Determinants of Effective Academia- Industry Collaboration in Building Construction Research in Ghana

Dok Yen D. M.^{1,*}, Adinyira E.², Dauda A. M.¹

¹Department of Building Technology, Tamale Technical University, Tamale, Ghana ²Department of Building Technology, Kwame Nkrumah University of Science and Technology, Kumasi, Ghana

Abstract This study seeks to establish the determinants of academia-industry collaboration in Building research in Ghana. A total of 130 construction practising professionals consisting of Ghana Institute of Construction (GIOC) corporate members (QS, Architects, Engineers and so on) from the industry, and academics from tertiary academic institutions (i.e. Lecturers from KNUST and UEW) that run postgraduate construction programmes in Ghana as at February 2016 constituted the respondents for this study. Census and systematic sampling technique were used for the population sample. Factor analysis was employed in analyzing the data for the study. The determinants of academia and industry collaborative building research were revealed to be; a common goal, healthy relationship, judicious use of resources, effective communication, benefits to partners, as well as a clearly defined objectives. A well structured and detailed deliberation on these research findings among partners can lead to effective as well as successful research collaboration between the academia and industry in reaping the benefits of building research.

Keywords Determinants, Academia and Industry, Collaboration, Building Construction, Research, Ghana

1. Introduction

Collaborative research is considered to be the best way for the academia and industry to pooling their individual resources for innovation and development in the construction industry. It is an established fact that the backbone of most innovations is as a result of joint research publication through collaborative research (Adinyira et al., 2011). Academia-industry collaboration often provides an excellent opportunity for new discovery and innovation (Tumbas et al., 2016). Studies have revealed that research collaborations between academic researchers and industry practitioners enable researchers to conduct research projects that are more relevant to current business practices and context (Amabile et al., 2001). However, whilst industry players wants quick research solutions to address their immediate problems in the real world, the academia is often committed to probing of theories over a longer period time (Angela and Rachel, 2016). Notwithstanding that, while most nations are dedicated to working collaboratively through research to overcome

dydavid@tatu.edu.gh (Dok Yen D. M.)

Copyright © 2018 The Author(s). Published by Scientific & Academic Publishing This work is licensed under the Creative Commons Attribution International License (CC BY). http://creativecommons.org/licenses/by/4.0/

significant problems in their construction industry (Yeung and Chan, 2002), these researchers are of the view that Ghana cannot boast of such interventions. Although, there have been several calls for closer collaboration between the academia and industry to network their various resources in the area of research and innovation to champion industrial and socio-economic growth in Ghana (modernghana, 2007). The Ghanaian construction industry cannot boast of any effective formal collaboration between the academia and industry in construction research. Moreover, a study by Adinyira et al. (2011) and Dok Yen (2010) in their examination of data on research publications from the College of Architecture and planning, now College of Art and Built Environments-KNUST, between the years 2006 to 2008, revealed that there was no any formal collaboration between academia and industry in building construction research, even though, this college is a unique college made up of all the departments directly responsible for training and dissemination of knowledge to various construction professionals responsible for managing the affairs in the construction industry in Ghana (CIG). This can only be improved if there is good formal research collaboration between the academia and industry. This research seeks to establish the determinant of academia and industry collaboration in building construction research to improve on the level of collaboration between the industry and academia to help address building construction problem in Ghana as

^{*} Corresponding author:

Published online at http://journal.sapub.org/ijcem

well as Africa.

1.1. Background of the Construction Industry in Ghana

The academia and industry are the main key players in the Ghanaian construction industry. The academia is made up of research institutions such as; The Building and Road Research Institute (BRRI), Council for Science and Research Industry (CSRI), Tertiary Institutions (That is Universities, Technical Universities and Polytechnics Building and Civil Engineering Faculties, Technical and vocational schools who run building craft programmes). The industry on the other hand is also made up of Professional Bodies and industry players such as; Ghana Institute of Surveyors (GHIS), Ghana Institutes of Construction (GIOC), Ghana institute of Architects (GIA), Ghana Institute of Engineers (GHIE), government departments (Laboratory's, survey departments, Land Commission and Town and Country Planning.), donors, contractors, consultants, Quantity Surveyors, Architects, Engineers, manufacturers, suppliers, skill and unskilled labour, and so on.

The academia is responsible for teaching and training of construction professionals (That is; Quantity Surveyors, Architects, Engineers, and so on) to feed the construction industry in Ghana. They also conduct construction research to contribute to knowledge, innovations, problem-solving, to the industry and society as a whole. The industry on the other hand, is responsible for the construction, consulting, supervision, monitoring, contract documentations, and so on and so forth that are all aspects of production of construction products in the country, they are responsible for absorbing or employing the professional's trained from the academia and converting their knowledge acquired from school into practice for the production of construction products. Hence, there is the need for the industry to share their major problems that needs to be researched with the academia for joint research and innovative solutions. On the other hand the academia needs should put effort by consulting to know the real problems areas industry faces that needs research and solutions, rather than just research into problems or issues perceive to be the real needs of the industry.

