A Principal Component Analysis of Project Management Competencies for the Ghanaian Construction Industry

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Abstract
The study adopts a data reduction technique to examine the presence of any complex structure among a set of project management competency variables. A structured survey questionnaire was administered to 100 project managers to elicit relevant data, and this achieved a relatively high response rate of 54%. After satisfying all the necessary tests of reliability of the survey instrument, sample size adequacy and population matrix, the data was subjected to principal component analysis, resulting in the identification of six new thematic project management competency areas; and were explained in terms of human resource management and project control; construction innovation and communication; project financial resources management; project risk and quality management; business ethics and; physical resources and procurement management. These knowledge areas now form the basis for lateral project management training requirements in the context of the Ghanaian construction industry. The main contribution of the paper is manifested in the use of the principal component analysis, which has rigorously provided an understanding into the complex structure and the relationship between the various knowledge areas. The originality and value of the paper is embedded in the use of contextual-task and conceptual knowledge to expound the six uncorrelated empirical utility of the project management competencies.

Keywords: Factor Analysis, Project Manager, Project Management, Project Control, Project Planning

Introduction
The traditional philosophy of management in construction projects places great emphasis on the ability to plan and execute projects. There has been a paradigm shift of project organisation from local and regional scope into a global context involving several multi-stakeholders (Chinowsky, 1998). Concurrently, the concepts of company loyalty, traditional competitors, and employee development are changing at a pace that has not previously been encountered in post-industrial times (Goodman and Chinowsky, 1997). It is the emergence of these concepts alongside issues such as knowledge transfer, new markets, and information technology that now form the requirements expected from today's construction projects graduates. As a result of these, the continued emphasis on project management as the key to organisation success is being reinforced, hence, the importance of Project Management knowledge and skills (Goodman and Chinowsky, 1997).

Given the impact of these economic issues in the construction industry, it is not surprising to see that project management education has evolved with a similar emphasis on project-level budget and schedule controls. Key aspects of project management practices in the construction industry require that projects are managed within time and cost (PMBOK Guide, 2004). Maylor (2005) emphasised that, a thorough planning of scope, time and cost is done before project implementation and these must be discussed with stakeholders.

Consequently, increased competition and changing economic conditions requires built environment professionals to understand a wider range of competency requirement issues in the 21st Century work environment (Egger et al.. 1996; Hauck, 1998). Specifically, the evolution of project management as an academic discipline in universities has both followed and reinforced the management traditions as they have prepared each succeeding generation of industry managers (Goodman and Chinowsky, 1997).

Dogbegah (2009) also suggested that, projects completed should be reviewed and lessons learnt documented and incorporated in the next project to avoid repetition of mistakes. Government sponsored projects in the building construction industry are plagued by a lot of challenges arising from myriad project management issues which leave stakeholders of projects not satisfied. However, in practice, the concept of project management has been broadened from an initial focus on management of largely unitary projects, with well defined and agreed goals and end products, to include multiple projects and programmes that are multidisciplinary, not pre-defined, permeable, contested and open to renegotiation throughout the project cycle (Atkinson, et al. 2006). This has resulted in management taking on a greater strategic focus in an attempt to create value within the corporate setting and complement the traditional metrics of performance with new methods that encourage a greater role for multiple assumptions of duty (Alter and Koontz, 1996).

For instance, many studies have focused on project management competencies and identified several competency areas specific to different economic sectors in both developed and developing countries (Ahadzie, 2007; Ahadzie et al. 2008a; 2009; Dogbegah, 2009). Albeit, studies in project management competencies is no new field, however, it is unfortunate that little efforts have been done in terms of exploring the intrinsic relationships of the various project management competencies in literature. Based on eighteen (18) project management competency areas (PMCA) identified in the literature, this paper adopts a data reduction technique, mainly, principal component analysis (PCA) to examine the presence of any complex structure among the PMCA variables and determine the variables that measure the same underlying effect. This is in line with the call by Alter and Koontz (1996) to identify key project management competency areas that conform with the lateral curriculum philosophy, assume few courses in advanced concepts, terminal in nature and continued professional development-based. The rest of the paper contains sections on literature review upon which the research aim is based, methodology used in collecting and analysing data necessary for findings answers to the research problem, discussion of results and conclusions.

