Critical Success Factors for the Innovative Training of Construction Professionals: The Nigerian perspective of a successful acquisition model.

Emmanuel OLORUNFEMI, Luqman OYEWOBI, Oludolapo OLANREWAJU, and Abdullateef BUSARI Nigeria.

Abstract

The constant evolution of new transformative technologies as well as other contemporary issues within the built environment such as the global pandemic, large skill gaps among others have further reinforced the need for the innovative training of Construction professionals. These competency deficiencies are in no small measure, the catalyst for reduced productivity and the obsoleteness of recent construction graduates upon their emergence in the innovative construction world. Training is key to addressing these issues. Hence, the need to examine the critical success factor required for acquiring innovative training for construction professionals. The study mainly adopted an electronic questionnaire survey approach, which was targeted at built environment professionals in Nigeria. A comprehensive literature review was conducted to identify 26 success factors for the innovative training of built environment professionals, which were later employed for the questionnaire design. Data collected were analyzed using descriptive statistics, mean score, Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy, Bartlett test of sphericity, and factor analysis to categories all the identified factors into four (4) critical elements which are Organization culture, personnel orientation, coaching quality and payback on investment. This research is needful in providing construction organizations, professionals bodies, training institutes, government parastatals among others with factors to pay keen attention to as they acquire innovative training for their employees.

Keywords: Innovative training, Success Factor, and Construction Professionals

1. INTRODUCTION

Innovation is defined to be the introduction of a new or significantly improved product, process, or method that boosts firm productivity and economic growth (González-Pernía 2015). It is considered as a core element of sustainable competitive advantage in a rapidly changing environment (Nam, T. and Tuan, N. and Minh N. 2017). The 21st-century construction industry has not just witnessed several changes such as advancement in technology and innovation, but also in effect, challenges to the industry and the professionals who operate within it (Ikupolati, Ikupolati, and Adeyeye, Mercy and Olatunle, Olatunle and Obafunmi, Obafunmi 2017). The emerging industrial revolution 4.0 which is focused on smart technology, artificial intelligence, and robotics; all of which now impact our everyday lives has further widened the existing skill gap (B. T. Waller 2017). More recently, the advent of the Novel disease/global pandemic known as Covid 19 where human physical contact was drastically reduced as a precautionary measure to curb the disease further revealed the necessity of innovation, hence the imperativeness of its training.

According to a research report by the Royal Institute of Chartered Surveyors (RICS) titled "Real Estate and Construction Professionals in India by 2020", there is some significant skills deficit across specialized domains of the built environment such as planning, architecture, civil engineering, quantity surveying, project management, facility management, and valuation. The gap is set to widen as the education sector is unable to provide adequate skill training to the students (A. Shimpi 2020). Investment in innovation training has the potential to help firms create more successful product offerings, but the extent to which companies do innovation training is unknown. Although efforts to optimize formal processes and integrate Agile methods into development have led to more efficient innovation systems, a large skill gap remains that cannot be overcome by tools and processes alone (Timothy L. Michaelis and Stephen K. Markham 2017). Hence the need to also invest in people-oriented innovative training, as systems, tools, and processes are useless if there is no capable human power to make it work.

Despite the importance of innovation training to construction professionals in the world generally and Nigeria specifically, researches on innovation training of built environment are very rare, which are mostly general reports without underlying analyses of the basis for their assertion,

especially critical success factor for innovation training of construction professionals. Therefore, this paper sought to analyse these critical success factors for the innovative training of built environment professionals in Nigeria with a view of helping organizations major in the majors.

2. SUCCESS FACTOR FOR ACQUIRING INNOVATIVE TRAINING

According to research conducted by (González-Pernía 2015), exploring the effects of firm Research and Development and firm-sponsored training on innovation. The results show that simultaneously engaging in R&D (Research and Development) and workers training significantly increases the likelihood of innovating. Despite this prospect, (Michealis, T. and Markham, S. 2017) in their paper Innovative training (Making innovation a core competency) asserted that the extent to which companies do innovative training is unknown.

