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Effect of Quality Management on Sustainability of Construction Projects in Rwanda: A Survey of Selected One Hundred First Category Public Buildings in City of Kigali

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Abstract: ***Quality management should complement modern project management as they both recognize the importance of customer satisfaction, prevention over inspection, management responsibility and processes within phases. The general objective of this study was to assess the effect of quality management on sustainability of construction projects in Rwanda. Its specific objectives were to analyse the effect of legal framework on sustainability of public building construction projects in Rwanda; to assess the effect of conformity assessment, building codes and standards on sustainability of building construction projects in Rwanda and to examine the effect of project management methodologies on sustainability of construction projects in Rwanda. Descriptive-comparative survey design was used. The population of this study equalled to 100 selected first category public buildings located in Kigali city. The researcher used a census as the study population was quiet small in numbers.Data were collected using questionnaires and interviews. Descriptive and inferential statistics were used to analyze data. The researcher concluded a weak significant relationship between the legal framework and sustainability of building construction projects. If the researcher considers the level of significance which is 0.05, there is therefore a weak relationship between them because their p-value (0.113) is statistically differently significant at 5% level of significance. The researcher concluded a different significant relationship between the building codes and standard and building and sustainability of building construction projects. If the researcher considers the level of significance which is 0.05, there is therefore a weak relationship between them because their p-value (0.057) is statistically differently significant at 5% level of significance. The researcher further concluded a weak relationship between the project management methodologies and sustainability of public building construction projects. If the researcher considers the level of significance which is 0.05, there is therefore a weak relationship between them because their p-value (0.038) is statistically significant at 5% level of significance. The researcher recommend that the project managers and engineers of public building construction to respect and comply with the set standards for first category public buildings as the study findings revealed that they have weaknesses in respecting the set standards. They should also adopt appropriate methodologies for quality control and testing in order to comply with the quality requirements for the first category public building. The owners, managers and engineers of public building construction projects should use materials that are certified by accredited certification body so as to ensure the sustainability of public building construction projects. Lastly but not least the managers of public building construction projects are advised to apply project management methodologies by initiating a project before its implementation, elaborating a clear project plan, execute the project after its plan has been put in place and agreed upon by both clients and contractors, frequently and regularly monitor the project activities to ensure that activities are being implemented as planned, conducting formative and summative evaluations and officially handing over the completed buildings in order to ensure their sustainability.***

Keywords: Quality, Quality Management, Project Sustainability, Project management

1. Introduction

Quality management within a construction project must address both the management of the project and the product of the project. Failure to meet quality requirements in either dimension can have serious and negative consequences for any or all of the project stakeholders. Quality management should complement modern project management as they both recognize the importance of customer satisfaction, prevention over inspection, management responsibility and processes within phases. Quality management is the act of overseeing all activities and tasks needed to maintain a desired level of excellence. This includes the determination of a quality policy, creating and implementing quality planning and assurance, and quality control and quality improvement. It is also referred to as Total Quality Management (TQM).In general, quality management focuses on long-term goals through the implementation of short-term initiatives (Abbidan, 2014).

2. Statement of the Problem

The building and construction sector is highly important for sustainable development because it is a key sector in national economies; it has a significant interface with poverty reduction through the basic economic and social services provided in the built environment and the potential opportunities for the poor to be engaged in construction, operation and maintenance. It is one of the largest industrial sectors and, while providing value and employment , it absorbs considerable resources with consequential impacts on economic and social conditions and the environment, it creates the build environment, which represents a significant share of the economic assets of individuals, organizations and nations, providing societies with their physical and functional environment and it has considerable opportunity to show improvement relative to its economic, environment and social impacts (Lewis, 2009).

