KNOWLEDGE TRANSFER FROM RESEARCH TO INDUSTRY: THE PANACEA FOR GHANA'S SOCIO-ECONOMIC DEVELOPMENT

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Short Research Article

ABSTRACT

The appropriate nexus between research and knowledge in commercializing research outputs and knowledge transfer to create science-based technologies have become a relevant part of the institutional mission statement of some universities, alongside education and research. Most academic institutions in Ghana tout their prestige for research. The extent to which these institutions are making efforts towards the achievement of these core values was the concern for this study. This study therefore endeavored to find out the extent to which the research institutions are making conscious efforts to transfer knowledge to industry. The main objective was to find out the extent to which research interacts with industry in Ghana. The literature review was based on knowledge transfer from research to industry. The quantitative research method was used for the study with close-ended questions with response recorded on the Likert scale. The target population for the study was faculty and other researchers of CARLIGH. Purposive sampling method was used to select 50 faculty and other researchers. The data collected was analysed with SPSS and the result was presented in tables, and diagrams with interpretations and discussions. Some of the findings were that lectures were tailored towards knowledge transfer to the industry, faculty was fully aware of the industrial and commercial research opportunities.

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I. INTRODUCTION

It is believed that there is a positive relationship between research and socio-economic development, more specifically on research and (Gross Domestic Product) GDP of a country. Bozeman 2000 quoting the European Commission (EC 2007), stated that the participation of business in the governance of research institutions can help orientate research and educational activities towards the needs of society, ensuring that expertise support knowledge transfer activities, and showing willingness to introduce innovation-oriented approaches in all activities (European Commission, 2014). In the developed economies such as the EC, positive interaction between research and industry has helped to facilitate inter-sectoral mobility, namely through temporary staff exchanges and through the hiring of young graduates by industry. It is worthy to note that students are a means of knowledge transfer through postgraduate job placements and they often provide enduring links as the social glue holding together research and industry (Bozeman, 2000). According to Bagheri, Kusters, Trienekens & Van der Zandt (2016), Knowledge transfer is a crucial condition for obtaining effective collaboration among various stakeholders. According to them knowledge transfer refers to the process by which actors share knowledge among themselves through ongoing interactions (Bagheri, Kusters, Trienekens, & van der Zandt, 2016). Development is defined here as a planned and comprehensive economic, social, cultural and political process, in a defined geographic area, that is rights-based and ecologically oriented and aims to continually improve the well-being of the entire population and all its individuals (Fritz, 2010).

Development can be viewed as multi-dimensional phenomenon. Some scopes of development include: the level of economic growth, level of education, level of health services, degree of modernization, status of women, level of nutrition, quality of housing, distribution of goods and services, and access to communication (Currie-Alder, 2016). a combined index of development is constructed using four broadly accepted components: (a) economic production and economic condition or in other words level of economic development; (b) common minimum needs; (c) health and health-related services and (d) communication (Currie-Alder, 2016).

It is acknowledged worldwide that transfer of knowledge has played a key role in the economic and industrial development of many nations. It is believed that Less Developed Countries (LDCs) can increase their productivity and efficiency levels through the acquisition of technical knowledge and skills from the developed countries. The effective transfer of technology enables these countries to utilize their natural and human resources efficiently through transformation of inputs into outputs. Also, technology transfer is considered very imperative strategic variable; it is prudent to integrate it into the national development planning of LDCs (Jafarieh, 2001). Technology transfer is important to understand how knowledge is transformed to economic value. (Brundenius & Göransson). Universities and other research institutions accordingly, emerge as crucial players in innovation systems and as providers of not only human capital, but also of entrepreneurs and potentially transferrable technologies.

According to Astrid (2010), the low incomes that characterize developing countries are a result of their low average productivity, reflecting "their limited capacity to develop new or to adopt and improve upon existing technologies" (Altenburg, 2008). In Africa, technological capabilities are often not well developed, and firms in LDCs are typically characterized by very low levels of technological capabilities. Hence, examining the mechanisms that enable the adoption, mastering and improvement of technologies can be an important focus of innovation system research in Africa (Astrid, 2010).

Research revealed that there is an important knowledge enabler on knowledge transfer in the construction industry in Ghana (Owusu-Manu, Edwards, Parn, Antwi-Afari, & Aigbavboa, 2018). Owusu et al (2018) mentioned the factors of knowledge transfer as knowledge strategy, organizational culture, information technology and knowledge leadership factors and stated further that it is plausible to agree that they are necessary to the performance of Ghanaian construction firms as well as the economy as a whole (Owusu-Manu, Edwards, Parn, Antwi-Afari, & Aigbavboa, 2018).

It is further believed that the knowledge enablers such as knowledge strategy; organizational culture; information technology; and knowledge leadership supports knowledge transfer. However, information technology has proved to be the most important enabler for knowledge transfer within the construction industry in Ghana this is closely followed by; knowledge strategy (De-Graft, Edwards, Parn, Antwi-Afari, & Aigbavboa, 2018). Both research and industry in Ghana therefore can leverage on the enablers to ensure an appropriate appreciable knowledge-sharing regime. De-Graph et al., (2018) suggested that both research and industry policy in Ghana should guarantee that there is conscious collaboration in terms of knowledge transfers.