2. Theoritical Framework

According to Fiedler *et al.* (2007) effective collaboration requires some level of professionalism, understanding, respect among partners, and some amount of benefit to all partners. Furthermore, Shelbourn *et al.* (2012) argued that collaborative research may also be influenced or achieved effectively by aligning the three fundamental strategic areas of concern; that is people, business and technology. The most important predominant aspect of successful collaboration is by the introduction of fresh ways of working by involving all the cooperating partners. It is indispensable to allow collaborating stakeholders to spend enough time from their routine duties as much as possible to see and

regularly interact with all collaborators to build a beneficial trust and respect among themselves. It is an obvious fact that academic institutions alone are not well equipped to respond flexibly to industry needs. (Tumbas et al., 2016).

Oberg (2016), study affirmed that parties that engage collaboration often leads increase their effectiveness. Therefore, academia- industry collaboration should broadly embrace and practiced in the area of construction research to address the numerous problems in the construction industry in Ghana, Whilst achieving the full benefits of returns on collaboration (Agyekum et al., 2017).

2.1. Key Influencing Factors of Successful Collaboration

The key element of successful collaboration in a similar study were identified as a common goal, mutual trust, shared vision. comprehensible defined roles. efficient communication, strategic and long-term focus, sincerity and honesty (Cheng and Li, 2004; Beach et al., 2005; Chan et al., 2006; Larson 1997 and Chan et al. 2008). However, Cheng and Li (2002), explained that the important factors influencing successful partnerships can be separated into three phases of the collaboration process, this includes; establishment, application and reactivation. Failure to include these elements is detrimental to successful collaboration (Chan et al. 2003b and Ng et al. 2002).

2.2. Drivers of Collaboration

Akintove and Main's (2007) study identified six drivers for tactical collaboration process as follows: usefulness of partners comes where they have a common vision of long-term development within the organisation/institution that calls for collaboration, with the perception being that this would have an improvement on the stance of the individuals; that requires for systematic fit in relation to their strategies; that the collaboration will only be prepared to make considerations with organisations/institutions when the partnership strategy is significant to partners; also, successful collaboration requires some mutual level of dependence; any collaboration should have at least some amount of benefits for the partners involved, and finally collaborating partners should carefully examine whether the kind of collaboration they go in for is really good for their market demand. According to Draulans et al. (2003) the characteristics of partnership, the competence level of partners on which organisation is built for control and management of collaborative activities can lead to a more enhancement in successful collaboration than just focusing on strategic fit of partners. However, the ultimate goal of the collaboration is often to achieve improvement and development among partners in their various individual objectives (Nystrom 2005). Therefore, every effective collaborative designed system should be the object of achieving a win-win issue for all parties within the collaborative agenda (Black et al. 2000). To accomplish a "win-win" agenda, it would be important for the effective collaboration if all the various parties align their individual

objectives to a mutual goal (Zuo et al. 2013).

2.3. Initiatives for Collaborative Research

According to Chun-Yu *et al.* (2013), collaborative research can be initiated through forums, conferences and congresses. Moreover, their study revealed that collaboration can be initiated through job training courses by inviting both academic and industry scholars to make presentation new management prospects. Furthermore, courses jointly taught by both academia and industries players can promote relationship and produces more effective collaborative knowledge such as teaching and learning materials.

3. Methodology

The compass of this research was constrained to a workable representation of the population by capturing only practising professionals directly within construction academia/industry in Ghana. A total of 130 construction practising professionals consisting of Ghana Institute of Construction (GIOC) corporate members (QS, Architects, Engineers and so on) from the industry, and academics from tertiary academic institutions (i.e. Lecturers from KNUST and UEW) that run postgraduate construction programmes in Ghana as at February 2016 constituted the respondents for this study. The Building Technology Department of KNUST-Kumasi was selected because they run MSc/MPhil/PhD in Construction Management and Building Technology, and also the Department of Construction and Wood Technology, University of Education, Winneba-Kumasi was selected as part of the sub-population sample for Academia because they also run MPhil Construction Technology and M. Tech.-Construction. These two were selected from academia because they are responsible for training and conducting higher level construction research works more frequently, which can be applied or implemented in the construction industry. Therefore, they are in the position to make effective contributions to this research study. The sub-population sample of the industry consisted of corporate members of the Ghana Institute of Construction (GIOC) as part of this research since this is the only professional body in Ghana that brings together all the professionals from across all sectors directly linked to the construction industry (such as; Quantity Surveyors, Architects, Construction Engineers and so on) who supervise the day-to-day construction activities in the Ghanaian construction industry. The logic behind the selected respondents was to ensure that the study has a representation of the major stakeholders within academia and industry who can make significant contributions to the aim and objective of this study. Census and systematic sampling technique were used for the population sample, and the Data gathered from the respondents for the determinants of academia and industry were analysed using factor analysis with the aid of version 20 SPSS software for the study.