(Wayne 2019) conducted a survey to explore the perception of the faculty and IT leaders regarding the critical success factors (CSFs) that impact technological innovation, adoption, and diffusion. The result identified professional development and training, executive and administrative level support, skilled technical support, stakeholder involvement, the skilled level commitment of faculty/students, innovation culture/collaborative environment, resources and financial support, incentives/rewards/time for innovation, technology/infrastructure, perceived value/addresses need, ease of use, quality, reliability, and flexibility of technology, proven effectiveness, strategic planning and governance, project management, enhanced teaching and learning, and cost efficiency as critical success factor necessary for acquiring innovation. These factors were further used to develop an innovative a? model to help illustrate technological innovation in the higher education environment. (Ottenbacher, M. and Harrington, R. 2010) also assessed the strategies for achieving success for innovative versus incremental new services. The research results show that there are two global success factors regardless of their degree of newness; market attractiveness and strategic human resources management. Several other factors, however, are found to influence the outcome of incremental projects, such as service advantage, empowerment, training of employees, behaviour-based evaluation, tangible quality, and marketing synergy.

Success Factor for the innovative training of Built Environment Professionals

S/n	Success Factors	References
1	Product Advantage and perceived Value	(Cooper 1999), (Timothy L. Michaelis and Stephen K. Markham 2017)
2	Awareness of leaders about innovation	(Nam, T. and Tuan, N. and Minh N. 2017)
3	Clients demand	(Cooper 1999) (Timothy L. Michaelis and Stephen K. Markham 2017)
4	Management commitment to innovation	(Zhou, Y. and Hong, Y. and Liu, J. 2013)
5	Quality, reliability, and flexibility of technology	(Serdyukov 2017)
6	Portfolio management	(Cooper 1999), (Timothy L. Michaelis and Stephen K. Markham 2017)
7	Age of the employee	(Timothy L. Michaelis and Stephen K. Markham 2017)
8	Collaboration of all employees	(Zhou, Y. and Hong, Y. and Liu, J. 2013)
9	Competitive Advantage	(Dess, G. G. and Picken, J. C. 2000), (Nam, T. and Tuan, N. and Minh N. 2017)
10	The skill level and commitment of trainee	(Serdyukov 2017)
11	Ease of use	(Serdyukov 2017)
12	Professional development and training	(Wayne 2019)
13	Executive- and administrative-level support	(Wayne 2019), (Jiang, J. and Wang, S. and Zhao, S. 2012)
14	Innovation certification	(Timothy L. Michaelis and Stephen K. Markham 2017)
15	Experience of the trainer	(Serdyukov 2017)
16	Skilled technical support	(Wayne 2019)
17	Favourable environment for innovative training	(Ottenbacher, M. and Harrington, R. 2010)
18	Return on training investment	(Timothy L. Michaelis and Stephen K. Markham 2017)
19	Resource and Financial support	(Serdyukov 2017)
20	provision of incentives for employees	(Nam, T. and Tuan, N. and Minh N. 2017)
21	Duration of the training	(Serdyukov 2017)
22	Individual/ Organizational Schedules	(Ottenbacher, M. and Harrington, R. 2010)
23	Research and development strategies	(Heffernan, C. and Heffernan, E. and Brosnan, M. and Brown, G. 2009)
24	Strategic Orientation	(Perdomo-Ortiz, J. and González-Benito, J. and Galende, J. 2009)
25	Change Management	(Ottenbacher, M. and Harrington, R. 2010)
26	Innovation culture and collaborative environment	(Timothy L. Michaelis and Stephen K. Markham 2017)

3. RESEARCH METHODOLOGY

As shown in figure 1 below, the research process for this study is divided into four distinct phases namely; Literature Review, questionnaire design and distribution, questionnaire collection and data analysis, and presentation of results.

