
Construction Industries Collaboration: Imperative for Sustainable Emerging Skills Acquisition of Building Trade Students of Technical Colleges in Enugu State, Nigeria

by

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Abstract

Construction industries are the first to acquire and explore new technologies; hence most of the industries are the first port of call for emerging technologies and serve for consultancy even in the development of technologies prior to emergence. This paper investigated the need for construction industries' collaboration, its imperatives for sustainable emerging skill acquisition of building trades' students of technical colleges in Enugu State. Survey design was used with structured questionnaire as instrument for data collection. 153 participants were purposively selected for the study from registered construction companies and NBTE accredited technical colleges in Enugu State. Data collected were analyzed using descriptive statistics - percentages and mean – for research questions while t-test was used to test the null hypotheses at 0.05 level of significance. Results revealed that there is a compendium of emerging technologies utilized in the construction industry that has neither been seen nor utilized in all the technical colleges within the state; also, the need for collaboration includes exposure to modern technologies for emerging skill acquisition, training opportunities for both teachers and students. However, bureaucracy and lack of interest on the part of the construction industries were part of the factors against collaboration of the two entities. Hence, there is need for a well formulated MoU for collaborations between construction industries and technical colleges, so as to enable the students' acquisition of sustainable emerging technologies for employment and global competitiveness.

Keywords: building trades, emerging skills, construction industries, collaboration

Introduction

Technical colleges offer post-primary vocational and technical education expected to develop knowledge, skills and attitudes for work. The major thrust of the technical colleges is to produce craftsmen and master craftsmen awarding National Technical Certificate (NTC) and Advanced National Technical Certificate (ANTC) (Anaele, Amadi & Obed, 2016). Because the programmes of the institutions are work or occupational specific, it is organized according to trades. Trades encompass occupations requiring practical or mechanical skills to function (Chukwu, 2019). Amongst the trade courses in technical colleges is the Building Construction Trades classified into Block/Brick Laying and Concreting; Building Draftsmanship; Painting and Decoration as well as Plumbing and Pipe Fitting (National Board for Technical Colleges [NBTE], 2016; Federal Government of Nigeria [FGN], 2013). Achieving the major thrust of the technical

colleges in producing graduates who could enter craftsmen level of employment, create employment through venturing or further their education, has been greatly challenged (Ayomike, 2014). Collaboration with industries has equally been identified as a worthwhile means to offset the challenges of technical colleges and derive the best of the institutions (Okoye & Arimonu, 2016).

Collaboration is a necessity in ensuring that today's graduate is up-to-date on knowledge and skills relevant in the building construction sector. The need for construction industry collaboration includes: alliance in education and training, innovative knowledge and technology transfer, promotion of entrepreneurship, coordination of research and development plans, additional private investment, and increase in mobility of labour between public and private sectors (Guimon, 2013). Industry collaborations according to Stiles (1995) are further propelled by

globalization demand, competition, risk and uncertainty within business environment with a reechoed need for research and development opportunities. Balanced relationship in collaboration will ensure sharing scarce resources; spreading training risks and opportunities; improved quality and productivity of graduates; access to alternative and emerging technologies not otherwise available in training institutions (Rahman, Endut, Faisol & Paydar, 2013; Crouse, 1991). However, it has been noted by Guimon (2013) that collaboration between institutions of learning and industries differ significantly between developed and developing countries in types, objectives, scopes and institutional arrangements.

Industry collaboration can be formal or informal as well as in long / short term bases. Formal collaboration lends to equity partnerships, contracts, research projects, patent licensing, extending to exchanges between institutions and industries in terms of human capital, publications, conferences and expert group alliances (Guimon, 2013; Hagedoorn, Link & Vonortas 2000). Formal industry collaboration is referred to as short term when it focuses on predefined goal of solving a known problem using concerted research, consulting and licensing; whereas long term industry collaborations are known to engender public-private partnership in funding at all levels, open-ended and multifaceted platform for innovative capacity building of the institutions. On the other hand, informal industry collaborations only serve for industries' recruitment of graduates for internship, staffing and consulting which is a minimal role in terms of the demands required of industries and institutions' collaboration (Hagedoorn, *et al*, 2000; Koschatzky & Stahlecker 2010; Guimon, 2013). Expanding the role of industry-institutions collaboration requires a shift beyond the traditional informal pattern which ultimately begins with overcoming the surrounding barriers to effective collaborations.