4. Analysis on Determinants of Collaborative Research

4.1. Kaiser-Meyer-Olkin and Bartlett's Measure Tests

Kaiser-Meyer-Olkin was measured to determine the sampling adequacy and **Bartlett's test of sphericity**. The KMO normally ranges between a value of 0 and 1 statistically. Where 0 signifies large sum of partial correlations, showing diffusion in the pattern of correlations (hence, factor analysis is likely to be incompatible), whilst 1 demonstrates relatively thick correlation patterns, therefore, result from factor analysis should be expected to produce divergent and reliable components. Kaiser (1974) recommends accepting values greater than 0.5 as acceptable (values below this should precede you to either gather more data or rethink which variables to include). The **KMO** value of this data was **0.641**, which falls within the acceptable range; thus, the researchers were sure that the factor analysis was appropriate for these data.

4.2. Total Variance Explained

Table 1 illustrates the lists of eigenvalues linked to their linear component before and after extraction as well as the rotation. It can be observed from the table that before extraction, 25 linear components were within the data set (note that, the eigenvectors shows in-line with the variables and to ensure there are as many factors as variables). The eigenvalues associated with each element represent the variation explained by that particular linear component. SPSS also displays the eigenvalue regarding the share of variance explained. The example above displays that the component 1 has an eigenvalue of 8.394 representing 33.574% of the total divergence of 25 agents for collaborative research. Component 2 has a variety of 2.707 representing 10.829%, of the total factors. Component 3, 4, 5, 6 and 7, also, with the variance of 2.552, 1.796, 1.538, 1.266 and 1.002, respectively representing 10.208%, 7.184%, 6.152%, 5.065% and 4.007% of the total factor respectively with the components and divisions. It can be seen that factor 1 and 2 have a larger value of variances than the factor 3, 4, 5, 6 and 7, respectively downwards with magnetic declination to the last component. From the table, it can be assured that only components with eigenvalues greater than 1 were considered, which leaves us with seven (7) factors. The eigenvalues again were displayed and the components with their percentage variance explained in the Sums of Squared Loadings section of the table. It should be noted that the values in squared loadings sections are the same as the values before extraction, except that in this case factors or values below the required range are rejected (thus, eigenvalues < 1 in the table is blank i.e. after the seventh factor). In the last portion of the table (labelled Rotation Sums of Squared Loadings), the eigenvalues of the factors after rotation are displayed. The rotation optimizes the component structure and one consequence of this data is that

the proportional importance of the seven (7) factors is equalised. Before rotation, factor 1 accounted for considerably more variation than the remaining three (33.574% compared to 10.829%, 10.208%, 7.184%, 6.152%, 5.065% and 4.007%). Nevertheless, after extraction it accounts for just 16.101% of variance compared to (12.059%, 11.690%, 11.064%, 10.963%, 9.747% and 5.396% respectively).

4.3. Factor Rotation

Table 1 gives an illustration of the rotated factor matrix (also called the rotated component matrix in factor analysis) representing the matrix of the factor loadings for each variable onto each factor. This matrix contains the same data as the component matrix in *table 1* except that it is calculated after rotation. Rotation helps to establish the end product

more understandable and is usually necessary to help the interpretation of factors. The eigenvalues summations are not affected by rotation, but the rotation will alter the eigenvalues (and percent of variance explained) of particular ingredients and will alter the factor loadings (Anon, 2007). First, factor loadings less than 0.5 were deemed not important, hence not displayed because the researcher considered only loading ≥ 0.5 . It should be noted that before rotation, most of the variables were highly loaded onto the first factor and the remaining factors did not get a look in. However, after the rotation of the elements the structure has clarified things considerably: resulting in seven (7) factors variable loaded very highly onto only one element. The suppression of loadings less than 0.5 was then to make interpretation considerably easier for readers.

Total Variance Explained									
Component	Initial Eigenvalues			Rotation Sums of Squared Loadings					
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %			
1	8.394	33.574	33.574	4.025	16.101	16.101			
2	2.707	10.829	44.403	3.015	12.059	28.159			
3	2.552	10.208	54.611	2.922	11.690	39.849			
4	1.796	7.184	61.795	2.766	11.064	50.913			
5	1.538	6.152	67.947	2.741	10.963	61.876			
6	1.266	5.065	73.012	2.437	9.747	71.622			
7	1.002	4.007	77.019	1.349	5.396	77.019			
8	.869	3.478	80.496						
9	.833	3.331	83.827						
10	.668	2.671	86.498						
11	.533	2.132	88.629						
12	.486	1.945	90.575						
13	.444	1.777	92.351						
14	.354	1.414	93.765						
15	.334	1.335	95.100						
16	.314	1.258	96.358						
17	.207	.828	97.186						
18	.176	.704	97.890						
19	.151	.604	98.494						
20	.131	.524	99.018						
21	.067	.270	99.287						
22	.059	.234	99.522						
23	.050	.201	99.723						
24	.045	.182	99.905						
25	.024	.095	100.000						
Extraction Mathad	. Principal Com	nonant Analysis							

Table 1. Total Variance

Extraction Method: Principal Component Analysis.