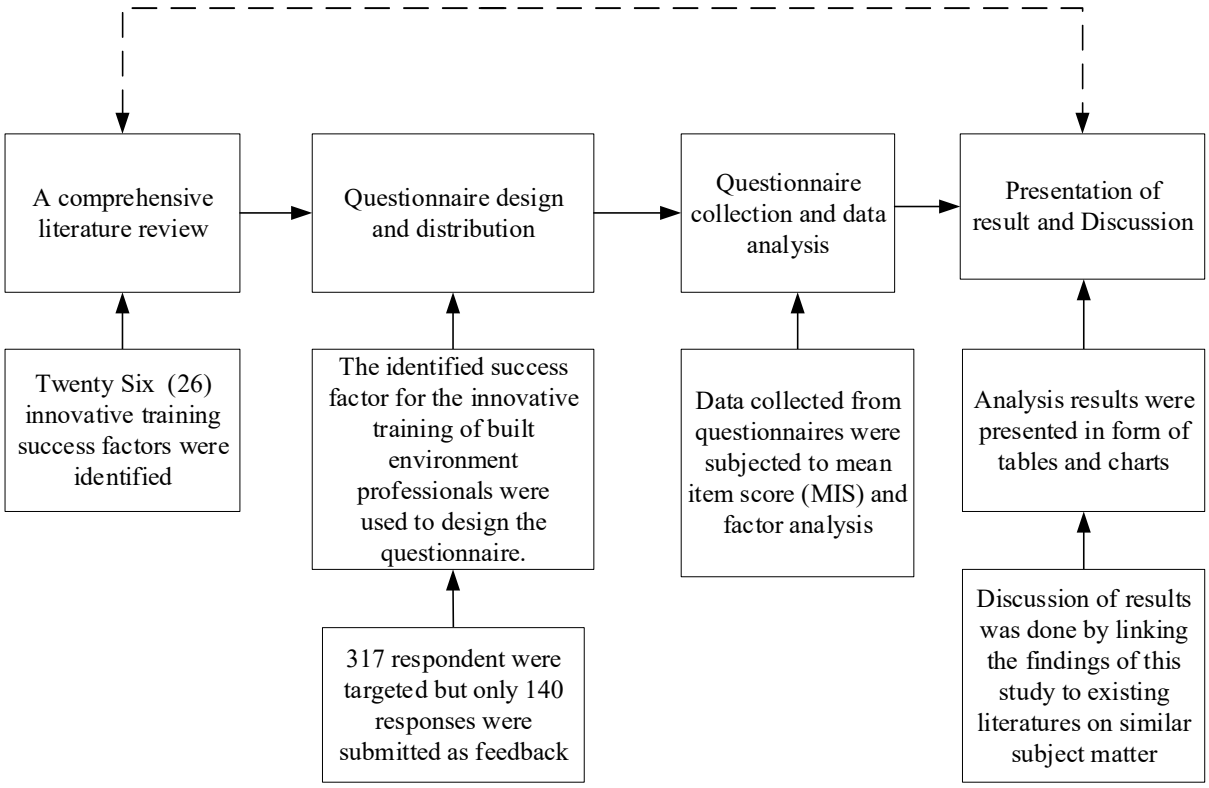


Figure 1. Flowchart of the Research process

3.1 Measurement Instrument

The instrument used during the research work was survey questionnaires, this was adopted to investigate the levels of agreement amongst the Nigerian construction professionals on the success factors for acquiring innovative training. The identification of the success factor was carried out through an extant literature review. The quantitative approach (questionnaire surveys) was adopted

for this study because it involves the generation of data in a quantitative form which can be subjected to rigorous quantitative analysis formally and rigidly (Kothari 2004). Furthermore, the review of relevant literature resulted in the formulation of a structured questionnaire based on a 5-point Likert-scale measurement.