Literature Review

There have been many studies on project management competence aiming at identifying determinant factors and/or criteria for a successful project or a competent project manager (Thamhain, 1991; Wateridge, 1998; Chen and Partington, 2006; Chen, et al. 2008; Ahadzie, et al. 2009). Most of these studies accord with attribute-based approaches, focusing on either the project work activities (work-oriented) or the personal characteristics of project managers (worker-oriented). For instance, Chen et al. (2008) used the two principal traditional approaches (worker-oriented and work-oriented) to distinguish project management competencies. The former emphasizes workers' attributes, such as knowledge, skills and abilities, and personal traits (Veres III et al. 1990; Chen et al.. 2008), whilst the latter treats work as existing independently of the worker, definable in terms of the technical requirements of work tasks (Holmes and Joyce, 1993). Nevertheless, both traditions view competence as an attribute- based phenomenon, constituted by a specific set of generic and context-independent attributes which do not determine practical competence in accomplishing work (Chen and Partington, 2006).

Crawford (2005) and Ahadzie et al. (2008b) have enhanced researchers' understanding of the project management competencies by providing three unique classifications, namely;

input competencies, output competencies and personal competencies. According to Crawford, whilst input competencies refer to the knowledge and skills that a person brings to a job, output competencies are identified as the “demonstratable” performance that a person exhibits at the job place. Both Crawford (2005) and Ahadzie et al. (2008a, b) explained that personal competencies relate to the core attributes underlying a person’s capability to execute a job. Ahadzie et al. (2008a) also indicates that the classifications relating to personal and output competencies provided by Crawford appear to bear some similarity to the contextual–task typology of project management competencies. It is well recognised that task performance competencies (TPCs) are job-specific and are associated with the project managers demonstratable functions such as organising, programming, planning, coordinating and controlling, thus, a likely input/output competencies (Ahadzie, et al. 2008; Chen, et al. 2008; Isik, et al., 2009). TPCs are best predicted by drawing on cognitive ability, job knowledge, task proficiency and experience (Ahadzie et al., 2008a, b). Similarly, Conway (1999) indicates that TPCs contribute either directly or indirectly to the technical function and usually vary between different jobs in the same organisation. Borman and Motowidlo (1993) identifies that the major source of variation in TPCs are human characteristics such as knowledge, skills and abilities that vary with task proficiency.

On the other hand, contextual performance competencies (CPCs) are those discretionary job-related acts which contribute to organisational effectiveness but are not formally recognised as part of the job (Conway, 1999; Ahadzie, et al., 2008; Chen, et al., 2008). Contextual performance competencies (as evidenced in the literature) are best predicted by drawing on the constructs of interpersonal facilitation and job dedication. CPCs support the organisational, social and psychological environment in which the technical function must operate; are common to many jobs or all jobs; are not role-prescribed and thus are normally not (explicitly) part of incumbents’ formal responsibilities and obligations to an organisation and the major source of variation in contextual behaviours is not proficiency but volition and predisposition (Borman and Motowidlo, 1993; Conway, 1999; Ahadzie, et al. 2008).

The implication of accepting the contextual–task distinction is that, the knowledge, skills and habits associated with task performance behaviours are likely to be different from those associated with contextual performance behaviours (Ahadzie, 2008). This suggests that in terms of developing training programmes, the antecedents of contextual performance behaviours are likely to be different from the antecedents of task performance behaviours (Fraser, 2000; Edum-Fotwe and McCaffer, 2000). The evidence also suggests that task performance behaviours are best predicted by individual differences in, for example, cognitive ability, job knowledge, task proficiency, and job experience (Gellatly and Irving, 2001; Ahadzie, 2008). Alternatively, contextual performance behaviours are best predicted by individual differences in job dedication and interpersonal facilitation (Conway, 1999). Job dedication is defined as the motivational foundation for job performance that drives people to act with deliberate intention of promoting an organisations best interest and includes self-disciplined behaviours such as following rules, working hard and taking initiative.