Researchers' survey, (2016)

Rotated	d Compon	ent Matrix ^a							
	Component								
	1	2	3	4	5	6	7		
Comprehensible definition of responsibilities	.746								
There should be common goals and shared vision among partners	.727								
Parties should align their individual objectives to a common goal.	.725								
Introduction of new ways of working by involving all the collaborating partners.	.700								
Commitment/dedication among the collaborating partners	.642								
Building trusting relationships	.629								
Group dynamics and dispute minimisation,		.814							
Developing a good relation among parties involves		.800							
Effective communication among all the parties responsible for decision making		.680							
Judicious use of available resources			.904						
Improving on motivational factors			.848						
There should be a high level of mutual trust			.591						
Effective communication				.900					
Good communication and Clarity				.729					
Line of communication should be kept open				.684					
Sincerity and honesty				.510					
There should be a shared understanding and respect among partners					.812				
Collaborating partners should ensure that the aim/objectives collaborative research they go in for is really good for their demand.					.663				
Connecting all the three strategic areas of: institution/industry, business, human resource and technology					.572				
A common platform for partners discussions, coordination's, implement, and delivering of strategic goals									
There should be some amount of benefits for the partners involve						.801			
There should be some level of flexibility						.778			
A certain amount of give-and-take, professionalism and hard work.						.576			
A joint problem solving informally without litigation and court cases.						.512			
Unambiguous objectives should be defined acceptable by all partners before the collaborative relationship is firmly established							.639		
Extraction Method: Principal Component Analysis. Rotation Method: Varimax with Kaiser Normalization.									
a. Rotation converged in 24 iterations.									

4.4. Extracted Components on Determinants

The extractions of rotated components of the factor analysis resulted in seven (7) major components identified as the representative for determinants of academia and industry collaborative research in the construction industry in Ghana. The below are the interpretations of the component classified by their factors for the academia and industry collaborative research as follows; *common goal, healthy relationship, judicious resource usage, effective communication, understanding, benefit to partners and clear defined objectives.*

4.4.1. Discussion on Common Goal

Component one (1) comprised six factors, namely: Comprehensive definition of responsibilities, common goals and shared vision among partners, alignment of individual objectives to a common goal, Introduction of new ways of working by involving all the collaborating partners, commitment among collaborating partners, and Building trusting relationships. With .746, .727, .725, .700, .642, and .629 (refer to table 2) as their respective factor loading. These component factors were centred on common goals among collaborating partners as the major determinant of academia and industry research. Katz and Martin (1997) in a similar study defined collaboration as the working together of two or more researchers with the aim of achieving a common objective, such as production of a new set of knowledge in a form of a journal and conference paper presentation or publications. Ma and Hagen (2011), held the same view that common goal set by collaborating partners enables researchers to have a better understanding of research objectives, phenomenon or data under investigations. Shelbourn et al. (2012) corroborated these findings in their study, "the significant influencing factors for collaboration" to include working partners having a common goal, priorities, and a shared vision. Oliver (1990) in his study explained reciprocity collaboration as the motivation to collaborate for the purpose of pursuing a common goal, benefit or interest among partners; all parties the power to function equally have and no organisation/institution has dominion over the other. Laudel (2002; 2001) developed a typology of six collaboration categories; one of which he stated collaboration to involve a division of labour, in which the collaborators share a common goal and divide the creative labour among partners. Given the above, it goes to suggest that one of the most significant factors for academia and industry research in the Ghanaian construction industry can be effective if all the various parties align their individual objectives to a common goal (Zuo et al., 2013).

4.4.2. Discussion on Healty Relation

Component 2 also comprised three (3) factors as; Group dynamics and dispute minimization, developing a good relation between parties involved, and effective

communication among all the parties responsible for decision making, with factor loading of .814, .800 and .680 respectively. This component focused on a healthy relationship among partners as the determinants of collaborative research. Akintoye and Main (2007) and Kumaraswamy (1996) in a similar study opined that for any effective collaboration to work there is the need for developing a good relationship among the partners involved, good healthy relationships among collaboration partners between the academia and industry can lead to disputes minimization. Likewise, Hoecht and Trott (1999) were of the view that the risk of information leakage has some relationship to level of openness to the technological developmental policy of an organisation. However, the trust can easily be built when a good healthy relationship exists among collaborating researchers. CDD-Ghana (2005) asserted that healthy relationship leads to partners developing some level of confidence among each other to hold on to the research protocols, professionalism and financial control without any form of unethical manipulation, misinterpretation of data; falsification, fabrication, and inducement for data from subjects, and so on.