Quality management is a silent tool to ensure sustainability of any project and success geared to developmental needs as

it serves the economic, environmental and social needs. On one hand this statement might create somehow a conflict in policy perception while it can be seen as a want on the other hand because in the context of developed world and even in urban areas of developing countries the perception is completely different from rural areas. However, what is clear is that development policies will continue to stress investment in infrastructure. Given this fact, an understanding of the consequences that result from and the determinants that shape the use of any such basic input is imperative for the design of more effective future policies as well as for the analysis of those of the past.

3. Objectives of the Study

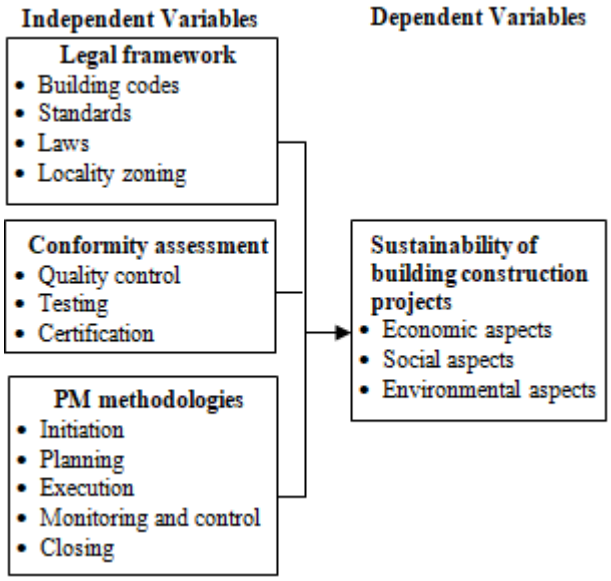
3.1 General Objective

The general objective of this study was to assess the effect of quality management on sustainability of public building construction projects in Rwanda.

3.2 Specific objectives

1) To analyse the effect of legal framework on sustainability of public building construction projects in Rwanda.
2) To assess the effect of conformity assessment, building codes and standards on sustainability of public building construction projects in Rwanda
3) To examine the effect of project management methodologies on sustainability of public building construction projects in Rwanda

4. Conceptual Framework



5. Research Methodology

- **Research Design**: A descriptive research design was used in this study
- **Target Population:** The population of this study was a 100 selected first category public buildings located in Kigali city.
- **Sample Size**: During this research, the researcher preferred to adopt a census where total population was considered as sample size. Therefore, the sample size of the study was made of 100 respondents.
- **Data collection instruments:** The primary data for this study were collected using questionnaires and interviews. Questionnaires were designed by the researcher and distributed to the respondents.
- **Data processing and analysis**: Descriptive and inferential statistics were used to analyze data after their collection.

6. Summary of Research Findings

6.1 Analysis of the effect of legal framework on sustainability of building construction projects in Rwanda

Table 1: Descriptive Statistic on legal framework and sustainability of building construction projects in Rwanda

Indicators	N	Mean	Std. Deviation
Building codes	100	2.88	1.166
Public buildings	100	3.31	.907
Legal requirements	100	2.49	1.345
Locality zoning	100	2.67	1.477
Valid N (listwise)	100		

Source: Field Data (2018)

The findings from Table 1, the mean values for all statements are approximately equal to the code of neutral and their standard deviation are above 0.5 meaning that respondents' answers on these statements were far different from the mean, in order words, their answers to the statement were heterogeneous.

Table 2: Correlation between legal framework and sustainability of building construction projects in Rwanda

Variables		Legal Framework	Sustainability of Construction Projects
Legal Framework	Pearson Correlation	1	.160
	Sig. (2-tailed)		.113
	N	100	100
Sustainability of construction Projects	Pearson Correlation	.160	1
	Sig. (2-tailed)	.113	
	N	100	100

Source: Field Data (2018)

The results in Table 2 demonstrated that the result of correlation between legal framework and sustainability of building construction projects was at 0. 160 meaning that legal framework affect sustainability of building construction projects in Rwanda at the weak level of 16% which prove weak significant relationship between the legal framework and sustainability of building construction projects. If the researcher considers the level of significance which is 0.05, there is therefore a weak relationship between them because their p-value (0.113) isstatistically differently significant at 5% level of significance.