3.2 Survey Administration

Questionnaires (in the form of a web-based google form) were distributed electronically to construction professionals based in Abuja via emails and AEC-related groups on social media such as Linkedin.com, WhatsApp, Twitter among others. These professionals include Architects, Quantity Surveyors, Builders, and Engineers. From the target of 317 responses, the survey received 140 answers, which is approximately 44% of the total responses expected. This return rate can be said to be sufficient for the study as posited by (Moser, C. A., and Kalton, G. 1989), who opined that a study can only be considered biased if the return rate is below 30%. The electronic method of distribution is widely used for obtaining data from a large number of people at a low cost and in a short period. The study also adopted a random sampling technique which gives every professional within Abuja the opportunity of being selected. Abuja was chosen as the study area because of the elevated level of construction works going on in the area, which empowered the researcher to get dependable data.

3.3 Data Analysis

IBM SPSS version 23 was used for data analysis. The study adopted descriptive and inferential statistics to analyse data obtained from respondents. A reliability test was also carried out for all the success factor variables used in this study. Factor analysis was used to categorize the 26 success factors for acquiring innovative training for built environment professionals into 4 critical groups. Factor analysis is a process in which items are analyzed in such a way as to create a mathematical model that estimates factors, or construct domains, within the pool of items. According to (Williams, B. and Brown, T. and Onsman, A. 2010), factor analysis involves multivariate statistical procedures that are employed for various multi-faceted purposes; part of which includes the reduction of a large number of variables into a smaller set of variables or factors.

4.0 RESULTS AND DISCUSSIONS

4.1. Demographic Information of Respondents

Table 1 shows the general characteristics of the respondents to the questionnaires, the characteristics include designation of the respondent, highest qualification of the respondent, years of experience in the profession, membership of the professional body, and type of membership.

Table 1: Summary of respondents Characteristics

Variables	Classification	Frequency	Percent
Designation of Respondent	Quantity Surveyor	48	34.3
	Civil Engineers	28	20.0
	Builders	21	15.0
	Architects	30	21.4
	Others	13	9.3
	Total	**140**	**100.0**
Years of working Experience	Less than 5 years	79	56.4
	5-10 years	31	22.1
	10-15 years	12	8.6
	16 years and above	18	12.9
	Total	**140**	**100.0**
Membership of professional body	NIA	30	21.4
	NIQS	47	33.6
	NIOB	20	14.3
	NSE	29	20.7
	Others	14	10.0
	Total	**140**	**100.0**
Professional Membership	Graduate	68	48.6
	Probationer	14	10.0
	Corporate	52	37.1
	Fellow	6	4.3
	Total	**140**	**100.0**
Highest formal qualification	ND	3	2.1
	HND	15	10.7
	BSc./B.Tech/B.Engine	91	65.0
	PGD	0	0.0
	MSc./MTech	26	18.6
	PHD	5	3.6
	Total	**140**	**100.0**

Source: Researcher's Literature Review (2019)

4.20 Factor Analysis of The Success Factors for Acquiring Innovative Training by Built Environment Professionals.

To test the appropriateness of the data used for the analysis of the success factors for acquiring innovative training by built environment professionals, the Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy and Bartlett test of sphericity was conducted for the data on success factor for acquiring innovative training by built environment professionals as shown in Table 2. The KMO value was 0.836 which is above 0.5 and the Bartlett test of sphericity value was found to be significant at *P*=0.000. The KMO value of 0.836 is above the recommended value of 0.6 (Kaiser 1970, 1974; and Olanrewaju, 2019) and Bartlett's Test of Sphericity (Bartlett's, 1954; Okorie and Olanrewaju, 2019) reached statistical significance, supporting the factorability of the data.

Table 2: KMO and Bartlett's Test for Success Factors

Method		Value
Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		0.836
Bartlett's Test of Sphericity	Approx. Chi-Square	3026.193
	Df	325
	Sig.	0.000

Source: Researcher Data Analysis (2019)

Table 3 shows the total variance explained for the success factors for acquiring innovative training of built environment professionals. For initial Eigenvalues, the percentage of variances from components 1 to 4 are 42.900, 9.879, 6.825, and 5.683 respectively. For Extraction sums of squared loadings, the percentage of variances from components 1 to 4 are 42.900, 9.879, 6.825, and 5.683 respectively while for Rotation sums of squared loadings, the percentage of variances from components 1 to 4 are 18.975, 17.589, 17.034, and 11.688 respectively.