4.4.3. Discussion on Judicious Resource Usage

Component 3 comprised three factors, namely; judicious use of available resources, improving on motivational factors, and high level of mutual trust. With their respective factor loadings, also as: .904. .848 and .591. These factors were also examined to focus on judicious resource usage. Research by Shelbourn et al., (2012) opined that successful collaboration can be achieved through the judicious use of available resources, by sharing the multiple project risk factors across multiple domains, whiles improving on motivational factors to influence collaboration among organisations/institutions. Their study revealed that effective collaboration can be achieved by linking all the available resource necessary for the partnership, such as the human resource, technology, equipment, and so on. Effective collaboration can be accomplished by linking or connecting all the three strategic areas of organisation/industry, human resource and technology available in a judicious manner. Tina and Hayar (2012) in a similar study suggested that collaboration consultant should facilitate collaborative workshop meetings, regular design meetings, conferences with invited lecturers from academia and the industry, introduction of а project intranet within organisations/institutions, the use of 3D-models for more precise demonstration, change of job roles of members, the formations of focus groups to collaborate to identify and solve problems. Furthermore, Levine and White (1961) in their study revealed that collaboration existence depends on scarcity of resources. Therefore, for effective collaboration to exist among the academia and industry in the construction industry in Ghana, collaborating partners should ensure that the scarce resources dedicated to collaborative purpose should be efficiently used in order to encourage stakeholders to invest more resources for further research works. The commitment for academia and industry collaboration to sustain, fund research programmes and implementation would greatly depend on the development of some sense of understanding and trust that comes with some form of expectations. Therefore, responsible partnership among academia-industry should be developed in order to create room for the possible long lasting relationship between partners.

4.4.4. Discussion on Effective Communication

Effective communication is also comprised four (4) factors as follows: effective communication, Good communication and clearly line of communication should be kept open: and sincerity and honestv also with .900, .729, .684, and .510 respectively as their factor loadings. These factors also concentrated more on effective communication as the primary tool for successful collaborative research. Akintoye and Main (2007) confirmed that the fragmented nature of the construction industry can be eliminated through effective communication; they explained that collaborating partners should both develop and champion a line of communication opening for the best decisions from both parties and preservation of good relationship. To ensure this, it would be substantial for both academia and industries to come out with a developmental or formalised network as a standard means of communication channels. To decide and be agreed by all key partners, also, modern technology, and social media (That is Website, link team, watsup group, webcams, Facebook, and so on.) platform or groups can be adopted by members to deliberate on significant issues (i.e. Discussing, developing. implementing, coordinating, and so on). Effective communication can also avoid or reduce certain disputes in collaboration, especially on matters of shared of benefits, control, responsibilities, contributions, and so on. Therefore, the results from the study revealed that for active collaborative between research to dwell the academia-industry in the construction industry in Ghana, one of the underlining factors should be to come out with effective communication procedures approved by all stakeholders in this collaborative drive.

4.4.5. Discussion on Benefit to Partners

Component six (6) comprised four factors as follows; *benefits to partners involved, some level of flexibility, partners should understand and appreciate each other's efforts and cultural background and A joint problem solving informally without litigation and court involvement. with .801, .778, .576 and .512 as their respective factor loadings. This also focused on benefits to partners as one of the major determinant of effective academia and industry collaborative research.*

Kaplan and Norton (1996) and Parung and Bititci (2008) research found that the primary objective of the collaboration is to become sustainable by creating benefits for stakeholders;

as well as assisting partners to maximise the returns on their investment. Barnes et al. (2002) opined that, the benefits of collaborative research to members may come in several forms to partners, including access to innovative techniques; tool and guideline for documentation to improve their efficiency: the opportunity to increase productivity and profitability, and being part of a body that sets benchmarks across the industry. The collaboration provides companies/organisations with the means to advance technologically at lower cost and with less inherent risk. Collaboration also provides access to a wide range of knowledge and technologies to partner's development. The benefits of collaboration with universities include additional public and private funding, and increasingly licencing and patenting income, through technology transfer activities. Also innovations and technology an advantage over competitors and increase performance and productivity, etc. can be some of the benefits to industry. Akintoye and Main (2007) suggested in their study that successful collaboration requires some mutual level of dependency; any collaboration should have at least some amount of benefits to the partners involved. This is paramount for the academia and industry collaborative research because it provides some level of motivations. EUA. (2005) study revealed that effective collaboration offers the potential of large improvements, greater effectiveness and bring us more returns on resource or capital investment. Therefore, collaborative research among universities/institutions enhances the value of the universities within society and produces new opportunities to improve the prospect for continued top-quality research and education. For this reason, effective collaboration helps to develop the capacity of partners by creating better mutual form of awareness and understanding.

