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Adoption of Sustainable Value Management (SVM) to Building Projects in a Developing Economy

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***Abstract:** In modern economy, sustainability has become the central issue in improving the quality of life. This study investigated the integration of sustainable value management (SVM) in the construction industry with focus on application, benefits and barriers. The research issue is the insufficient information to construction professionals on the way of integrating sustainable value management and sustainability which hence affect its usefulness in Rwanda's construction industry. Plenty of works are available in other sectors of the economy but very few in the construction industry. A quantitative research design was used for this study and the population size was 961 construction professionals registered under the Institute of Engineers Rwanda (IER) and Rwanda Institute of Architects-Quantity Surveying chapter (RIA/Qs Chapter). A sample of 132 firms used for the study were determined with the use of Slovin's formula. The survey findings indicated that risk analysis, SWOT analysis, Simple Multi-Attribute Rating Technique (SMART) methodology, lessons learned technique, and cost-benefit analysis are the most known SVM techniques. On the other hand, the results show that risk analysis, cost-benefit analysis, SWOT (Strengths, Weakness, Opportunities, and Threats) analysis, SMART methodology and target costing are the most applied SVM techniques. Regarding benefits, ensuring that projects are delivered in the most cost-effective way was overall ranked first followed by reduction of overall cost and enhancing and promoting team spirit. Limited political will, legislation, and enforcement at various governmental levels was identified as the most hampering factor to proper practice of SVM. The study concluded that the level of application of sustainable value management significantly depends on the level of awareness. Based on the findings of the study, it was recommended that the increase awareness of sustainable value management from regulatory bodies to internal organization of the companies would without doubt result to a significant rise of application.*

***Keywords:** Sustainability, Sustainable Development, Sustainable Value Management, Sustainable Construction, Building Projects, Developing Country, Developing Economy, Rwanda.*

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I. INTRODUCTION

The construction industry plays a huge role in the economy of many developed and developing countries through its contribution in terms of gross domestic products, creation of employment, provision of shelter and satisfaction of the social needs of the citizens. However, the industry is continually faced with many seemingly insurmountable challenges such as cost overrun, building collapse, disputes, variation, project abandonment, dented reputation, design errors and waste [1].

Methods and solutions such as the application of modern procurement, digital technologies, sustainable design and construction, lean construction techniques and building information modeling have been adopted to ameliorate these challenges [2]. However, these solutions seem not to have abated the challenges as there are continuous records of the persistence of the construction problems. Another argues that the not application of sustainable value management (SVM) to construction projects is of the causes of the persistent construction challenges and without its application to construction projects, the construction challenges may continue to bedevil the construction industry [3]. (Gahenda et al., 2019, [4]) described value management as a systematic, multidisciplinary attempt to analyze project features in order to achieve highest quality at the smallest general project price of the life cycle. Ngubane et al., 2015, [5] further noted that value management can be seen as a process that is directed towards analyzing the functions of a project from its inception to completion and commissioning for the purpose achieving the best value for money and returns on investment at the lowest possible overall life cycle cost.

Various benefits have been associated with the application of SVM to construction projects. For instance, (Oke et al., 2018, [6]) claimed that SVM is capable of examining and analyzing alternative materials for the purpose of selecting the best one with the least cost. [6] concluded that SVM can lead to project cost reduction, value for money, better quality, profitability and positive business image. (Ahmed et al., 2020, [7]) affirmed that the construction industry could be modernized through the application of SVM to construction projects. (Abidin et al., 2016, [8]) asserted that SVM focuses on the selection of the most economical solution from various alternatives to get the lowest possible investment on projects without compromising its performance and quality.

However, despite these benefits, many developing countries seem not to be aware of the benefits of adopting SVM to construction projects and hence it is not adopted [6]; [9]. This lack of awareness and application of SVM to construction projects may be responsible for the occurrence of cost and time overrun, poor quality, use of projects for unintended purposes and abandonment of construction projects [1].

Therefore, this paper investigates the level of awareness, application, benefits and challenges of adopting SVM to construction projects. The study is important to complement existing studies on the application of SVM in developing countries. The study would also provide empirical evidence on the awareness, application, benefits and challenges of adopting SVM to construction projects. The study is divided into an introduction, literature review, research methodology, data analysis and discussion of findings and conclusion.

II. LITERATURE REVIEW

2.1. Application

Sustainable Value Management (SVM) is a concept that integrates the principles of sustainability into project management and decision-making. In the construction industry, SVM can be used to reduce the negative impacts of construction activities on the environment and society while creating value for all stakeholders involved [10]. Here are some prominent applications of SVM in construction:

According to (Ebrahimi et al., 2021, [11]), SVM uses Life cycle assessment (LCA) and costing (LCC) to evaluate the environmental impact and cost-effectiveness of construction projects over their entire life cycle. Further, they said that LCA can be used to identify the environmental hotspots of a project and to optimize the use of resources, while LCC on the other hand, can help to identify cost-saving opportunities while considering the long-term costs associated with a project.