6.2 Assessment of the effect of conformity assessment, building codes and standards on sustainability of building construction projects in Rwanda

Table 3: Descriptive Statistic on conformity assessment, building codes and standards on sustainability of building construction projects in Rwanda

Indicators	N	Mean	Std. Deviation
Quality control	100	2.89	1.053
Quality testing	100	3.25	.903
Certification	100	2.70	1.235
Valid N (leastwise)	100		

Source: Field Data (2018)

From Table3, for all statements the mean values are approximately equal to the code of neutral and their standard deviation are above 0.5 meaning that respondents' answers on these statements were far different from the mean, in order words, their answers to the statement were heterogeneous.

Table 4: Correlation between the conformity assessment, building codes and standards and sustainability of building construction projects in Rwanda

Variables		Conformity Assessment	Project Sustainability
Conformity Assessment	Pearson Correlation	1	.191
	Sig. (2-tailed)		.057
	N	100	100
Project Sustainability	Pearson Correlation	.191	1
	Sig. (2-tailed)	.057	
	N	100	100

Source: Field Data (2018)

The findings from the Table4 demonstrated that the result of correlation between conformity assessment, building codes and standard and sustainability of building construction projects was at 0. 191 mean that conformityassessment, building codes and standard have weak correlation of 19.1% which prove a different significant relationship between the building codes and standard and sustainability of building construction projects. If the researcher considers the level of significance which is 0.05, there is therefore a weak relationship between them because their p-value (0.057) is statistically different significant at 5% level of significance.

6.3 Examination of the effect of project management methodologies on sustainability of construction projects in Rwanda

Table 5: Descriptive Statistics on project management methodologies and sustainability of public building construction projects in Rwanda

Indicators	N	Mean	Std. Deviation
Project initiation	100	2.35	1.438
Project Planning	100	2.91	1.147
Project execution	100	3.25	.936
Monitoring and control	100	3.31	1.080
Conducting evaluations	100	2.97	1.087
Officially handing over the building	100	3.17	1.138
Valid N (leastwise)	100		

Source: Field Data (2018)

According to the findings from Table 4.18 above, the mean values for the first, second, third, fourth, fifth and sixth statements are 2.35 which is respectively rounded off to2 (the code for agree), 2.91; 3.25; 3.31; 2.97 and 3,17 are respectively rounded off to 3 (the code for neutral). The standard deviation for all statements is above 0.5 meaning that respondents' answers on these statements were far different from the mean, in other words their answers to the statement were heterogamous. This means that respondents' views on the above statements were varied.

Table 6: Correlation between the project management methodologies and sustainability of public building construction projects in Rwanda

Variables		Project M. Methodologies	Project Sustainability
Project Management Methodologies	Pearson Correlation	1	.208*
	Sig. (2-tailed)		.038
	N	100	100
Project Sustainability	Pearson Correlation	.208*	1
	Sig. (2-tailed)	.038	
	N	**100**	**100**

Source: Field Data (2018)

According to the findings from Table 6; the results of correlation between project management methodologies and sustainability of building construction projects was at 0. 208 meaning that management methodologies affect sustainability of public building construction projects at the weakest level of 20.8% which prove a weak relationship between the project management methodologies and sustainability of public building construction projects. If the researcher considers the level of significance which is 0.05, there is therefore a weak relationship between them because their p-value (0.038) is statistically significant at 5% level of significance.

6.4 Estimated parameters for Legal Framework, Conformity Assessment and Project Management Methodologies

Table 7: Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.219[a]	.048	.018	1.147

Source: Field Data (2018)

a. **Predictors:** (Constant), Independent variables (Legal Framework, Conformity Assessment and Project Management Methodologies)
b. **Dependent variables:**Sustainability of Public Building Construction Projects

The findings from Table 7An$R^2 = 0.048$ indicate that 4.8% of legal framework, conformity assessment and project management methodologies can be explained by sustainability of Public building construction projects leaving only 95.2% of the variation in the dependent variable being explained by the error-term or other variables.