Collaborative research has a significant benefit to society, especially when the fruits/products of research are fully exploited, developed and implemented. Chun-Yu et al. (2013) are of the view that both academia and industry needs to come together to put initiatives for collaborative effort due to the mutual benefit partners are likely to get through collaboration. Shelbourn et al., (2012) opine that collaboration often comes with benefits that can enable participants or partners to build capacity to complete a set of tasks that cannot easily be carried out by individual institutions/organisations. It also helps to eliminate fragmentation, repetitions and suspicion among partners. Fiedler et al. (2007) shared the same view that the financial motivation resulting from the collaborative outputs as well as motivation for collaborative research, may also include coming out with findings that could be used to solve the pressing issues in the construction industry. Among this issues are affordable housing and improved quality construction products. It can also serve as an educational vehicle for the public to develop a positive environmental outcome, complying with the standards of expectations, and setting a precedence for other building construction companies to follow.

4.4.6. Discussion on Clearly Defined Objectives

Component seven comprised the following: Unambiguous objectives should be defined acceptable by all partners before the collaborative relationship is firmly established with .639 as factor load. Sonnenbery (1992) holds the view that unambiguous objectives should be defined and accepted by all partners before venturing into partnership. Striving for a long-term partnership is necessary to both parties. For Academia and industry collaborative research in the construction industry to be more efficient, it would be important to set clear defined objectives such as research agenda, roles, responsibilities, inputs and if possible the benefits (That is direct and indirect) clear and straightforward for partners to fully appreciate and understand the risks and rewards involve at the initial state before commencement of collaboration.

5. Conclusions/Recommendations

The determinants for effective academia and industry collaborative research in the Ghanaian building industry can thus be grouped into seven (7) main key determinants as; 1. Partners should come together to set a common goal, 2. Partners should put effort to ensure that a healthy relationship exists among members, 3. Measures should also be put in place to ensure judicious and efficient use of resources, 4. There should be effective communication that exist among partners; 5. There should be some level of understanding among partners, 6. For Effective collaborative partnership, there should be mechanisms in place to ensure there are benefits to all partners, and 7. Research objectives should be clearly defined to move along with all partners. The researchers recommend that industry should share their major problems that need to be researched with the academia for them to join forces for solutions. On the other hand, the academia should also consult the industry to know the real problems they are facing that need solutions, rather than just research into problems or issues perceive to be the real needs of the industry.

Appendix (A)

TAMALE TECHNICAL UNIVERSITY COLLEGE OF ENGINEERING AND BUILT ENVIRONMENT DEPARTMENT OF BUILDING TECHNOLOGY QUESTIONNAIRE

Academia-industry collaboration is required to bridge the gap between the theory/(basic) and practice (applied). The aim of this questionnaire is to solicit the independent opinions of respondents on the topic: **Determinants of Effective Academia-Industry Collaboration in Building Construction Research in Ghana**. I would be very grateful if you could kindly spare me some little time to give me your view on the questions below. The confidentiality of respondents would strictly be assured. For any clarification you can please contact:

DOK YEN, M.D.: 0246807001/0507814084

E-mail: dydavid@tatu.edu.gh

THANK YOU.

SECTION (A): DEMOGRAPHIC QUESTIONS

The following questions concern your position and other personal information.

Tick [] or click in the box as shown \boxtimes

1. Which of the following category do you belong to?

Academic institutions \Box Construction Industry/Company \Box Research institution \Box Consultancy Department/Sector \Box others (please specify) \Box

2. How long have you being with the category chosen above in question (1)?

 $0-5 \square 6-10 \square 11-15 \square 16-20 \square 21-30 + years \square$

3. What is your highest level of Education?

HND \square Bachelor's degree \square Master's degree \square PhD \square Others (please specify) \square

4. Have you ever been involved with any collaborative research before? Yes \Box No \Box

DETERMINANTS OF COLLABORATIVE RESEARCH

Collaborative research is often influence by certain factors that determines its outcome.

SECTION B: How would you rate the following factors as the determinants of collaborative research? Tick [] or click in the box as shown \boxtimes

Key: 1 = not important, 2 = less important, 3 = quite important, 4 = important and 5 = very important