The collaboration must appraise the knowledge base of the industry which according to them is incapable of handling large-scale projects (De-Graft, Edwards, Parn, Antwi-Afari, & Aigbavboa, 2018).Studies have demonstrated that social ties play an important role in agricultural knowledge exchange, resulting in more effective and sustainable farming practices, particularly in developing-country agriculture (p. 2) (Hoang, Castella, Novosad as cited in Cadger, Quaicoo, Dawo and Marney 2016). According to Wood (as cited in Cadger, Quaicoo, Dawo and Marney 2016) the gap between research and industry can be attributed to inadequate communication and collaboration among institutions in Ghana and this has an adverse implication for agricultural development and improving farmer livelihoods (p. 4) (Wood as cited Cadger, Quaicoo, Dawo and Marney 2016).

Nonetheless, it has been reported that a lot of European research institutions have established knowledge transfer offices in recent years, with the view to collaborating and exploiting research results and their uptake by businesses (European Commission, 2007). Unfortunately, such collaborations are not common in Ghana. Therefore, there is a disjoint between

research and industry in Ghana. Consequently, as industry needs knowledge to improve their performances, there is a vast knowledge stored by universities and other research organizations. It is believed that this development has a negative result on Ghana's socio-economic developmental agenda.

In identifying the factors, that influence knowledge application in industries in Ghana Boateng and Narteh (2013) noted that in the present times, knowledge is very crucial to enhancing socio-economic development. It is a chief ingredient for organization's success and all its activities. There is therefore the need to enhance knowledge transfer initiatives in Ghana. This will speed up quickly socio-economic development of the country (Gunnlaugsdottir, 2003; Davenport and Prusak, 1998 as quoted in Boateng and Nartey 2013). Industry now looks for knowledgeable people to employ. Therefore, professional with management qualifications who can apply their knowledge in organizations are now being poached by competing firms (Rizvi and Aggarwal, 2005 as quoted in Boateng and Nartey 2013).

Consequently, according to Domfeh (2013) such an industry-academia collaborative initiative of the British Council has yielded positive results in knowledge and skills transfer from research to industry for productivity and effectiveness. Because of the knowledge transfer partnership programme, five Ghanaian industries acquired skills to find lasting solutions to industrial problems resulting into the outdoor of a sugar free chocolate and waste management technology inter alia. The initiative also among other things provides a networking platform for the private sector and higher education institutions to explore scientific knowledge, technology and skills for wealth creation (Domfeh, 2013). To achieve such knowledge, transfer regime, Cadger et al., (2016) quoting Tittonell et. Al., (2012) in their study on the farmer knowledge transfer in Ghana noted that agriculture-related development interventions, including training projects, often target 'key' individuals that may be considered influential within their community. The intention is that this knowledge gained will be transferred to the larger population (Cadger , Quaicoo , Dawo, & Marney , 2016). However, Rui, Zhang and Shipman (2017) noted that the African typically finds it more conducive to use informal medium in knowledge sharing and or transfer. The finding according to Rui, Zhang and Shipman (2017) could be one of the reasons why there seem to be no formal way of knowledge transfer in Ghana (Zhang & Shipman, 2017).

The relationship between research and socio-economic development cannot be overemphasized. According to Bayarcelik and Tasel (2012), the most pertinent factor for inventions are research and development activities. Consequently, socio-economic growth of a country is underpinned by vibrant research and development. Therefore, the countries aiming to improve the performance of economic growth should put gigantic emphasis on research and industry nexus. There is an alarming accusation by industry in Ghana that the graduates from the country's tertiary institutions are not really apt for the jobs in terms of the graduates' expertise (Awayiga, Onumah & Tsamenyi 2010, British Council 2013).

The Centre for Scientific and Industrial Research (CSIR) is mandated to pursue, among others, the implementation of government policies on scientific research and development, coordinate (Research and Development) R&D activities in the CSIR and other Science and S&T institutions nationwide and assist the government in the formulation of S&T policies for national development. The CSIR is further required to commercialize appropriate technologies, in partnership with the private sector and other stakeholders, and encourage in the national interest, scientific and industrial research of importance for the development of agriculture, health, medicine, environment, technology and other service sectors of the economy.

The extent to which CSIR is achieving this will be one of the core mandates of this research. In the case of Ashesi University College, it has also established a reputation as a leader in undergraduate education in Africa, with an educational experience that fosters ethical leadership, an entrepreneurial mindset and the ability to solve complex problems. The mission of Ashesi university is to educate ethical and entrepreneurial leaders in Africa; to cultivate in students, the critical thinking skills, concern for others and the courage it will take to transform the continent. The mandate, of KNUST essentially is to provide higher education, undertake research, disseminate knowledge and foster relationships with the outside persons and bodies. In summary, the vision can be stated as "Advancing knowledge in Science and Technology for sustainable development in Africa" It also aims at producing high caliber graduates with knowledge and expertise to support the industrial and socio-economic development of Ghana and Africa. University of Ghana on the other hand aims to create a vibrant intellectual climate that stimulates relevant cutting-edge research and community engagement globally. According to UG research will be central to the University's transformation process, and ultimately strengthening their impact and visibility internationally. Among other things UG aims to create a vibrant intellectual climate that stimulates relevant cutting-edge research and community engagement.