Table 3: Total Variance Explained of success factors for innovative training of Built environment professionals

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	11.154	42.9	42.9	11.154	42.9	42.9	4.934	18.975	18.975
2	2.568	9.879	52.779	2.568	9.879	52.779	4.573	17.589	36.564
3	1.775	6.825	59.604	1.775	6.825	59.604	4.429	17.034	53.599
4	1.477	5.683	65.287	1.477	5.683	65.287	3.039	11.688	65.287
5	1.148	4.414	69.701						
6	1.111	4.274	73.975						
7	0.995	3.827	77.802						
8	0.839	3.226	81.028						
9	0.792	3.048	84.075						
10	0.523	2.01	86.086						
11	0.478	1.839	87.925						
12	0.422	1.623	89.548						
13	0.375	1.442	90.99						
14	0.331	1.274	92.264						
15	0.311	1.196	93.46						
16	0.294	1.132	94.592						
17	0.258	0.993	95.585						
18	0.221	0.851	96.437						
19	0.197	0.757	97.194						
20	0.174	0.668	97.862						
21	0.14	0.538	98.4						
22	0.115	0.442	98.841						
23	0.094	0.362	99.204						
24	0.085	0.326	99.53						
25	0.063	0.242	99.773						
26	0.059	0.227	100						

Extraction Method: Principal Component Analysis.

Source: Researcher Data Analysis (2019)

Table 4 shows the summary of the Rotated component Matrix of the success factor acquiring innovative training by built environment professionals. The factor analysis was performed following Principal Component Solution with a Varimax Rotation (Kaiser, The Varimax Criterion for Analytic Rotation in Factor Analysis 1958). The data fed into Factor analysis consisted of the data obtained from respondents (140). 4 Factors were extracted from the 26 variables. To retain different factors from the variable taken in this study, the cutting point of the eign value was taken is equal to one (1). These component factors were further rotated by varimax solution. The discussion of the result has been based on the varimax rotated factor matrix. To discuss the result of the factor matrix the factor loading of 0.50 or above is considered to be significant. Factor loadings are simply the correlation coefficient between an original variable and an extracted factor. However, the factor loading (except those less than 0.5) of the success factor necessary for innovative training of built environment professionals are categorized based on components. Component 1 consists of eight significant factors with factor loadings ranging from .783 to .558, Component 2 consists of eight significant factors with factor loadings ranging from .815 to .534, Component 3 consists of six significant factors with factor loadings ranging from .795 to .612, and Component 4 consists of four significant factors with factor loadings ranging .807 to .522.

Table 4: Rotated Component Matrix of Success Factors for Innovative Training

Success Factors	Component			
	1	2	3	4
Product Advantage and perceived Value	.558			
Awareness of leaders about innovation	.680			
Clients demand	.573			
Management commitment to innovation	.688			
Quality, reliability, and flexibility of technology	.783			
Portfolio management				.807
Age of the employee				.758
Collaboration of all employees		.722		
Competitive Advantage	.740			
The skill level and commitment of trainee	.567			

Ease of use				
Professional development and training		.692		
Executive- and administrative-level support	.640			
Innovation certification		.580		
Experience of the trainer		.815		
Skilled technical support		.724		
Favourable environment for innovative training			.612	
Return on training investment			.714	
Resource and Financial support			.795	
provision of incentives for employees			.694	
Duration of the training		.534	.659	
Individual/ Organizational Schedules			.631	
Research and development strategies		.584		
Strategic Orientation		.608		
Change Management				.624
Innovation culture and collaborative environment				.552

Extraction Method: Principal Component Analysis.
Rotation Method: Varimax with Kaiser Normalization.
a. Rotation converged in 9 iterations.
Source: Researcher Data Analysis (2019)

4.30 Categorization of Success Factors for Acquiring Innovative training by built environment professionals.

Table 5 to Table 8 shows the categorization of the success factor for acquiring innovative training by built environment professionals.