DETERMINANTS			RANK				
	1	2	3	4	5		
There should be a respect and understanding among partners							
Professionalism, and some inputs and rewards to partners.							
Introduction of new ways of working by involving all the collaborating partners.							
A joint problem solving informally without litigation and court involvement.							
There should be common goals and shared vision among partners							
There should be a high levels of mutual trust							
Comprehensible definition of duties and roles							
Effective communication							
Sincerity and honesty							
A common platform for partners discussions, coordination's, implement, and delivering of strategic goals							
Judicious use of available resources							
Improving on motivation factors							
Connecting all the three strategic areas of: institution/industry, business, human resource and technology							
Workshop meetings formation, facilitated by collaboration experts							
Frequent meeting on designs, conferences with invited lectures from academia,							
There should be an initiative from both parties to collaborate,							
Development of problem solving focus groups among partners							
Allow for Some mutual level of dependency							
There should be some amount of benefits for the partners involve							
Collaborating partners should ensure that the aim/objectives collaborative research they go in for is really good for their demand.							
Partners should ensure that they only make promises they can delivered							
Unambiguous objectives should be defined clearly, acceptable by all partners before the collaborative relationship is strongly established							
Partners understanding of each other's culture;							
Line of communication should be kept open;							
Developing a good relation among parties involve							
Group dynamics and dispute minimisation,							
Effective communication among all the parties responsible for decisions making							
Building trusting relationships							
Good communication and Clearly							
Parties should align their individual objectives to a common goal.							
There should be some level of flexibility							
commitment/dedication among the collaborating partners							
Others (please specify)							
•							
•							

SECTION (C): Please in your opinion what other factors do you think are the major Determinants of Effective Academia-Industry Collaboration in Building Construction Research in Ghana?

REFERENCES

- Adinyira, E., Fugar F. D. K.D and Osei, A. (2011), "Underlying Factors for Construction Research Collaboration in Ghana". *Proceeding 6th Built environment conference*, Vol.6, August 2011, pp.385–399.
- [2] Angela, C., and Rachel, L. (2016), "The ceiling to coproduction in university-industry research collaboration" Angela McCabe (corresponding author) Department of Management and Marketing University of Melbourne.
- [3] Agyekum, K., Salgin, B., and Kwablah, N. M. (2017). Collaboration in the Ghanaian Construction Industry: Perceived Barriers and Benefits. Digital Proceeding of ICOCEE CAPPADOCIA2017 S. Sahinkaya and E. Kalıpcı (Editors) Nevsehir, TURKEY, May 8-10, 2017.
- [4] Akintoye, A. and Main, J. (2007), "Collaborative relationships in construction: the UK contractors' perception", *Engineering, Construction and Architectural Management*, Vol. 14 Iss 6 pp. 597-617.
- [5] Amabile, T. M., Patterson, C., Mueller, J., Wojcik, T., Odomirok, P. W., Marsh, M., and Kramer, S. J. (2001), "Academic-practitioner collaboration in management Research: A case of cross-profession collaboration". *The Academy of Management Journal*, vol.44, no.2, pp.418-31.
- [6] Anon, (2007), "Factor Analysis", viewed 14th May, 2016, www.chass.ncsu.edu/garson/pa765/factor.htm.
- [7] Barnes, T., Pashby, I., and Gibbons, A. (2002), "Effective University–Industry Interaction: A Multi-case Evaluation of Collaborative R&D Projects". *European Management Journal*, vol.1, pp.272–285.
- [8] Beach, R., Webster, M. and Campbell, K.M. (2005), "An evaluation of partnership Development in the construction industry", *International Journal of Project. Management.*, Vol. 23, no 8, pp.611-621.
- [9] Chan, A.P.C., Chan, D.W.M. and Ho, K.S.K. (2003a), "An empirical study of the benefits of construction partnering in Hong Kong", *Construction Management. Economics.* vol.2, PP.2
- [10] Chan, A.P.C., Chan, D.W.M., Fan, L.C.N., Lam, P.T.I. and Yeung, J.F.Y. (2006), "Partnering for construction excellence: a reality or myth?", *Building and Environment*, Vol. 41, no. 12, pp. 1924-1933.
- [11] Chan, A.P.C., Chan, D.W.M., Fan, L.C.N., Lam, P.T.I. and Yeung, J.F.Y. (2008), "Achieving partnering success through an incentive agreement: lessons learned from an underground railway extension project in Hong Kong", *J. Mgmt. Eng.* vol.25, no.5, pp:475-184.
- [12] Cheng, E.W.L. and Li, H. (2004), "Development of a practical model of partnering for construction projects", J. Constr. Eng. Manage., Vol. 130, no. 6, pp. 790-798.
- [13] Chun-Yu Chen, Yen-Chun Jim, and W.-H.W. (2013), "A Sustainable Collaborative Research Dialogue between Practitioners and Academics". *Management Decision*, Vol. 51, no.3, pp. 566-593.