Moreover, UG is determined to establish University-Industry partnerships to promote research in areas of industrial/national interest. Develop and implement a training and career development programme for staff involved in research and research support.

The University's vision is to become a world class research-intensive University over the next decade. Its mission is to create an enabling environment that makes University of Ghana increasingly relevant to national and global development through cutting-edge research as well as high quality teaching and learning.

The appropriate nexus between research and knowledge in commercializing research outputs and knowledge transfer to create science-based technologies have become a relevant part of the institutional mission statement of some universities, alongside education and research. It is clear from the core values of the four research institutions involved in this study that all of them have made some level of commitment towards industry engagement. However, the extent to which these

institutions are making efforts towards the achievement of these core values will be a concern to this research. This study will therefore endeavor to unearth the extent to which the research institutions are making conscious efforts to transfer knowledge to industry.

II. LITERETURE REVIEW

Relationship between research and socio-economic development

The relationship between research and socio-economic development cannot be overemphasized. Because of this, many advance and developing economies have put a lot of premiums on knowledge transfer from research to industry. The attitude of leadership of governments towards supporting this important nexus has, therefore, witnessed a positive change in recent times. According to Tijssen and Wong (2016), many advanced economies witness increasing public positive attitude towards the utility and commercialisation of publicly funded research, and growing pressure for apparent socioeconomic impact (Tijssen & Wong3, 2016).

According to this arrangement, many research-driven universities actively promote Research and Development (R&D) cooperation with, and knowledge transfer to the industry. Leading research-driven universities in industrial-relevant fields of science are often actively involved in contract research, consultation, and engaged in other R&D linkages with the business sector to generate funding for research. This linkage is not common in Ghana.

The knowledge generated in Ghanaian universities hardly see the light of the day so far as commercialization is concerned which, according to Osabutey and Jin (2016), is attributed to absence of requisite government policies and a poorly regulated industry. In their study on "Factors influencing technology and knowledge transfer: configurational recipes for Sub-Saharan Africa" Osabutey and Jin (2016) further noted that some of the most significant factors for the absence of technology and knowledge (T&K) transfer in Africa sub of the Sahara are ineffective industry associations, lack of professional bodies, and educational systems' commitment (Osabutey & Jin, 2016). According to Henrekson and Rosenberg (as cited in Baraldi, Lindahl, and Severinsson 2016), "Swedish universities are progressively expected by their national government to support innovations" (Henrekson & Rosenberg as cited in Baraldi, Marcus, & Kristofer, 2016. In a knowledge-based economy, the university plays a significant role as a knowledge producer and its disseminator to industry and wider society (Guerrero, Urbano, Cunningham, & Organ, 2014). In this regard, Trencher et al. (2014) stated that some universities have introduced entrepreneurship as the universities' third mission so that it contributes significantly towards socio economic development. Due to the eagerness to provide knowledge for industry's consumption, entrepreneurship has therefore emerged alongside the main two missions of teaching and basic research in some universities (Trencher, Yarime, McCormick, Doll, & Kraines, 2014).

Several approaches are deployed by the universities to stimulate their usefulness regarding knowledge production and subsequent assimilation by industry. Universities, according to

Aldridge and Audretcsh (2012), have brought together various disciplines of knowledge and research to engineer solutions to perplexing situations (Aldridge & Audretsch, 2012).

Collaboration across disciplines has become crucial because research has become more complex by exploring the synergies of multiple domains (Haythornthwaite, 2006). Thus, collaboration between knowledge creators and industry as well as flexibility have become very important factors in the world of great scientific advances in the areas of knowledge transfer to engender socio-economic development (Can˜ ibano, Otamendi, & Andujar, 2008). Undeniably, academics' relationship and interactions in various disciplines as well as cooperation with industry partners are the chief factors in reconciling the necessary knowledge and skills needed for joint advances in research leading to socio-economic development (Katz & and Martin as cited in Bhatti 2011).

Establishing various networks within the scientific community are crucial for scientific progress by researchers. Personal networks outside of academia are equally essential to commercial progress (Nordfors, Sandred, & Wessner, 2003). Indeed, networking among researchers strengthens both scientific productivity and university–industry knowledge transfer for socio-economic development (Varga & Parag, 2009). On the one hand, knowledge networks have the potential to create innovation benefits, as channels through which knowledge spillover reaches all closely or loosely connected parties, and on the other hand, as closed canals which ensure that information exchange only occurs between the specific connected parties (Owen-Smith & and Powell, 2004). Thus, formal and informal networks with public and private organizations serve as umbrellas for interaction and collaboration (Inzelt, 2004). Indeed, networking stimulates individuals with different technological backgrounds to engage in collaborative activity (Protogerou, Caloghirou, & Siokas, 2013). The importance of networks in knowledge transfer is also evident from a domain of research. The growing awareness of the importance of networks in knowledge sharing has also raised an interest in conducting network analysis, which has become an important methodology used in innovation research by studying relationships among a set of individuals or nodes. Despite the various interactions occurring between European knowledge institutes and industries, there is still an opportunity (Coulon, 2005). According to the EC (2007), every relevant industry player in the knowledge transfer from research to industry should become aware of the imperative link with the industry. It is therefore important to ensure that researchers are aware of the benefits of the interaction and that decisions are made on the basis of socio-economic impact (European Commission, 2007). Johnson as cited in (Kaklauskas , et al., 2018) stated that awareness, which includes career fairs and interviews among industry players is imperative for knowledge transfer from research to industry.