Component 1: Personnel Orientation

Table 5 shows the categorization for Component 1. The component contains eight factors which include; Product Advantage and perceived Value, Awareness of leaders about innovation, Clients demand, Management commitment to innovation, quality, reliability, and flexibility of technology, Competitive Advantage, Skill level, and commitment of trainee, and Executive- and administrative-level support. Many of these factors relate to the orientation of these professionals

about the need for innovative training, as such this component may be named "Personnel Orientation".

Table 5 Categorization for Component 1

Name	Success Factors	Component
		1
Personnel Orientation	Product Advantage and perceived Value	.558
	Awareness of leaders about innovation	.680
	Clients demand	.573
	Management commitment to innovation	.688
	Quality, reliability, and flexibility of technology	.783
	Competitive Advantage	.740
	The skill level and commitment of trainee	.567
	Executive- and administrative-level support	.640

Source: Researcher Data Analysis (2019)

Component 2: Coaching quality

Table 6 shows the categorization for Component 2. The component contains eight factors which include; Collaboration of all employees, Professional development and training, Innovation certification, Experience of the trainer, Skilled technical support, Duration of the training, Research and development strategies, and Strategic Orientation. Many of these factors relate to the quality of training received by built environment professionals, as such this component may be named as "Coaching quality".

Table 6: Categorization for Component 2

Name	Success Factors	Component
		2
Coaching Quality	Collaboration of all employees	.722
	Professional development and training	.692

	Innovation certification	.580
	Experience of the trainer	.815
	Skilled technical support	.724
	Duration of the training	.534
	Research and development strategies	.584
	Strategic Orientation	.608

Source: Researcher Data Analysis (2019)

Component 3: Payback on training investment

Table 7 shows the categorization for Component 3. The component contains six factors which include; Favourable environment for innovative training, Return on training investment, Resource and Financial support, provision of incentives for employees, Duration of the training, and Individual Schedules. These factors relate to benefit that will be accrued as a result of such training, as such this component may be named as "Payback on investment".

Table 7: Categorization for Component 3

Name	Success Factors	Component
		3
Payback on Investment	Favourable environment for innovative training	.612
	Return on training investment	.714
	Resource and Financial support	.795
	provision of incentives for employees	.694
	Duration of the training	.659
	Individual/ Organizational Schedules	.631

Source: Researcher Data Analysis (2019)