The divergent interests of industries and learning institutions have hindered collaborations of both parties. Guimon (2013) observed inherent mismatch between research orientation of industry and institutions. While the later seeks clear contributions in short-term

bases, the former is favoured by long term collaborations that are cost-intensive on the part of the industries. As such there is an age long quest for the real value of knowledge and research; is it for the expansion of thought space or is knowledge and research related directly to the market value of its products as industry demands (Bosley, 1995). Also, institutions operate curriculum that emphasizes "design-thinking as opposed to design-making and design-doing" (Saffer, 2007; Roberts, 2007). In addition, industries require delay in publication as opposed to institutions' idea of publishing on discovery (Guimon, 2013). Students need to understand that industries thrive on doing (synthesis, presentation, and evaluation of a design) which serves as bridge between thinking and making (Saffer, 2007). Industries are equally advancing in emerging technologies, methodologies as well as organizational models which are not in any way close to the existing standards in learning institutions (Roberts, 2007). The ever increasing level of emerging technologies integration in industries further widens the gap between training and practice in technical colleges.

Among the roles of the technical colleges is to prepare students using best teaching and learning method that incorporates theory and practice for employment. Teachers must therefore tie theory to practical skills and strategies needed to execute same in the world of world (Sutliff, 2000). But how can effective blend of theory and practical skills be achieved using obsolete equipment and training materials? How possible can students be prepared to work with new and emerging technologies without being exposed to such technologies all through their period of learning? Traditional industry-institution alliances currently explores corporate internships, work-study programs, curriculum advisory, guest lectureships and research funding especially in higher institutions (Roberts, 2007). However, with the understanding that not much can change if the training of the building construction trades' students in technical colleges is abandoned in the hands of the institutions alone, there is need for collaborations.

Purpose of the Study

The overarching purpose of this study was to investigate the need for construction industry collaborations with technical colleges to enhance the acquisition of sustainable emerging skills in building trades. Specifically, the study aims to determine:

1. the emerging technologies currently utilized in construction industry, absent in technical colleges.
2. the importance of construction industry and technical colleges collaborations.
3. the factors against the efficient and effective collaborations of construction industries and technical colleges.

Hypotheses

1. The mean responses of technical college teachers and building industry workers on the importance of collaborations do not differ significantly
2. There is no significant difference in the mean responses of technical college teachers and building industry workers on the challenges of efficient and effective collaborations

Methodology

The study adopted a descriptive survey research design. Survey research design was used to seek opinions of TVET Technical College Teachers and building industry site-workers on emerging technologies present in the building industry but absent in the technical colleges, importance of collaborations and challenges hindering efficient and effective collaborations. Area of study was Enugu State, Nigeria; having massive urbanization growth with many an industry engaging in estate developments to meet the housing demands of the growing populace. The population for the study was 153, comprising of 52 teachers from technical colleges and 101 site-workers from notable construction industries registered under the Enugu State Ministry of Commerce and Industry as well as Enugu State Chamber of Commerce, Industry, Mines and Agriculture. Purposive sampling was used in selecting building industry site-workers who have attained some level of education (secondary,

college or university). Same was applied in the technical colleges as not all teachers specialize in building construction trades.

The instrument used for the study was a structured questionnaire, validated by three experts and tested for reliability using Cronbach Alpha. The reliability coefficient obtained for various sections were .961, .959 and .890 with an overall coefficient of .981. The questionnaire has three sections: A, B and C; section A elicited information on the availability of the emerging technologies currently used widely in constructions across the globe; section B ascertained the importance of collaboration between technical colleges and industries; and section C enquired on the challenges for effective industry and institutions collaborations. Items on research question 1 were designed with two response options of: *Available* = 2 and *Not Available* = 1; the response options to question 2 and 3 were based on five Likert point scale of: *Strongly Agree*, SA = 5; *Agree*, A = 4; *Unsure*, U = 3; *Disagree*, D = 2; and *Strongly Disagree*, SD = 1.