- [14] Centre for Democratic Development (2005). "The challenges of collaborative policy Research/research ethics". Paper Presented by the Ghana Centre for Democratic Development CDD at the research and advocacy organizations convention Friday 13 May 2005.
- [15] Dok Yen, M.D. (2010), "The Determinants of collaborative research in the Ghanaian Building Industry, the case of College of Architecture and Planning, Department of Building Technology, Kwame Nkrumah Uiversity of Science and Technology": Thesis
- [16] Draulans, J., deMan, A. and Volberda, H.W. (2003), "Building alliance capacity: management techniques for superior alliance peformance", *Long Range Planning*. vol.28, no.6.
- [17] Fiedler, T. and Deegen C., (2007), "Motivations for environmental collaboration within the building and construction industry", *Managerial Auditing Journal*, vol.22, pp.4.
- [18] EUA, ProTon Europe, EARTO, E., (2005), Partnering, Joining forces in a world of open innovation, A guide to better practices for collaborative research between science and industry, Revised edition Handbook.
- [19] Field, A. P. (2005), "Is the meta-analysis of correlation coefficients accurate when Population Effect sizes vary?" *Psychological Methods*, vol.10, no.4, pp.444-467.
- [20] Hoecht, A. and Trott, P. (1999), "Trust, risk and control in the management of collaborative Technology development", International Journal of Innovation Management, Vol. 3.
- [21] Kaiser, H. F. (1974), "An index of factorial simplicity". Psychometrika, vol.39, pp.31–36.
- [22] Kaplan, R.S. and Norton, D.P. (1996), *The Balanced Scorecard*, Boston, MA. The Harvard Business, School Press.
- [23] Kumaraswamy, M.M. and Chan, D.W.M. (1999), "Factors facilitating faster construction". Journal of Construction Procurement, vol.5, no.2, pp.88–98.
- [24] Katz, J. S., and Martin, B. R. (1997), "What is research collaboration?", *Research policy*, vol. 26, no.1, pp.1-18.
- [25] Larson, E. (1997), "Partnering on construction projects: a study of the relationship between partnering activities and project success", *IEEE Transactions on Engineering Management*, Vol. 40, no. 2, pp. 188-195.
- [26] Laudel, G. (2001). Collaboration, creativity and rewards: why and how scientists collaborate? International Journal of Technology Management, vol.22, no.7, pp.8.
- [27] Laudel, G. (2002), "What do we measure by co-authorships?" *Research Evaluation*, vol.1, pp.3-15.
- [28] Lee, Y.S. (2000), "The Sustainability of University-Industry Research Collaboration: An Empirical Assessment", *The Journal of Technology Transfer*, vol.25, no.2, pp.111-133.
- [29] Ma, K. and Hagen, H., (2011), "Collaborative Visualization: Definition, Challenges, and Research Agenda", *Journal (IVS)*, SAGE, vol.10, no.4, pp.310–326.
- [30] Modernghana, (2007), "CSIR boss calls for collaboration between research development and other sectors". Viewed

10th september, 2016, www.modernghana.com./csir-bosscall s-for-Collaboration-between-research-development.

- [31] Ng, S.T., Rose, T.M., Mak, M. and Chen, S.E. (2002), "Problematic issues associated with Project partnering - the contractor perspective", *International Journal of Project Management*, vol.20, no.6, pp.437–49.
- [32] Nystrom, J. (2005), "The definition of partnering as a Wittgenstein family resemblance concept", *Construction Management & Economics*, Vol. 23, no.5, pp.473-81. www.ghanatrade.gov.gh/./Developing%20the%20Constructi on%20Industry.
- [33] Oberg, C. (2016). What creates a collaboration-level identity. *Journal of Business Research*, 69.
- [34] Oliver, C. (1990), "Determinants of interorganizational relationships: integration and future directions", Academy of Management Review, Vol. 15, no. 2, pp. 241-65.
- [35] Parung, J. and Bititci, U.S., (2008), "A metric for collaborative networks", *Business* Process Management Journal, Vol.14, no.5, pp.654-674.
- [36] Yeung, N.S.Y. and Chan, A.P.C. (2002), "Collaborative Research Better Value for Construction". Presented at the Project Management Impresario of the Construction Industry

Symposium March 22-23, 2002, Kowloon, Hong Kong. viewed 8th December, 2015. http://www.bre.polyu.edu.hk/rc cree/events/pm_symposium/NicolasYeung.pdf.

- [37] Shelbourn, M, Bouchlaghem, N., M., Anumba, C., and Carrillo, P. (2012), "Planning and Implementation of effective collaboration in construction projects", *Construction Innovation*, Vol. 7, no 4, pp. 357-377.
- [38] Sonnenbery, F.K. (1992), "Partnering entering the age of cooperation", *Journal of Business Strategy*, Vol. 13, no. 3, pp. 49-52.
- [39] Tina K. G., Hayar, G. (2012), "Boundary action in construction projects: new collaborative project practices", International Journal of Project Organisation and Management, vol.4, no. 3, pp. 272-285.
- [40] Tumbas, P., Matkovic, P., Maric, M. and Veselin, P. (2016). Organisational aspects of university-industry collaboration. Paper presented at the EDULEARN16, Barcelona, Spain. Retrieved from, 4th-6th July 2016.
- [41] Zuo, J., Chan, A., Zhao, Z., Zillante, G., and Xia, B. (2013). "Supporting and impeding factors for partnering in construction: a China study.", viewed on 16 August, 2015. http://ascelibrary.org/doi/10.1061.