Improving knowledge transfer between research institutions and industry

The increasing relevance of knowledge generation by research institutions and subsequent transfer to industry has been touted as a catalyst for socio economic development (Merchán-

Hernández, , Valmaseda-Andia , & Fernández-Esquinas , 2015)**.** And, in the contemporary times research institutions and industry have realized the need to engage in conscious and active knowledge sharing practices. Since time immemorial, research institutions were leaders in generating new ideas which culminates into innovations. Industry therefore offers the normal course to optimal the use of these novel ideas. In current times, many organizations in the developing world have espoused the idea of joining together research and industryto improve knowledge transfer from research to industry.

According to the EC (2007), organizations tend to treat public research as a strategic resource. It is obvious, according to the EC, that research institutions need to play a more dynamic role in their partnership with industry to maximize the use of the research result. It is, therefore, incumbent on industry to recruit and adequately train staff who are required to identify and manage knowledge resources with business potential, that is, how to take novel ideas to their industries (European Commission, 2014).

Positive industry-university partnership is key in supporting the missions and motivations of both research institutions and industry. The incentive for universities and research institutions to collaborate with industry involves, among other things, the improvement of research access to funding and access to empirical data from industry.

For industries, the incentive to partner with universities and other research organizations may involve, but not limited to, technological knowledge such as patent and tacit knowledge, having access to talented workers, providing training to existing or potential employees, accessing the university's facilities and equipment, having access to public funding and other motivations, inter alia (Guimon, 2013). Again, industry could also pursue to mitigate risk by sharing the cost of R&D, and to influence the teaching and research agenda in totality in universities and research organizations (Guimon, 2013).

Justas raw materials were prominent during the early times of industrialization, in the knowledge-based economy of today, it is imperative to see increasing public commitment resulting into policies, emphasis on the utility and commercialization of publicly funded research, and growing pressure for demonstrable socio-economic impact as key. Brain power, inventiveness, and creativity have become highly valued resources in contemporary 'knowledge-based' economies. Therefore, both industry and research institutions must make better bilateral commitments toward improving knowledge transfer from research to industry (Hughes & Moore, 2008).

Responding to improving knowledge transfer from research to industry, many research-active universities actively promote R&D cooperation with industries and ensures knowledge transfer to the business sector (Hughes & Moore, 2008). Leading research-active universities in industrial-relevant fields of science are often actively involved in contract research, consultation, and engaged in other R&D linkages with the business sector to generate funding for research. Commercializing research outputs and transferring knowledge to create science-based technologies have become an integral part of the institutional mission statement of such universities,

alongside education and research (International Encyclopedia of the Social Sciences 2008).

Thus, the knowledge generated by academia is, in principle, valuable; however, the value is realized only when the knowledge is applied in practice. Indeed, this is true of all scientific and engineering researches (Tijssen & Wong, 2016).

According to D'Ester et al. (2012), the literature shows that interactions with industry are a good predictor of successful technology transfer. Karlar and Antoncic (2015) also averred that interactions with industry facilitate the transfer of knowledge between academia and industry, thereby contributing to national innovation performance (Bishop et al. 2011). Based on these assertions, it is therefore a win-win strategy for both research and industry to engage each other in knowledge transfer and stimulate conscious knowledge sharing (Kalar & Antoncic, 2015).

Challenges of Knowledge transfer from research to industry

To effectively transfer knowledge from research to industry, several challenges needed to be considered. Guimón (2013) mentions some of these challenges that needed to be eliminated for such a collaboration to see the light of the day. Accordingly, there is an inherent mismatch between the research orientations of firms and universities, with an excessive focus on fast commercial results in firms and on basic research in universities (Guimon, 2013). Collaboration is costly, and the returns only accrue in the medium to long run, but firms seek short- term results and clear contributions to current business lines. In terms of outputs, firms are usually interested in how quickly new patents or new products can be obtained and want to delay publications to avoid disclosing information. University researchers, in contrast, are typically motivated to publish research results as fast as possible.

In another development, industry is concerned about secrecy and misalignment of expectations about intellectual property (IP) rights and making a profit from them. Thus, agreements need to be established in a commercially timely manner that ensures the ability to commercialize with appropriate returns. These and other bottlenecks needed to be removed for that collaboration between research and industry to reach mutual consensus.

Garcia and Mitra (2007) states that besides this lofty appraisal of the collaboration between research and industry, concerns exist towards such a valuable partnership. Because of such collaboration, universities' research is likely to be skewed towards market-orientation concerning firms' innovative problems. This may imply fewer publications, as well as changes in the research agenda of the university (García-Almeida & Yu , 2015).