The data generated from the questionnaire were analyzed using percentages, mean and t-test. Percentages was used to analyze research questions 1 while research question 2 & 3 were analyzed using Mean and the results obtained were interpreted using real limit of numbers as follows: *Strongly Agree*, SA = 4.5 – 5.0; *Agree*, A = 3.50 – 4.49; *Unsure* = 2.50 – 3.49; *Disagree*, D = 1.50 – 2.49; and *Strongly Disagree*, SD = 0.50 – 1.49. The Mean value based on real limit of numbers as indicated is 3.50; therefore, any item with a Mean value of 3.50 and above was regarded as agreed, while any item with a Mean value of 3.49 and below was regarded as disagreed.

Data collected for the null hypotheses were analyzed using t-test for independent sample at 0.05 level of significance. Therefore, any item where the calculated *p*-value was greater than 0.05, hypothesis of no significant difference was upheld at 0.05 level of significance and 155 degree of freedom, but where *p*-value was less than 0.05, the hypothesis of no significant difference was rejected.

Results

Table 1

Percentage Responses of Technical College Teachers and Building Industry Site-workers on the Emerging Technology Available in Industries

S/N	School Production Units / Consultancy Services	N	A (%)	N	NA (%)
1	Building information modeling (BIM)	95	64.6	52	35.4
2	Prefabrication	78	53.1	69	46.9
3	Modularization (off-site construction)	90	61.2	57	38.8
4	Plaster of Paris (POP)	95	64.6	52	35.4
5	Expanded Polystyrenes (EPS)	55	37.4	92	62.6
6	Dry construction technology (DCT)	66	44.9	81	55.1
7	Augmented reality / virtual reality	0	0.0	147	100.0
8	Building integrated photovoltaic (BIPV)	54	36.7	93	63.3
9	Hempcrete	0	0.0	147	100.0
10	Insulating concrete forms (ICFs)	0	0.0	147	100.0
11	Synthetic rubber damp proofing materials	15	10.2	132	89.8
12	Engineered/laminated lumber	0	0.0	147	100.0
13	Light gauge steel frames	0	0.0	147	100.0
14	Structurally insulated panels (SIPs)	12	8.2	135	91.8
15	Recycled aluminum and wood fiber	76	51.7	71	48.3
16	Fiber cement (for siding)	23	15.6	124	84.4
17	Light coloured roofs	88	59.9	59	40.1
18	Recycled-content organic shingles	68	46.3	79	53.7
19	Green or cool roofs	34	23.1	113	76.9
20	High performance window glazing	48	32.7	99	67.3
21	Light pipes	0	0.0	147	100.0

Key: N = Number; A = Available; NA = Not Available

Data in Table 1 shows 21 different emerging technologies in building construction across the globe. Table 1 shows that Building Information Modeling, Prefabrication, Modularization (off-site construction), Plaster of Paris (POP), Expanded Polystyrenes (EPS),

Dry construction technology (DCT), Recycled aluminum and wood fiber, Light coloured roofs and use of Recycled-content organic shingles, have been in practice majorly in the industries. It also shows that some emerging technologies are not yet integrated by many while some (Augmented reality, hempcrete, light pipes etc.) have not been used amongst the respondents.

Table 2

Mean and T-test Analyses of the Responses of Building Construction Site-workers and Technical College Teachers on the Importance of Construction Industry and Technical College Collaborations

S/N	Importance of Collaboration	Mean	Remark	t-cal	Sig.	Decision
1	Access to new and emerging technologies	3.62	Agreed	0.74	0.46	NS
2	Creates opportunities to work with machines and equipment beyond the school	3.52	Agreed	0.95	0.34	NS
3	Long-run research plan and development programme	3.59	Agreed	-0.41	0.68	NS
4	Initiates training opportunities/needs for teachers and students	3.52	Agreed	-0.65	0.52	NS
5	Steers-up innovative projects and designs	3.56	Agreed	0.22	0.82	NS
6	Commits the industry to social support allegiance	3.47	Disagreed	0.23	0.82	NS
7	Generates innovative knowledge and technology transfer	3.61	Agreed	0.13	0.90	NS
8	Creates alliance in education and training	3.64	Agreed	-0.49	0.63	NS
9	Promotes entrepreneurial inclination of schools and students	3.59	Agreed	-0.43	0.67	NS