Interpersonal facilitation on the other hand refers to those attributes that help maintain the interpersonal and social context needed to support job effectiveness (Van Scotter and Motowidlo, 1996). Given the inherently complex nature of construction projects, particularly, in an increasingly technological and competitive work environment, the behavioural competencies of construction project managers (CPMs) are likely to be more complex and diverse than in most other industries (Ahadzie et al. 2008a). These authors have further argued that the contextual–task typology offers a potentially significant methodology that could help isolate, in a somewhat explicit term, the different dimensions of the CPMs competency profiles so that a more detailed understanding could be made of them. Based on the evidence gathered so far in the literature, the view held by this work is that, the contextual–task distinction might be worth exploring in the pursuit of an empirically rigorous

understanding of the CPMs competency profiles required for managing large and complex projects in the context of Ghanaian construction industry.
Drawing on the ongoing discussions, it is undeniably factual that, the various studies on contextual–task typology of project management competencies have significantly contributed to the conceptual understanding of project management competencies. Despite these enormous contributions, it is not clear in the literature as to specific project management knowledge areas and competencies specific to managing large and complex projects in Ghana. Subsequently, Dogbegah (2009) identified eighteen (18) project management competency areas, mainly; "schedule management and planning, cost management, quality management, human resources management, risk management, supply chain management, claims management, knowledge management, health and safety management, conflict and dispute management, environmental management, ethical management, stakeholders' management, information technology management, communication management, materials resources management, financial management and plant and equipment resources management". "Indeed, these findings support the conceptual maps of project management competency in the literature and the argument made by Alter and Koontz (1996), Chen and Partington (2006), Cheng et al. (2008) and Ahadzie et al. (2008a,b; 2009), that project management must be conceptualised beyond the commonly emphasized project administration expertise" (Dogbegah, 2009, p. 40).

Methodology

The above literature review provides a thorough understanding of the recent developments in project management competencies. It provides profound opportunity for the identification of appropriate theoretical framework and project management competency knowledge areas for the study. The review identified eighteen (18) project management competency areas (PMCA) specific to managing large and complex projects in the context of the Ghanaian construction industry (GCI). Subsequently, a self-administered structured survey questionnaire was used to collect primary data from a large number of project managers. The structured survey questionnaires were administered to 100 project managers to elicit relevant data on the PMCA which achieved a relatively high response rate of 54%. The analytical tool adopted was aimed to explore the latent characteristics and relationships between these 18 variables identified. Justification for looking at the PMCA variables at this stage is that, these variables are firmly rooted in the theoretical literature of project management but it is not clear which of the variables would measure the same underlying effect. In the survey, respondents (Project Managers) were asked to respectively rate the relative importance of the 18 PMCA in those variables. The rating involved the respondents to decide whether the variable is "Not Important (1)", "Less Important (2)", "Quite Important (3)", "Important (4)" and "Very Important (5)"; and Not Proficient (1)", "Less Proficient (2)", "Quite Proficient (3)", "Proficient (4)" and "Very Proficient (5)" respectively.

Data Analysis

Factor Analysis (Principal Component Analysis)

According to Field (2005a, b), Ahadzie (2007) and Owusu and Badu (2009), factor analysis is useful for finding clusters of related variables and thus ideal for reducing a large number of variables into a more easily understood framework. The first attempt to the use of factor analysis was to address some pertinent issues relating to the appropriate sample size for undertaking and establishing the reliability of factors analysis (Field, 2005a, b). Cronbach's reliability test, which is mostly used in this circumstance (Field, 2005a) was conducted and the test results of Cronbach's alpha achieved an overall high of 0.785 suggesting overall reliability of the research instrument for factor analysis. Furthermore, the data was subjected to the Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy which recorded substantial value of 0.750. The KMO and Bartlett's measure are used to measure sampling adequacy in the use of factor analysis (Field, 2005a, b). The KMO statistic varies between 0 and 1 with a value of zero indicates that the sum of partial correlations is large relative to the sum of correlations, indicating diffusion of pattern of the correlations and hence factor analysis is likely to be inappropriate (Gorsuch, 1983 and Field, 2005a). A value close to 1.00 indicates that patterns of correlation are relatively compact and so factor analysis should yield distinct and reliable factors (Field, 2005). However, literature recommends that the KMO value should be greater than 0.50 if the sample size is adequate (Child, 1990 and Field, 2005b). Subsequently, as presented in Table 1, the KMO measure of this study achieved a high value of 0.750 suggesting the adequacy of the sample size for the factor analysis. The Bartlett's test of sphericity was also significant suggesting that the population was not an identity matrix.

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.744
Bartlett's Test of Sphericity	Approx. Chi-Square	498.276
	Df	113
	Sig.	.000

Table 1 KMO and Bartlett's Test

After satisfying all the necessary tests of reliability of survey instrument, sample size adequacy and population matrix, the data was subjected to factor analysis using principal component analysis (PCA), with varimax rotation. Prior to principal component analysis, the communalities involved were first established. Communality explains the total amount an original variable shares with all other variables included in the analysis and is very useful in deciding which variables to finally extract.