Table 8: ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
	Regression	6.379	3	2.126	1.615	.191[b]
	Residual	126.381	96	1.316		
	Total	**132.760**	**99**			

Source: Field Data (2018)

a. Predictors: (Constant), Independent variables
b. Dependent variable: Sustainability of Public building construction projects

The findings from Table 8 show that predictors: legal framework, conformity assessment and project management methodologieshave a weak effect on dependent variable which sustainability of public building construction projects. This is weak statistically significant with a p-value (.191).

Table 9: Coefficients

Model		Un-standardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
	(Constant)	2.589	.528		4.906	.000
	Legal framework	.029	.099	.029	.288	.774
	Conformity assessment	-.080	.130	-.063	-.619	.537
	Project Mgt methodologies	.174	.082	.217	2.128	.036

Source: Field Data (2018)

a. Dependent Variable: Sustainability of Public building construction projects

The results indicate that legal framework, conformity assessment and project management methodologies have different statistically significant effect on construction project with a positive coefficient of determination of 0.219 which indicates that there is a weak positive correlation between legal framework, conformity assessment and project management methodologies. The coefficients of independent variables β_1, β_2 *and* $\beta_3$are respectively 0.029; - 0.080 and 0.174 with a statistical significance ($p = 0.191$). Therefore, the model equation derived is: $y = 2.589 + 0.029x_1 - 0.080x_2 + 0.174x_3 + e$. The positive coefficient further demonstrates that a 1% increase in the legal framework is attributed to 0.029% improvement in sustainability of public building construction projects and the t-statistic value (0.774) indicates that the effect is different statistically significant at 95% confidence level. A decrease of 1% inconformity assessment will decrease sustainability of construction project given by 0.080 % at the t-statistic value (0.537) indicates that the effect is statistically significant at 95% confidence level while a positive coefficient demonstrates that a 1% increase at project management methodologies will increase 0.174% on sustainability of public building construction projects with t-statistic value (0.036) indicates the confidence level of 91% the effect is statistically significant.

7. Conclusions and Recommendations

7.1 Conclusions

The researcher concluded a weak significant relationship between the legal framework and sustainability of building construction projects. If the researcher considers the level of significance which is 0.05, there is therefore a weak relationship between them because their p-value (0.113) is statistically differently significant at 5% level of significance. The researcher concluded a different significant relationship between the building codes and standard and building and sustainability of building construction projects. If the researcher considers the level of significance which is 0.05, there is therefore a weak relationship between them because their p-value (0.057) is statistically differently significant at 5% level of significance. The researcher further concluded a weak relationship between the project management methodologies and sustainability of public building construction projects. If the researcher considers the level of significance which is 0.05, there is therefore a weak relationship between them because their p-value (0.038) is statistically significant at 5% level of significance.

7.2 Recommendations

The researcher recommend that the project managers and engineers of public building construction to respect and comply with the set standards for first category public buildings as the study findings revealed that they have weaknesses in respecting the set standards. They should also adopt appropriate methodologies for quality control and testing in order to comply with the quality requirements for the first category public building. The owners, managers and engineers of public building construction projects should use materials that are certified by accredited certification body so as to ensure the sustainability of public building construction projects. Lastly but not least the managers of public building construction projects are advised to apply project management methodologies by initiating a project before its implementation, elaborating a clear project plan, execute the project after its plan has been put in place and agreed upon by both clients and contractors, frequently and regularly monitor the project activities to ensure that activities are being implemented as planned, conducting formative and summative evaluations and officially handing over the completed buildings in order to ensure their sustainability.

7.3 Areas for future research

The researcher propose the following areas for future studies

1) Factors influencing implementation of total quality management in construction companies in Rwanda
2) Influence of government institutions on quality completion of government infrastructure projects

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