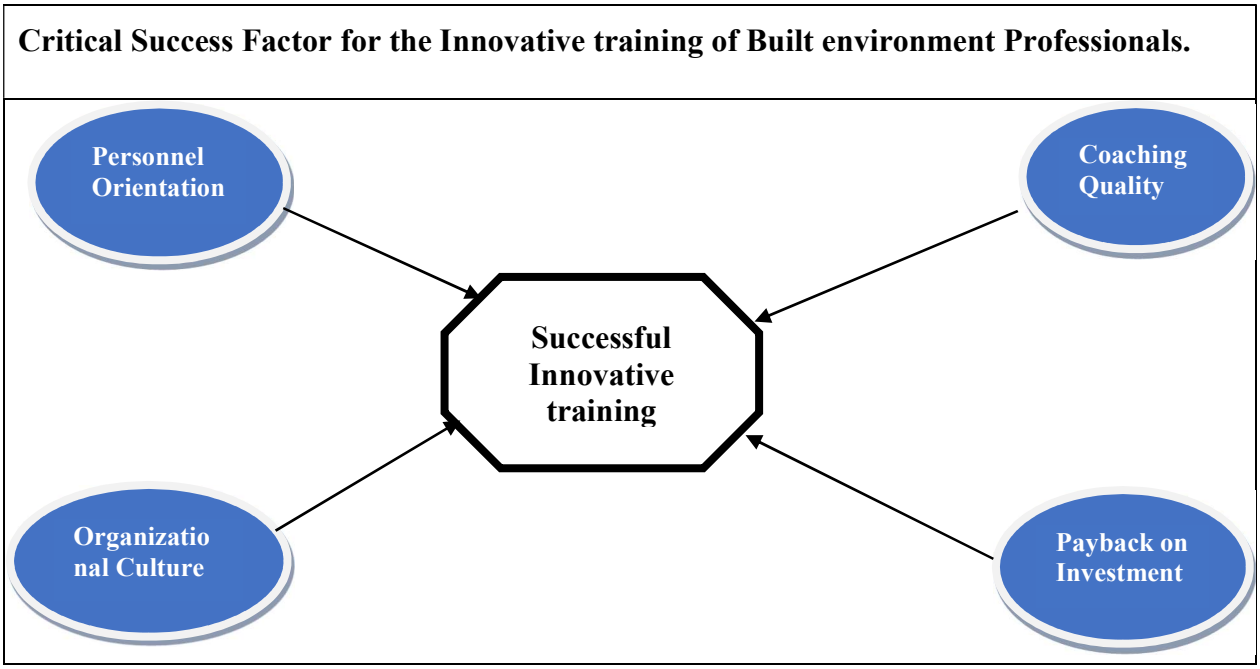
Component 4: Organizational culture

Table 8 shows the categorization for Component 4. The component contains four factors which include; Portfolio management, Age of the employee, Change Management, Innovation culture, and collaborative environment. Many of these factors relate to the positive attitude of the organization towards innovation and as such, this component may be named "Organizational culture".

Table 8: Categorization for Component 4

Name	Success Factors	Component 4
Organizational culture	Portfolio management	.807
	Age of the employee	.758
	Change Management	.624
	Innovation culture and collaborative environment	.552

Source: Researcher Data Analysis (2019)



Source: Researcher Data Analysis (2019)

Figure 2. Model for successful innovative training of built environment professionals

Discussion of result/summary of findings

The discussion is based on the findings from the analysis of data obtained from the electronic questionnaire Survey and extant literature review as presented in the previous section. The inference was made; relationships were drawn between observed information through the analysis of past studies similar to the research work to determine the agreement or otherwise.

The 26 factors obtained from the literature review and ranked by respondents were subjected to principal components analysis (PCA) using IBM SPSS version 23. Principal components analysis revealed the presence of four (4) components with eigenvalues exceeding 1, explaining 42.900%, 9.879%, 6.825%, and 5.683% of the variance respectively while the scree plot revealed five components before it level-off to the horizontal. The four-component solution explained a total of 65.287% of the variance which is ideal. Furthermore, the success factor for acquiring innovative training was classified into four categories based on the factor loadings and components. The categories were; Personnel Orientation, Coaching quality, Payback on Investment, and Organizational Culture. This is in agreement with (Wayne 2019) which identified Executive and administrative level support, Enhanced teaching and learning, skilled technical support, innovation culture/collaborative environment, resources and financial support, and Incentives/rewards/ for innovation as critical success factors necessary for acquiring innovative training.

5.0 CONCLUSION

Conclusion

The continual emergence of new technologies, notwithstanding the ever-increasing skill gaps, has made innovative training more of a necessity than just a skill luxury that professionals add to their profile. Hence, this study, therefore, presents four (4) critical success factors that construction

organizations, professionals' bodies, training institutes, government parastatals among others need to pay keen attention to as they acquire innovative training for their employees. These factors are established to be Organizational culture, Personnel Orientation, Coaching Quality, and Payback on training investment.