10	Opens up additional private investment	3.63	Agreed	-1.09	0.28	NS
11	Increases mobility of labour between public and private sectors	3.63	Agreed	-0.33	0.74	NS
12	Meets globalized skilling-up demand	3.60	Agreed	0.51	0.61	NS
13	Shares training risks and opportunities	3.65	Agreed	-0.88	0.38	NS
14	Improves quality and productivity of graduates	3.70	Agreed	-0.09	0.93	NS
15	Serves as ground for industries' recruitment of graduates for internship	3.72	Agreed	0.09	0.93	NS
	Cluster	3.73	Agreed	-0.12	0.91	NS

Table 2 shows the responses of technical college teachers and building industry site-workers on the importance of collaborations amongst the parties. Data shows concession on the expected benefits of collaboration as all the items have mean values above the 3.50 benchmark except one (item 6). Thus, 14 items were agreed as underlying importance for which collaborations should be enhanced to achieve. The disagreement on item 6 'commits the industry to social support allegiance' suggests that collaboration is not

necessarily the driver of industries' social support. Furthermore, the Table shows the t-test analysis, comparing the mean from both groups. The 15 items including the cluster t-cal, have p-values above .05 at 0.05 level of significance. Therefore, the hypothesis that the mean responses of technical college teachers and building industry site-workers on the importance of collaborations do not differ significantly was not rejected.

Table 3

Mean and T-test Analyses of the Responses of Building Construction Site-workers and Technical College Teachers on the Factors against Efficient and Effective Collaborations of Construction Industries and Technical Colleges

S/N	Collaboration Challenging Factors	Mean	Remark	t-cal	Sig.	Decision
1	Mismatch in research orientations	3.64	Agreed	-0.48	0.63	NS
2	Skill demands and curriculum positions	3.70	Agreed	0.45	0.66	NS
3	Design-thinking culture in institutions without making	3.53	Agreed	-0.42	0.68	NS
4	Delay in publication for industries against publish or perish mentality in institutions	3.55	Agreed	-0.06	0.95	NS
5	Disparity in technologies and methodologies	3.59	Agreed	0.29	0.77	NS
6	Industries poor/lack of interest in collaboration	3.84	Agreed	-2.66	0.01	S
7	Governments' bureaucracy issues	3.80	Agreed	-2.91	0.00	S
8	Lack of memorandum of understanding to create win-win opportunities	3.95	Agreed	-2.50	0.01	S
9	Under-preparation of students for the world of work	3.76	Agreed	-0.90	0.37	NS
10	Non-existence of symbiotic or mutually benefitting relationship arrangement	3.90	Agreed	0.01	0.99	NS
	Cluster	3.36	Agreed	-1.32	0.19	NS

The data in Table 3 reveal agreement on the challenging factors against effective and efficient collaborations of construction industry and technical colleges. All the items shows mean value above 3.50 with 'lack of memorandum of understanding to create win-win opportunities' having the highest mean (3.95). The Table also reveals that although seven items show not significant p-values above

0.05, three items were significant (items 6, 7, & 8) at 0.05 level of significance. However, the cluster t-cal shows a p-value of 0.19 at 0.05 level of significance, therefore the null hypothesis was not rejected. Hence, there is no significant difference in the mean responses of technical college teachers and building industry site-workers on the challenges of efficient and effective collaborations