Project Management Competency Area (PMCA)	Initial	Extraction
Schedule management and planning (PCMAF 01)	1.000	.812
Cost management (PCMAF 02)	1.000	.786
Quality management (PCMAF 03)	1.000	.576
Human resource management (PCMAF 04)	1.000	.876
Risk management (PCMAF 05)	1.000	.793
Supply chain management (PCMAF 06)	1.000	.680
Claims management (PCMAF 07)	1.000	.720
Knowledge management (PCMAF 08)	1.000	.761
Health and Safety management (PCMAF 09)	1.000	.784
Conflict and dispute management (PCMAF 10)	1.000	.579
Environmental management (PCMAF 11)	1.000	.763
Ethical management (PCMAF 12)	1.000	.792
Stakeholders' management (PCMAF 13)	1.000	.792
Information Technology (PCMAF 14)	1.000	.699
Communication management (PCMAF 15)	1.000	.735
Materials resources management (PCMAF 16)	1.000	.739
Financial management (PCMAF 17)	1.000	.670
Plant and equipment resources management (PCMAF 18)	1.000	.676
Extraction Method: Principal Component Analysis		

Table 2: Communalities

As indicated in Table 2, the average communality of the variables after extraction was above 0.60. The conventional rule about communality values is that; extraction values (eigenvalues) of more than 0.50 at the initial iteration indicates that the variable is significant; and should be included in the data for further analysis or otherwise removed (Field, 2005a, b). The eigenvalue and factor loadings were set at conventional high values of 1.00 and 0.50 respectively (Field, 2005a). Applying the latent root criterion on the number of principal components to be extracted suggests that 6 components should be extracted as their respective eigenvalues are greater than one.

As demonstrated in Table 3 and supported by the scree plot in Figure 1; six (6) components with eigenvalues greater than 1.0 were extracted using the factor loading of 0.50 as the cut-off point. The total variance explained by each component extracted is as follows: The first principal component (component 1) accounted for 33.62 % of the total variance whilst the second principal (component 2) component, explained 9.475% % of the remaining variation not explained by the first component. Component 3 accounted for 9.209%, component 4 accounted for 7.516%, component 5 accounted for 6.577% and component 6 accounted for 6.051%. The cumulative proportion of variance criterion, which says that the extracted components should together explain at least 50% of the variation, shows that the 6 extracted components cumulatively explained 72.444% of the variation in the data set. Scores are numbers that express the influence of an eigenvector on a specific sample.