Problems of orientation can also arise, because firms' innovative projects are usually linked to short-term problems driven by their operational needs (Perkmann, et al., 2013). It is also a fact that there are a set of goals accepted as legitimate within the academic community and others accepted within the industry community. While the academic community is concerned with additions to the stock of public knowledge, the

community of firms' researchers is concerned with adding to the stream of rents that may be derived from possession of the rights to use private knowledge. Nonetheless, to safeguard a prudent collaboration between research and industry towards production of new knowledge, there is the need to have both communities firmly in place and attend to maintaining a synergetic equilibrium between them (Larkin, 2014).

García-Almeida & Yu (2015) stated further that there are important barriers that affect knowledge transfer from research to industry. Prominent among them is orientation barrier. This relates to the main motivations and concerns of academic researchers. One of the main characteristics of researchers is the possibility of pursuing research freely, according to personal curiosity, and to some extent job promotion (García-Almeida & Yu , 2015).

In engaging industry towards knowledge transfer, researchers are often concerned about respective logics prevailing in university and industry. One of them is the confidentiality of knowledge, which refers to the extent to which interaction with firms could lead to restrictions on exposing research findings and on the dissemination of research results, with hazards to norms of open science (Tartari, Salter, & D'Este, 2012)

For commercial purposes, industry prefers that research results, may be delayed, or if possible, totally foregone, the publication of the results (Perkmann & Walsh , 2007) This has the potential to limit academic freedom if researchers are encouraged to produce research results for commercial purposes and to move away from basic research (Mowery , Oxley, & Brian, 2002).

Interaction with industry could delay or avoid researchers from publication since their partnership with industry could neither produce novel nor sufficiently academically innovative papers qualified for publication in academic journals (Perkmann & Walsh, 2009; Tartari Salter, & D'Este 2012). As a result, skewing problems could arise from the collaboration with industry, since interaction could impose constrains on academic researchers' autonomy to establish their own research agenda (Tartari, Salter, & D'Este, 2012)

Boateng and Narteh (2015) studied knowledge application in Ghanaian industries and stated that numerous factors hinder knowledge absorption by industry. Firstly, they believed that trust is very crucial for knowledge application (Boateng & Narteh, 2015). According to Gupta and Govindarajan (as cited in Boateng and Narteh 2015) knowledge application can only be possible if there exist trust between the research community and industry (Boateng & Narteh, 2015). It was explained that trust is needed to overcome problems and unforeseen obstacles during knowledge transfer processes. Narteh (2008) also asserts that trust is a very critical factor in every successful collaboration and relationship including knowledge transfer from research to industry (Narteh, 2008).

It is also noted that culture is a significant factor in knowledge transfer (De Long & Fahey , 2000). Karlsen & Gottschalk (2004) further identified four ways that culture affects knowledge application. First, the kind of knowledge worth transferring is shaped by culture (Karlsen & Gottschalk , 2004). Secondly, the relationship between an individual and organizational knowledge is defined by culture, affecting the control and sharing of knowledge in an organization. Thirdly, culture offers congenial environment for social collaboration, which impacts knowledge sharing either positively or negatively. Lastly, culture shapes the legitimate use and distribution of knowledge. In the words of Hayes &Clark as cited in Boateng and Narteh (2015) some organizations reject knowledge that emanates from outside their organization, especially if that will mean its members abandoning existing knowledge and abilities (Leonard-Barton cited in Boateng and Narteh 2015).

According to Boateng and Narteh (2015) knowledge application is made with expectations, and therefore overall value is likely to increase for both organizations and individuals when there is a reward system. Motivation, whether intrinsic or extrinsic, is key to knowledge transfer from research to industry. Motivation could lead to willingness for knowledge transfer from research to industry. Knowledge application is likely to occur when the transferors are willing devoid of fear of losing ownership to share their knowledge (Boateng & Narteh 2015, Liyanage et al. 2009).

According to Nangia and Pramnik (2011) faculties or academia have pervasive apathy towards applied research and they are reluctant to leave the comfort zone of pure teaching. There is obstinate among academics towards collaborative projects with industry that typically hinder innovation. Academia seems chiefly unaware of the real industrial and national needs and unable to market its strengths to industry adequately. The challenges inhibiting knowledge transfer from research to industry are lack of appropriate incentive to faculty and specialized technical infrastructure such as laboratory (R&D Lab.), absence of proper recognition for practicing faculty as compared with pure academics celebrant, bureaucratic hiccups in utilisation of consultancy funds, absence of exclusive university-industry interaction cell in campus, etc (Nangia, & Pramanik, 2011). On the other hand, Industry, characteristically, is always interested in survival, profit and targeted development. During its interaction with the academia, industry's preferred time frames are prompt, and investment is directed by efforts that produce result-oriented solutions. The costing frames are typically directed by reluctance to invest in its internal R&D which has either long term or unclear output. The other factors which hinder research-industry interaction are insensitivity to, or lack of awareness of, the tons of resource potential of the academia; abundant dependence on easily available foreign know-how; an unhealthy obsession with expensive, eminent professional consultants; earlier bitter experience of interactions with the academia; obligations of ongoing technical collaboration agreements; anxiety to keep secret information of failure or success, confidential for fear of losing the competitive edge etc (Nangia, & Pramanik, 2011).