Discussion of findings

The major thrust of emerging technologies lies in challenging the status quo, reorganizing application of known models and modus operandi with inclination to sustainability. Although characterized by many uncertainties (Rotolo, Hicks & Martin, 2015), building industries engage, explore and integrate a couple of emerging technologies as time progresses. BIM for instance has mostly been applied in design, drafting and visualization (Opoko, Sholanke, Joel, Caiafas, Fakorede, & Oyeyemi, 2019). 'Building Information Modeling or BIM is a new approach to design, construction, and facility management in which a digital representation of the building process is used to facilitate the exchange and interoperability of information in digital format' (Vozzola, Cangialosi & Lo Turco, 2009). More so, EPS has equally been greatly embraced by construction experts in Nigeria. According to Ibukunoluwa and Adedeji (2014), Expanded Polystyrene is a sustainable material used as concrete facias with advantages of faster construction time, lightweight, variability in design due to flexibility of material, economy etc. Alongside, EPS uses are insulating concrete forms (ICFs) and structural insulated panels (SIPs) recognized as innovative products used in building envelopes (Ibukunoluwa & Adedeji, 2014). Sadly, these technologies and products are far from the institutions expected to supply the sub-professionals and craftsmen needed as site-workers in construction industry. It therefore suggests urgency of collaboration to help students garner experiences while still in school.

The importance of collaborations between industries and institutions of learning cannot be overemphasized. The sustainability of skills especially with respect to the emerging technologies can be achieved when the knowledge is effectively transferred to the younger generations following necessary strategies on collaboration (Kinash, *et al*, 2015). Among the top importance of collaboration are to: improves quality and productivity of graduates; serves as ground for industries' recruitment of graduates for internship; share training risks and opportunities; creates alliance

in education and training and grant access to new and emerging technologies. Improving quality of the graduates of technical colleges should be a collective effort as only the institutions cannot afford all that is required to offer students worthwhile experience while in school. For a wholesome experience in times as this, part of the time for studies must be held in industries/on field (Remington, 2018), even as interns. Also, when training risks are shared, every party knows well what has been invested and therefore would guard against wastage of any sort. Again, aligning training and practice is also a concerted effort where the industry must come in to help institutions realize.

However, challenges inherently exist in the detached interest of industries in collaborating with institution. The findings of this study show that lack of memorandum of understanding to create win-win opportunities; non-existence of symbiotic or mutually benefitting relationship arrangement and governments' bureaucracy issues were among the top challenges. There is need for government's sincerity in achieving partnership with industries for technical colleges. Beyond regular lip service should follow policy documents showing vital distinct and cooperative roles as well as benefits accrued to being part of the programme for the industries. Industries lack of interest seems to be sustained as the current situation portrays parasitic relationship where the industries suffer without being appreciated.

Conclusion

Building construction industries are the first to acquire and explore new technologies. They are mostly offered a trial testing opportunity before technology finally reaches the market; hence they partake in research and development. It is imperative to have students in building trades across technical colleges attached to industries where technologies, beyond the obsolete machines and equipment in school laboratories, could be used and explored. Exposure beyond what the school offers aligns students' entrepreneurial thoughts and results in acquisition of emerging technology skills related to the compendium of innovations.

Recommendations

The following is required to achieve effective and efficient collaborations between building construction industries and technical colleges:

1. Government should create policy document to serve as memorandum of understanding between industries and technical colleges. It should show clearly what each party stands to contribute and the benefits of such alliance to participating industries.
2. Technical colleges should go beyond design thinking in projects to design-doing in line with specific industry products to show mutually beneficial potentials to industries.
3. Teachers should be given adequate exposure through trainings and retraining, as well as competitions with respect to being updated on trends. Outdated teachers using outdated machines, curriculum and equipments cannot produce modern graduates.