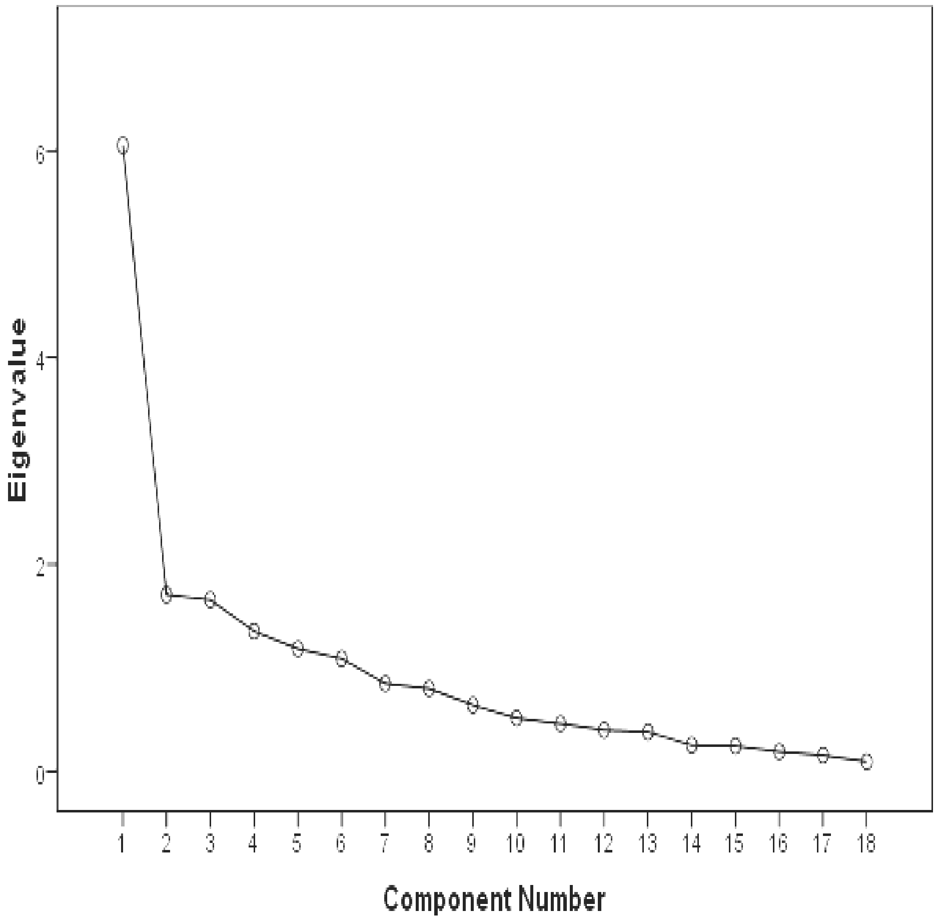

Figure 1 Scree Plot

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	6.051	33.617	33.617	6.051	33.617	33.617	3.409	18.936	18.936
2	1.706	9.475	43.092	1.706	9.475	43.092	2.429	13.495	32.431
3	1.658	9.209	52.301	1.658	9.209	52.301	2.204	12.246	44.677
4	1.353	7.516	59.817	1.353	7.516	59.817	1.826	10.145	54.822
5	1.184	6.577	66.393	1.184	6.577	66.393	1.705	9.475	64.296
6	1.089	6.051	72.444	1.089	6.051	72.444	1.467	8.148	72.444
7	.846	4.701	77.146						
8	.799	4.437	81.583						
9	.639	3.549	85.131						
10	.513	2.850	87.981						
11	.459	2.548	90.529						
12	.398	2.210	92.739						
13	.379	2.106	94.845						
14	.251	1.395	96.240						
15	.243	1.352	97.592						
16	.189	1.047	98.639						
17	.154	.853	99.492						
18	.091	.508	100.000						
Extraction Method: Principal Component Analysis									

Table 3: Total Variance Explained

The ability to interpret of results PCA can be improved through rotation (Norusis, 1988). The rotated factor solution is displayed by default and is essential for interpreting the final rotated analysis. Rotation suggests the bahaviour of the variables under extreme conditions and maximizes the loading of each variable on one of the extracted factors whilst minimizing the loading on all other factors and it is best factor output solutions for interpreting factor analysis. Table 5 presents the results of the rotated component matrix of the PCA. The interpretations of the results are provided in the next section of the dissertation.

The next stage involved the examination of the presence of any complex structure among the variables. A complex structure is said to be present when a variable has a factor or component loading greater than 0.50 on more than one component. Loadings express the influence of each original variable within the component. After checking for complex structure in the variables, the factor loadings are again examined, but this time to check for components that have only one variable loading on them. A check on Table 4 shows that all 6 components had more than one variable loading on them, thus resulting in the keeping of all the 6 components. What remains is the interpretation of the 6 principal components extracted. It is instructive to note that the original 18 variables have been summarised into 6 new uncorrelated variables that explain 72.444% of the total variance in the variables included on the components. This often is the challenge posed by this analysis as the combinations of variables that load high on a component are difficult to interpret.