The Contingent Effectiveness Model of Technology Transfer

This study employs the Contingent Effectiveness Model's model by Bozeman (2000) (Bozeman, 2000). This model, originally entitled the "Contingent Effectiveness Model of Technology Transfer," has by this time been adapted or applied

directly in scores of analyses or evaluations of technology transfer or knowledge transfer in a wide variety of articles, ranging from industrial ecology to higher education innovations to transfer of vaccines (Ramakrishnan, 2004; Albors, Hervas, and Hidalgo, 2006; 2009; Mohammed, et al., 2010; Kitagawa and Lightower, 2012; Hendriks, 2012) as quoted in Bozeman (2013) (Ramakrishnan, 2004). In the current study, the model is used to analyze knowledge transfer from research to industry in Ghana (Bozeman, 2000)
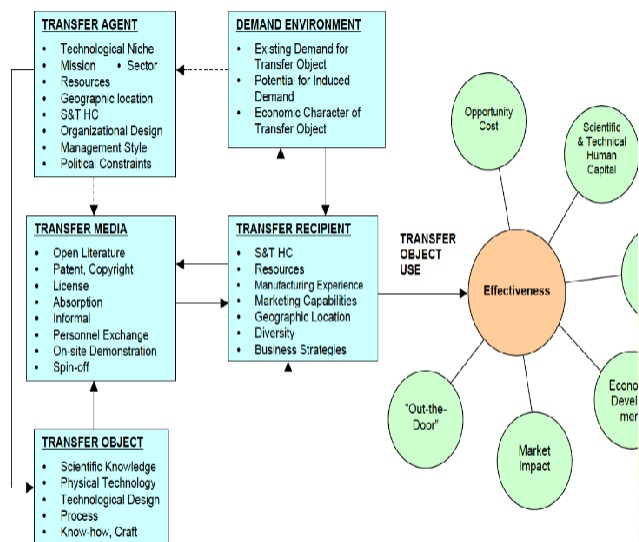

Figure One: Contingent Effectiveness Model of Technology Transfer

Figure 1 by Bozeman, 2000

Fig. 1 shows the rudiments of the Contingent Effectiveness Model of technology transfer. The Contingent Effectiveness Model acquires its name from its assumption that parties to technology transfer have multiple goals and effectiveness criteria (Bozeman2013). The model is made up of five wide dimensions determine effectiveness:

1. Characteristics of the transfer agent;
2. Characteristics of the transfer media;
3. Characteristics of the transfer object;
4. The demand environment, and;
5. Characteristics of the transfer recipient (Bozeman 2000).

These dimensions are mutually inclusive and, therefore, they are broad enough to include most of the variables examined in studies of knowledge transfer from research to industry. The relations in the models are specified by the arrows among the various dimensions while broken lines show weaker relations. In applying the model to this study, it simply says that the effects of knowledge transfer can be understood in terms of who is doing the transfer, how they are doing it, what is being transferred and to whom (Bozeman B. , Technology Transfer Research and Evaluation: Implications for Federal Laboratory Practice, 2013). The major assumption of the Contingent

Effectiveness Model is no single notion of effectiveness makes much sense, either theoretically or practically (Bozeman 2000). It is rather unfortunate that many studies of technology transfer do not elucidate what is meant by effectiveness rather appears simply to assume that people in general hold some indefinite unitary concept of effectiveness.

III. METHODS

The research approach involved a survey of researchers from five institutions to achieve its purpose of finding out knowledge transfer from research to industry as a panacea for Ghana's socio-economic development. The study specifically targeted Faculty and other researcher of University of Ghana, Kwame Nkrumah University of Science and Technology, Centre for Scientific and Industrial Research Institute of Technological Information, Methodist University College Ghana and Pentecost University College. The study employed purposive sampling method to sample 20 researchers from each institution making 100 respondents in all. The data was collected by the use of a questionnaire. The questionnaire has two sections, section A for demographic data and the B for the main questions on the knowledge transfer from research to industry which was measured on a five-point likert scale: Strongly agree, Agree, Neutral, Disagree and Strongly Disagree. The findings of the study covered faculty and other researchers of the institutions covered. The gender, age, education, institution, occupation and position of the respondents. The male respondents, more than thrice outnumbered their female counterparts.
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IV.   RESULTS

Table 1: Table Demographic information on the participants

Gender	Frequency	Percentages
Male	59	59
Female	41	41
Total	100	100
Ages	**Frequency**	**Percentages**
Below 30years	15	15
31-40	37	37
41-50	30	30
Above 50years	18	18
Total	**100**	**100**
Name of Institutions	**Frequency**	**Percentages**
UG	20	20
MUG	20	20
KNUST	20	20
CSIR	20	20
PU	20	20
Total	**100**	**100**
Positions of the Participants	**Frequency**	**Percentages**
Professor	5	5