References

- Anaele, E. O., Amadi, S. W. & Obed, O. O. (2016). Assessment of the adequacy of material resources for effective teaching of building technology: a panacea for promoting entrepreneurial skills in River State Technical Colleges. *British Journal of Education*, 4(4), 29-37.
- Ayonmike, C. S. (2014). Challenges in Implementing the TVET Curriculum in Technical Colleges in Southern Nigeria. *Makerere Journal of Higher Education*, 6(1), 87-97. DOI: <http://dx.doi.org/10.4314/majohe.v6i1.5>
- Bosley, D. S. (1995). Collaborative partnerships: academia and industry working together. (Symposium Part IV). *Technical Communication*, 42(4), 611-619.
- Chukwu, D. U. (2019). Competencies required by building trade graduates of technical colleges in green technology for sustainable constructions in Enugu State. An unpublished research project submitted to the Department of Industrial Technical Education, University of Nigeria, Nsukka.
- Crouse, H. J. (1991). The power of partnerships. *The Journal of Business Strategy*, 4-8.
- Federal Government of Nigeria (2013). *National policy on education* (5th Ed.). Abuja: Ministry of Education.
- Guimon, J. (2013). Promoting university-industry collaboration in developing countries. Policy Brief, World Bank. Retrieved from: http://innovationpolicyplatform.org/sites/default/files/rdf_imported_documents
- Hagedoorn, J., Link, A. N. & Vonortas, N. S. (2000). Research partnerships. *Research Policy*, 29: 567-86.
- Ibukunoluwa A. O. & Adediji, Y. M. D. (2014). Sustainable Construction: Comparative Advantages of Expanded Polystyrene (EPS) Fascia in Housing Delivery in Nigeria. *Civil and Environmental Research*, 6 (10), 66-75. Retrieved from <https://www.iiste.org/Journals/index.php/CER/article/viewFile/16399/16747>
- Kinash, S., Crane, L., Mitchell, K., McLean, M., Knight, C., Dowling, D., & Schulz, M. (2015). *Supporting graduate employability from generalist disciplines through employer and private institutions collaboration*, report prepared for the Office for Learning and Teaching. Australian Government.
- Koschatzky, K., & Stahlecker, T. (2010). New forms of strategic research collaboration between firms and universities in the German research system. *International*

- Journal of Technology Transfer and Commercialization* 9: 94–110.
- National Board for Technical Education, NBTE, (2016). Curricula for Technical Colleges. Retrieved from <https://net.nbte.gov.ng/downloads>
- Okoye, R. & Arimonu, M. O. (2016). Technical and Vocational Education in Nigeria: Issues, Challenges and a Way Forward. *Journal of Education and Practice*, 7(3), 113-118. Retrieved from <https://files.eric.ed.gov/fulltext/EJ1089786.pdf>
- Opoko A. P., Sholanke A.B., Joel O.O.O., Caiafas M.A., Fakorede O.A., & Oyeyemi B.O. (2019). Appraisal of the use of building information modelling (bim) in the construction project planning in Lagos State. *Nigeria Journal of Digital Innovations & Contemp Res. In Sc., Eng& Tech.*, 7(1), 1-12.
- Rahman, S. H. A., Enduta, I. R., Faisola, N. & Paydard, S. (2013). The Importance of Collaboration in Construction Industry from Contractors' Perspectives. *International Conference on Innovation, Management and Technology Research, Malaysia*, 22 – 23 September, 2013.
- Remington, T. F. (2018). Public–private partnerships in TVET: Adapting the dual system in the United States. *Journal of Vocational Education and Training*, 70(4), 497-523.
- Roberts, J. L. (2007). The future of academic-industry collaboration. Retrieved from <https://www.researchgate.net/publication/241785533>
- Rotolo, D., Hicks, D. & Martin, B. R. (2015). What is an emerging technology? *Research Policy* 44(10): 1827–1843. Retrieved from https://en.wikipedia.org/wiki/Emerging_technologies
- Saffer, D. (2007). Design Schools: Please Start Teaching Design Again. Retrieved from <http://www.adaptivepath.com/blog/2007/03/06/design-schools-please-start-teaching-design-again>
- Stiles, J. (1995). Collaboration for competitive advantage: the changing world of alliances and partnerships. *Long Range Planning*, 28(5), 8-9.
- Sutliff, K. (2000). Integrating Academics and Industry: A Challenge for Both Sides. *ACM Journal of Computer Documentation*, 24(1), 33-38.
- Vozzola, M., Cangialosi, G. & Lo Turco, M (2009). BIM Use in the Construction Process. DOI: 10.1109/ICMSS.2009.5305126. Retrieved from https://www.researchgate.net/publication/224610492_BIM_Use_in_the_Construction_Process