Project Management Competency Area (PMCA)	Component PC 1	PC 2	PC 3	PC 4	PC 5	PC 6
Human resource management (PCMAF 04)	**.912**	.105	.148	.155	-.013	.083
Schedule management and planning (PCMAF 01)	**.888**	-.023	.111	.063	.077	.034
Environmental management (PCMAF 11)	-.104	.061	.051	.261	**.806**	.169
Health and Safety management (PCMAF 09)	-.046	.296	.410	-.079	**.685**	.226
Stakeholders' management (PCMAF 13)	.166	.356	.177	.188	**.725**	-.214
Ethical management (PCMAF 12)	.293	.323	.089	.108	**.762**	.038
Knowledge management (PCMAF 08)	-.133	**.762**	.063	-.024	.321	-.235
Communication management (PCMAF 15)	.157	**.732**	.034	.400	-.120	.005
Information Technology (PCMAF 14)	.415	**.581**	.330	.164	.049	-.228
Cost management (PCMAF 02)	-.011	-.187	**.773**	.106	.171	.335
Financial management (PCMAF 17)	.287	.269	**.713**	-.009	-.055	-.066
Claims management (PCMAF 07)	-.067	.186	**.528**	.403	.466	-.151
Risk management (PCMAF 05)	.283	.051	.105	**.796**	.016	.255
Quality management (PCMAF 03)	.461	.039	.365	**.571**	.123	-.136
Conflict and dispute management (PCMAF 10)	.274	.203	.269	**.606**	.131	.072
Materials resources management (PCMAF 16)	.000	.002	.229	.077	.111	**.818**
Supply chain management (PCMAF 06)	.107	.250	.224	.115	.126	**.725**
Plant and equipment resources management (PCMAF 18)	.351	.400	.110	-.142	.273	**.535**
Extraction Method: Principal Component Analysis; Rotation Method: Varimax with Kaiser Normalization; a. Rotation converged in 8 iterations						

Table 4: Rotated Component Matrix

Discussion of Results

Based on critical examination of the inherent relationships among the variables under each component, the following interpretation was deduced to represent the underlying dimensions of the components. For instance, component 1 was labelled *project human resource management and control*; component 2 was labelled *construction innovation and communication*; component 3 was themed *project financial resources management*; component 4 was themed *project risk and quality management*; component 5 was *termed business and ethical management*; and component 6 was termed *physical resources and procurement management*. These names were derived based on their interrelated characteristics and combination of variables with high factor loadings.

Component 1: Project Human Resource Management and Control

The first principal component (PC1) in Table 4 reported high factor loadings for the variables *human resource management* (91.2%) and *schedule management and planning* (88.8%). The numbers in brackets indicate the respective factor loadings, which assume the relative importance of the variable in the data set of the component. The component (cluster of the listed variables) accounted for 33.617% of the variance explained as shown in Table 3. Without difficulty, the component was themed *project human resource management and control*; and the interpretations that follow. This findings support the proposition of Ahadzie (2007), that project managers' competency and performance domain can reasonably be put under contextual performance behaviours and task performance behaviours. No wonder, the human factor including the associated managerial competencies have been reported to be crucial in project management genre. Quoting Isik et al. (2009), "human resources management is an inevitable dimension of project management since it is people who deliver projects". This assertion is true because, people are the predominant resource in organisations and there is a positive association between human resources management practices and achievement of project delivery. On the other hand, project control enables the project to be completed on time by the use of a series of processes, including activity definition, sequencing, resource estimating, duration estimating, schedule development and schedule control;

Component 2: Construction Innovation and Communication

The second principal component (PC2) in Table 4 reported factor loadings for the variables *knowledge management* (76.2%), *communication management* (73.2%), and *information technology (58.1%); and* accounted for 9.475% of the variance explained as shown in Table 3. Subsequently, examining critically the latent characteristics of the variables, the component was labelled *construction Innovation and Communication management.* This component is easy to interpret, in the sense that, conventionally, innovation interweaves knowledge management applications and information technology; and driven by communication. For instance Kamara et al. (2002) interpreted knowledge management in construction as a vehicle fuelled by the need for innovation and improved business performance and client satisfaction. The capability of a company to cope with sophisticated projects is the result of a successful knowledge management. Adoption of innovation practices also entails application of information technology knowledge and the various software packages available in the project management cordon. This has become a common practice in many project management outfits. Therefore it is essential to keep information on best practices in order to learn lessons and not to repeat the mistakes. It is critical that a project manager has the expertise to manage this component of the overall project effectively. Conventional wisdom suggests that effective communication drives innovation; bring project stakeholders to the both business and project interfaces; and work towards achieving project goals. A key component of communication competency is the ability to recognize each individual's communication style and adapt to it. This ability enables the project manager to influence different types of individuals and communicate innovation intentions to project stakeholders.