Senior Research Assistant	6	6
Senior Assistant Librarian	24	24
Deputy Librarian	18	18
Lecturers	31	31
Senior Lecturers	16	16

The table above analyses the demographic information of the participants. According to the table, the gender of the participants indicates 59% being males and 41%% being females. The ages of the respondents ranged from 31years to above 50years. Majority of the respondents were aged between 31years and 40years. The figure above shows respondents from the various institutions, 10 respondents each were sampled from the institutions making a total of 50 researchers. The finding shows that majority (76%) of the respondents were lecturers with equal percentage (12%) of librarian and other researchers. Most of the other researchers were from CSIR. The positions of the respondents according to the table were senior research assistants (6%), senior assistant librarians (24%), deputy librarians, (18%) lecturers, (31%) senior lecturers (16%) and professors (5%).

Table 2: Staff Awareness of Research-Industry Partnership

Awareness	Frequency	Percentages
Strongly Agree	22	22
Agree	54	54
Neutral	14	14
Disagree	8	8
Strongly Disagree	2	2

The findings included faculty staff awareness or consciousness of academic-industry partnership, sufficiency of research capabilities of faculty towards relevant industry related research, confidence of faculty towards industry research, motivation of faculty towards industrial research inter alia.

Table 3: Academics feel confident to undertake industrial Projects

Academics Confidence	Frequency	Percentages
Strongly Agree	22	22
Agree	52	52
Neutral	10	10
Disagree	14	14
Strongly Disagree	2	2

The finding in Table 3 indicates that majority of the respondents (54% agree and 22% strongly agree) agree that there is an awareness among researchers towards knowledge transfer to industry.

Table 4: Faculty is Motivated for Industry Oriented Research

Faculty Motivation	Frequency	Percentages
Strongly Agree	6	6
Agree	54	54
Neutral	12	12
Disagree	20	20
Strongly Disagree	8	8

As shown in the Table 4 the finding indicates that majority of the respondents (52% agree and 22% strongly agree) agree that there is an awareness among researchers towards knowledge transfer to industry.

Table 5: Teaching and Other Administrative Load Prevents Faculty from Undertaking Industrial Projects

Teaching Loads	Frequency	Percentages
Strongly Agree	16	16
Agree	34	34
Neutral	6	6
Disagree	30	30
Strongly Disagree	14	14

The analyses of the data according to Table 5 shows that majority respondents (a total of 48%) agree and total of 46% disagree that teaching loads of prevent researchers from conducting industrial research.

Table 6: Academic researchers do not consider industrial collaboration as part of their job

Collaboration is not part of Job	Frequency	Percentages
Strongly Agree	6	6
Agree	20	20
Neutral	26	26
Disagree	48	48
Strongly Disagree	---	---

Further, the findings indicate that majority of the respondents disagreed that researcher/faculty did not consider industrial collaboration as part of their job. This implies that majority of the respondent believed that researchers considered industrial research as part of their job. According to the literature review, knowledge transfer is a crucial condition for effective collaboration among the stakeholders. These findings therefore concur with previous findings.

Table 7: Faculty is fully aware of the industrial and commercial research opportunities.

Aware of industrial Opportunities	Frequency	Percentages
Strongly Agree	18	18
Agree	52	52
Neutral	20	20
Disagree	6	6
Strongly Disagree	4	4

Table 7 demonstrates that majority (52%) responses went in favour of agreement to the statement that faculty is fully aware of the industrial and commercial research opportunities, this was followed by 20% neutral and 18% strongly disagree. The finding implies that there is a general consciousness among faculty concerning industrial research.

Table 8: Academic-Industry Collaboration has a Negative Influence on the Instructional Mission

Collaboration has Negative influence	Frequency	Percentages
Strongly Agree	2	2
Agree	6	6
Neutral	12	12
Disagree	54	54
Strongly Disagree	26	26

The table above shows how the researchers responded to academic-industry collaboration negative influence on the instructional mission. To majority (disagree 54%, strongly disagree) the collaboration did not have negative influence on the core mission.

Table 9: Two-Way Communication between University and Industry is a Regular Activity of University's Calendar

Two-Way Communication	Frequency	Percentages
Strongly Agree	2	2
Agree	26	26
Neutral	36	36
Disagree	30	30
Strongly Disagree	6	6

The result from the above table indicates that majority (36%) of the respondents neither agreed nor disagree with the two-way communication between university and industry as a regular activity on the universities calendar. In aggregate however a total of 36% disagree, while 30% agree.

Table 4.10: Gaps between actual and expected performance of Academic-Industry collaborations are systematically measured

Gaps between performance	Frequency	Percentages
Strongly Agree	----	----
Agree	52	52
Neutral	6	6
Disagree	42	42
Strongly Disagree	-------	----

The table above shows responses to gaps between actual and expected performance of Academic-Industry collaborations. The result shows that 52% of the respondents agree disagree, 42% were neutral and 6% agree. This means majority of the respondents did not believe that the gap between actual and expected performance of Academic-Industry collaborations are systematically measured.

