurship education, case research, humane entrepreneurship, and managing entrepreneurial income

Education and Professional Qualification

- MBA in Small and Medium-Sized Enterprise Development, University of Leipzig, Leipzig, Germany
- Diploma in SMEs Management and Development, Galillee College, Israel
- Bachelor of Management Studies, University of Cape Coast, Cape Coast, Ghana
- Certified consultant and trainer, CEFE International, Germany

Current Employment and Engagement

- Senior Lecturer at the Centre for Entrepreneurship and Small Enterprise Development (CESED), University of Cape Coast, Cape Coast, Ghana
- Member of the editorial board of the Journal of Business and Enterprise Development (JOBED), School of Business, University of Cape Coast, Cape Coast, Ghana
- External Chief Examiner in Marketing Research for the BSc. Marketing Programme of the College of Distance Education, University of Cape Coast, Cape Coast, Ghana

Awards and Grants

- Award of the "Small Grants for Theses and Dissertations: 2014/2015 Academic Year", by the Association of African Universities (AAU) towards the completion of the Ph.D. thesis titled "Research collaboration for attainment of a knowledge-based economy in Ghana"
- Travel grant by the Deutscher Akademischer Ausländer-Dienst (DAAD) to attend the 12th International SEPnet workshop in Ethiopia
- Travel grant by the Deutscher Akademischer Ausländer-Dienst (DAAD) to attend a DAAD-SEPT International Workshop in Ghana
- Scholarship by the Katholischer Akademischer Ausländer-Dienst (KAAD) to pursue six-month language course and two-year post graduate study at the University of Leipzig, Germany.