Component 3: Project Financial Resource Management

Component (PC3) accounted for 9.209% of the variance (see Table 4). The reported factor loadings for the variables are *cost management* (77.3%), financial *management* (71.3%), and *claims management* (52.8%); and without difficulty, the component was labelled project financial resource management. It has earlier been highlighted the need to include financial management training in construction education as a requirement of the 21st century business strategy (Owusu-Manu, 2008). This is because, financial management controls are vital to the project success or failure (Grosskopf, 2005). Frequently cited problems in financial systems implementations are related to costs. Cost management activities include planning, estimating, budgeting, and controlling the costs of the project (Isik, et al. 2009). All these activities ensure the lowest overall project cost possible consistent with the owner's investment objectives. Quoting Owusu-Manu et al. (2009), "business and capital market environment is changing rapidly, financial markets are becoming global, competition is becoming more intense and the financial communication is becoming increasingly complex". The need for financial management competency has been dominated in project management education. In addition, several competencies are related to keeping the project within budget, including the ability to perform resource planning, cost estimation, and cost control. The project manager must also have a strategy to deal with the need to ensure adequate funding over a series of years if the project is to be funded from annual or multiple appropriations. Also, claims management is of particular importance because the construction activity involves a large number of parties, an environment conducive to conflicts (Isik, et al. 2009). Claims and disputes between construction owners, contractors and other participants can be avoided by clearly stated contractual terms, early nonadversarial communication, and a good understanding of the causes of claims. Moreover, documentation, processing, monitoring and management of claims are a part of contract life cycle (PMBOK Guide, 2004).

Component 4: Project Risk and Quality Management

As demonstrated in Table 4, component 4 consists of *risk management* (79.6%), *conflict and dispute management* (60.6%) and *quality management* (57.1%); and without much difficulty, it was labelled *project risk and quality management*, accounting for 7.516% of the total variance (see Table 3). Considering the complex, dynamic and challenging nature of construction projects, risk seems unavoidable and affects productivity, performance, quality and budget significantly. According to Isik et al. (2009), risk management processes include identification, analysis, responses, monitoring and control of uncertainties associated with project delivery. It is therefore imperative that project managers thoroughly understand the various risks that may affect the implementation and must be prepared to manage risks as they develop. As it may be commonly known, risks may be internal or external. Internal risks are those that the project team can control or influence, such as staff assignments and cost estimates. External risks are issues beyond the control or influence of the project team, such as market shifts or failure to perform by outside vendors. On the one hand, quality management refers to the activities that determine quality policies, objectives, and responsibilities. The processes of a quality management system include quality planning, quality assurance, and quality control (PMBOK Guide, 2000). Construction companies are incrementally implementing total quality management (TQM) for improving customer satisfaction, obtaining better quality products and higher market share (PMBOK Guide, 2000). The project manager must be able to manage the quality of the project to ensure that it satisfies the needs and objectives for which it was undertaken.

Component 5: Business and Ethical Management

Component 5 consists of *environmental management (80.6%)*, stakeholder management (72.5%), *ethical management* (72.2%), and *health and safety management (68.5%)*. Again, examining the inherent characteristics, it was labelled *business and ethical management.* This component accounted for 6.577% of the total variance (see Table 3). In dealing with the continuum of project stakeholder, project managers have to contend with issues such as managing stakeholder values and aspirations.

It is striking to note that the above-mentioned knowledge constructions underpin both ethical issues in business and project interfaces. An ethical issue can be seen as a problem, situation, or opportunity which has several possible options and where each must be evaluated as right or wrong, ethical or unethical. The issue of business ethics has engaged both practitioners and academic in recent times. The study of business ethics does not just mean ‘moralising’ about what should or should not be done in a particular situation. Rather, it systematically links the concepts of morality, responsibility, and decision-making in organisations. More recently, business ethics literature has focused on the business case for organisations developing ethical cultures. Related to the issue of trust between businesses and stakeholders; the development of ethical cultures and business practices, as evidenced by the existence of codes of ethics, integrity systems and socially responsible strategies, strengthens the relationship between the organisation and key stakeholders such as consumers (Freeman, 1999). Whilst there are researches that support the view that ethics is good for business (Carroll and Meeks, 1999). There is another reason why we should consider ethics at the micro level of managerial decision making. We all have slightly different understandings about what is ethical. Our moral values are shaped over time, influenced by a range of factors including our parents and upbringing, religion, formal and informal education and our cultural identity among other experiences (Walker et al. 2007). It should not be presumed that our understanding and application of ethics is necessarily correct or that others will agree with our interpretation.