Table 4.11 People are recognized for taking initiative for Commercial/Industrial research projects

Recognition for initiative	Frequency	Percentages
Strongly Agree	6	6
Agree	50	50
Neutral	14	14
Disagree	22	22
Strongly Disagree	8	8

Individuals want recognition for positive contributions they make. The result of the study shows that 50% of the respondents agree that they were or other people were recognized for taking initiative for Commercial/Industrial research projects.

Table 4.12 Lack of enough laboratory facilities to support academic-industry partnerships

Lack of Labs	Frequency	Percentages
Strongly Agree	26	26
Agree	42	42
Neutral	12	12
Disagree	10	10
Strongly Disagree	10	10

The study inquired about sufficiency of laboratory and research facilities in support of research-industry partnership, 42% of the respondent's representing majority agreed that they did not have enough of such facilities, 26% strongly agreed and 20% disagreed.

Table 4.13 During the past 5years, did your organisation receive any public financial support specifically for innovation activities

Public Support	Frequency	Percentages
Strongly Agree	----	---
Agree	16	16
Neutral	34	34
Disagree	30	30
Strongly Disagree	20	20

Majority (34%) of the respondents neither agreed nor disagreed that their institutions received funding support towards research from the public, 30% disagreed. However, 16% agreed.

Table 4.14 My lectures are tailored towards knowledge transfer to the industry

Transfer of Knowledge	Frequency	Percentages
Strongly Agree	20	20
Agree	46	46
Neutral	18	18
Disagree	10	10
Strongly Disagree	6	6

The faculties were to indicate if their lectures were tailored knowledge transfer to industry, most (40%) of respondents agreed while 16% disagreed.

Table 4.15 Producing research results for commercial purposes and moving away from basic research has the potential to limit academic freedom

Moving from Basic Research	Frequency	Percentages
Strongly Agree	16	16
Agree	14	14
Neutral	22	22
Disagree	20	20
Strongly Disagree	28	28

Lastly respondents did not agree that producing research results for commercial purposes and moving away from basic research has the potential to limit academic freedom as shown in the Table 4.15.

V. DISCUSSION

Relationship between research and socio-economic development

The discussions of the study were based on the objectives of the study. The first objective sought to find out the relationship between research and socio-economic development. According to the study, researchers were aware of academia-industry partnership; there are active research teams/groups who are focused on industrial and commercial projects, faculty is fully aware of the industrial and commercial research opportunities, classroom lectures were tailored towards knowledge transfer to the industry among others. These findings are consistent with previous studies. In the literature review, it was indicated that the is an awareness among researchers towards knowledge sharing (Kaklauskas , et al., 2018, Coulon, 2005, EC, 2007).

Improving knowledge transfer between research institutions and industry

The researcher also discovered that faculty is motivated for industry-oriented research, researchers were recognized for taking initiative for industrial research, the university has clear procedures and processes in place to support academia-industry collaboration, researchers received funding specifically towards innovation activities, two-way communication between university and industry is a regular activity of university calendar. While the finding on recognition disagrees with Nangia, & Pramanik, (2011), other findings however agree with previous studies. According to Boateng & Narteh (2015), Liyanage et al. (2009).

knowledge application is made with expectations, and therefore overall value is likely to increase for both organizations and individuals when there is a reward system. Motivation, whether intrinsic or extrinsic, is key to knowledge transfer from research to industry. Motivation could lead to willingness for knowledge transfer from research to industry. Knowledge application is likely to occur when the transferors are willing devoid of fear of losing ownership to share their knowledge

Challenges of Knowledge transfer from research to industry

According to the findings, there were some challenges of knowledge transfer between industry and research, some of them were insufficient research capabilities, for industry collaboration, teaching and other administrative load preventing faculty from undertaking industrial projects, Academic-Industry collaboration has a negative influence on the instructional mission, insufficient research facilities by the university towards industrial research, skewing problems by research institutions arising from the collaboration with industry among others. This finding is consistent with (Guimón 2013, Garcia and Mitra 2007, García-Almeida & Yu , 2015, Nangia and Pramnik 2011, artari, Salter, & D'Este, 2012).

The literature stated that research is likely to be skewed towards market-orientation causing academics to lose their autonomy, and also, while the academic community is concerned with additions to the stock of public knowledge, the industry is concerned with patents, product and service development, profits etc. This finding did not agree with similar studies in Ghana by Wood as cited in Cadger, Quaicoo, Dawo and Marney (2016). They have found gaps in communication between research and industry. This result is consistent with the view of Boateng and Narteh (2015). They emphasized the need for such recognition in the form of reward system.

VI.   CONCLUSION

Knowledge transfer from research to industry is key for innovations and socio-economic development of any country. There is need for conscious awareness among researchers towards the knowledge needs of the industry. Academics and other researchers ought to form an active research team focusing on industrial and commercial projects. Further, faculty must be motivated for industry-oriented research and also two-way communication between university and industry being regular activity on university calendar is key. Academic-industry collaboration to some extent has a negative influence on the instructional mission of universities and the insufficient research facilities by the university towards industrial research, are serious issues that need a redress. Lastly as a result of this collaboration, there is skewing problems by research institutions culminating into the loss of academic freedom.

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