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BIOGRAPHICAL NOTES

Emmanuel Temidayo Olorunfemi is a highly intelligent, trail-blazing, and extremely motivated millennial with an undying passion for excellence. He has demonstrated capacity in various aspects of life with construction being one of his strongest niches. Emma Femi as fondly called graduated from the Federal University of Technology Minna in 2019, with a First-class honor in Quantity surveying, coming out as one of the top 1% best students in the university. He has proven himself over time as a first-class construction analyst who pays keen attention to details and is highly adept at construction project management. One of his distinguishing factors is his unbridled enthusiasm to share information and knowledge on his expertise with others, this singular character trait has helped him in the training of several Quantity surveyors on the use of much 21st-century Quantity

surveying software. He presently works with Cost Generals Consult as a freelance Quantity surveyor and Ifeanyi Anago & Partners as a Project manager (National Youth Service Corps). He is also the present *Secretary for professional development* of the Nigerian Young Quantity Surveyors Forum (YQSF) FCT chapter, where he is volunteering in capacity building of Young Quantity Surveyors. His research interest includes but is not limited to Construction Psychology, Construction blockchain financing, Building Information Modelling, Environmental Sustainability, and Affordable housing development.

Dr. Luqman Oyekunle Oyewobi is a Senior Lecturer of Quantity Surveying in the School of Environmental Technology at the Federal University of Technology, Minna, Nigeria. Luqman is a Registered Quantity Surveyor with Quantity Surveying Registration Board of Nigeria. Before going to University of Cape Town for his PhD, he received B.Tech Honours Degree in Quantity Surveying with a First Class (Summa Cum Laude) from Federal University of Technology, Minna (2006) and Master Degree from Federal University of Technology, Akure (2010). He has been working as a lecturer in the Department of Quantity Surveying, Federal University of Technology, Minna since 2007. Prior to that, he has had stint as a Practicing Quantity Surveyor with Oyo State Local Government Service Commission. While working as a practitioner in the construction industry, he became worried why some organisations fail while others succeed. This experience informed his decision to examine the causes of performance differentials among large construction organizations in South Africa. Dr. Oyewobi has received numerous awards including Vice-chancellor's award for the best graduating student in School of Environmental Technology, Federal University of Technology, Minna, Niger State 2005/2006 session.

Oludolapo Ibrahim Olanrewaju is a young multitalented Quantity surveyor, researcher, and programmer. He attended the Federal University of Technology, Minna where he studied Bachelor of Technology in Quantity surveying and graduated in 2017. He graduated with a First Class and emerged as the best graduating student in the department of Quantity surveying for the 2017 set. Oludolapo is currently a Ph.D. student at Victoria University of Wellington, New Zealand. He has a strong passion for ICT and he has been involved in series of software projects like DOLLAQUESS (Quantity surveying software he designed), decision support systems, inventory manager, and others. He is the founder of Dollasoft Technologies. His research interests are environmental health, building information modeling, construction informatics, construction health and safety (H&S), construction management, construction emissions, green construction, etc.

Abdul-Lateef Babatunde Busari is a brilliant Entrepreneur with a passion for innovation and business development. He graduated from the prestigious Federal University of Technology Minna, (FUT Minna) in 2019 with a Second-class Upper honor in Quantity Surveying, coming out as one of the best students in the department. His commitment to innovation and entrepreneurship has helped him harness a lot of opportunities in the Agri-construction value chain, with fish farming being his business domain. He presently works at The Federal Polytechnic offa Kwara state (Fedpoffa) as a Lecturer in the Department of Quantity Surveying (National Youth Service Corps), where he is privileged to impact and guide a lot of QS newbies on navigating through their career path.

CONTACTS

Emmanuel Temidayo Olorunfemi
Federal University of Technology, Minna
211 his glory plaza, 3 Ose close behind UBA/Access bank, Abuja
Federal Capital Territory, Abuja
NIGERIA
Phone: + 2348136781144
E-mail: temidayoolorunfemi10@gmail.com

Mr. Oludolapo Ibrahim Olanrewaju
Victoria University of Wellington,
Kelburn,
New Zealand
Email: Oludolapoolanrewaju2012@gmail.com

Mr. Abdullateef Busari Babatunde
Federal Polytechnic Offa,
Kwara State,
Nigeria
Phone: +2348117500991
Email: Busariabdullateef@gmail.com

Miss Roseline Toluwalashe Olorunfemi
Cost Generals Consult
No 18 Jesse Jackson Street Asokoro, Abuja.
Abuja
Nigeria
Email: toluwalasheroseline@gmail.com