What is required is a considered and informed approach rather than an intuition to ethical decision-making. Incorporation of a systematic approach to defining the ethical dimensions to business decisions and ensure that business practices are ethical because it is the right and profitable thing to do. Albeit, environmental sustainability and health and safety practices have been of interest to project management practitioners (Walker, et al. 2007), much has not been achieved in terms of positioning environmental management and health and safety practices in business practices of developing countries (Ahadzie, et al. 2007). With the recent intense global recognition of the inclusion of EMHS in academic programmes, it has become instructive for project managers to understand the impact of project activities on the sustainability of the environment. However, it is not surprising that health and safety relating to project delivery has been shown to be related to environmental criteria under this component. This is because studies have shown that safety standards have environmental implications and project delivery consequences and vice versa (Ahadzie, et al. 2007). Ringen et al. (1995) has also reported that the aim of ensuring health and safety practice in project delivery is to reduce the number of accidents and accidents' effects on project costs such as the cost of insurance, inspection and conformance to regulations.

Component 6: Physical Resources and Procurement Management

Interestingly, the last component, PC6 accounted for 6.051% of the total variance explained (see Table 3) and comprise of *materials resource management* (81.8%), supply chain management (72.5%) *and plant and equipment resource management* (53.5%); and was labelled *physical resources and procurement management*. This component is not strange in the sense that, aside the human resources and financial resources earlier discussed; it is common that every project would also require physical resources such as materials resources and plant and equipment resources. Inevitably, the project manager is predominantly positioned to seek to the procurement and management of these physical resources. A widely accepted view indicates that project management competencies have both direct and indirect linkages to other knowledge domains such as supply chain management and project management (Dogbegah, 2009). Accordingly, procurement management comprises the processes required to acquire goods and services from outside the organization. The processes include, determining what to procure and when; documenting product requirements and identifying potential sources; obtaining quotations, bids, offers, or proposals as appropriate; choosing from among potential sellers; managing the relationship with the seller; and completing and settling the contract, including resolution of disputes and conflicts (Turner, 2006). The procurement manager must comply with the requirements of the Procurement Act 2003 (Act 663), be knowledgeable about contracts and contract negotiations. The Procurement manager must be able to determine and justify the need for goods and services required by the project, work with appropriate contracting personnel, develop an acquisition plan, solicit competition, and select sources.

Conclusions and Recommendations

The complexity of project environments nowadays has placed renewed emphasis on the need for project management educators to understand the contextual-task competency issues surrounding project management education, the world over. It is factual that, studies on project management competencies have been evolving eccentrically on issues that affect project performance. However, until now, the literature underpinning project management competencies has been fragmented and loosely tied without concrete understanding of the intricate relationships between the various project management knowledge areas. Drawing extensively on the conceptual maps of project management competencies in the literature studied, the eighteen PMCA variables have been reduced to six competency areas forming the basis for lateral project management training requirements in the context of the Ghanaian construction industry. Key contribution of the paper to the body of knowledge is manifested in the use of the principal component analysis, which has rigorously provided understanding into the complex structure and the relationship between the various knowledge areas. The originality and value of the paper is embedded in the use of contextual-task conceptual knowledge to expound the six uncorrelated empirical utility of the project management competencies. This brings together a simple framework that should guide the planning of project management lateral programmes. Undeniably, a well-designed and delivered project management education and training programme is critical to developing and maintaining the required level of technical, professional and managerial expertise for managing construction projects in Ghana. Addressing the research objectives and drawing on the research findings, the study has wider implications for the aspirations of project management and project delivery within the Ghanaian construction industry. The following recommendations are therefore prescribed to planning, designing and evaluating education and training programmes for project management practice in Ghana; thus, project management education and training providers should provide flexible, effective alternative methods of course delivery, including on-site classroom, distance learning and self-study in order to meet the diverse needs of students. Importantly, project management education and training providers should meet the standards for accreditation or certification that are appropriate for their course offerings. Providers should have an on-going process to assess and enhance the relevance, currency and technical soundness of course content. These assessments should draw from employers as well as project. Instructors should be evaluated for their effectiveness in communicating course content. This research, like any other, had limitations in its conduct and scope, thus, the relatively small sample size used for the study could have been better on large sample size say, 100 and above for the use of factor analysis to be robust. However, this should not nullify the conclusions drawn, given that the relevant preliminary tests associated with the adequacy of sample size proved favorable for the analysis to proceed. These limitations provide the basis for future research recommendations. Future research to explore problems and challenges confronting project management education and practice would be important. Studies to explore project management competencies requirement for specialized projects such as public-private-partnerships (PPP) projects and project finance strategy (PFS) projects will be interesting.

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