According to Singh and Chauhan, 2020, [12]), SVM can as well be used to encourage sustainable procurement practices in the construction industry. This involves the selection of suppliers and materials that meet environmental and social criteria. In addition, sustainable procurement practices can help to reduce the environmental impact of construction projects and to promote social responsibility.

Another study by Tariq and Arif, 2020, [13]) found that SVM can be used to promote energy efficiency in construction projects by encouraging the use of renewable energy sources and the implementation of energy-efficient technologies. They continued that energy-efficient technologies such as solar panels and heat pumps can help to reduce the energy consumption of buildings and to mitigate their carbon footprint.

The proper application of SVM concept result also to waste reduction in construction projects by encouraging the use of recycled and reusable materials and by implementing waste management strategies, [14]. The use of recycled materials can help to reduce the environmental impact of construction projects while reducing costs and promoting sustainability.

According to Anvuur et al., 2021, [15]), SVM can be used to engage stakeholders in the decision-making process and to consider their needs and interests. Moreover, the stakeholder engagement can help to promote social responsibility and to ensure that the needs of all stakeholders are considered in project planning and execution.

Overall, SVM can be used to promote sustainability in construction projects by considering the environmental, social, and economic impacts of projects over their entire life cycle. By integrating sustainability principles into project management and decision-making, SVM can help to create value for all stakeholders involved while reducing the negative impacts of construction activities on the environment and society.

2.2. Benefits of Implementing Sustainable Value Management

Sustainable value management (SVM) is an approach to managing projects that aims to balance economic, social, and environmental considerations over the long term. In the construction industry, SVM is particularly important because of the sector's significant impact on the environment and society [16]. Below are some of the benefits of SVM in construction, supported by relevant citations:

(Ettouney and Sohail, 2017, [17]) developed a conceptual framework on Sustainable value management of construction projects and showed that SVM can improve project performance by reducing environmental impact, enhancing social outcomes, and improving economic returns. More on that is that SVM can help identify and manage sustainability-related risks, leading to better project outcomes. Another study by (Shen et al., 2015, [18]) found that by implementing SVM, it can help reduce costs over the life cycle of a project. Furthermore, it was that integrating sustainability considerations into construction projects can lead to significant cost savings in areas such as energy consumption, water use, and waste reduction. Adopting sustainable practices can as well enhance a company's reputation, attracting customers who value sustainability [19]. That is possible when, sustainable practices are adopted which in end can also attract and retain employees who are motivated by the social and environmental impact of their work. SVM can help to ensure compliance with sustainability-related regulations and standards. For companies that are committed to maximize the benefits of SVM principles, it can help them to meet regulatory requirements related to environmental impact, labor practices, and social responsibility [20].

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Lastly, adopting sustainable practices improves stakeholder engagement by demonstrating a commitment to social and environmental responsibility. SVM help companies to build trust with stakeholders and create shared value by considering the interests of all stakeholders [21].

Overall, implementing SVM in construction bring multiple advantages, including improved project performance, cost savings, enhanced reputation, compliance with regulations, and improved stakeholder engagement. These benefits can help companies achieve long-term success in a rapidly changing business environment.

2.3. Challenges

Sustainable value management (SVM) is an approach that aims to maximize the value of construction projects over their entire life-cycle, while also minimizing their environmental impact. While SVM has the potential to deliver significant benefits, there are several challenges that need to be addressed to ensure its successful implementation in the construction industry [10]. The following paragraphs discuss some of the key challenges of SVM in construction, supported by relevant citations:

Lack of standardized frameworks: One of the major challenges of SVM in construction is the lack of standardized frameworks to measure and evaluate the sustainability of construction projects. This makes it difficult to assess the environmental impact of different construction projects, and to compare their sustainability performance [22].

Limited understanding of sustainability: Another challenge is the limited understanding of sustainability by construction professionals, which can lead to a lack of commitment to sustainable practices [23]. This is due to the fact that the construction industry has traditionally been focused on delivering projects on time and within budget, without necessarily considering their long-term sustainability.

Short-term thinking: Another challenge is the short-term thinking prevalent in the construction industry, which can result in a focus on immediate costs and benefits, rather than long-term sustainability [24]. This can lead to unsustainable practices, such as using materials that are not environmentally friendly or constructing buildings that are not energy-efficient.

Lack of collaboration: A key challenge of SVM in construction is the lack of collaboration among different stakeholders, such as designers, builders, and clients [25]. This can result in conflicting priorities and interests, which can make it difficult to achieve sustainable outcomes.

Regulatory constraints: Another challenge is the regulatory constraints that can limit the implementation of sustainable practices in construction projects. For example, building codes and regulations may not require the use of environmentally friendly materials or energy-efficient designs [26].

(Sari and Susilowati, 2019, [27]) fine-tuned the barriers of implementing sustainable value management that are centered towards the front-end decision making phase of a project like Low demand from client on sustainable measure, limited political will, legislation and enforcement at various governmental levels, lack of technical understanding by team members, cost for sustainability measure perceived as too expensive. Although cost analysis on sustainable building and usual building works had not been thoroughly done, developers have thought that anything other than 'usual businesses will be more expensive, sustainability measure was not practiced by the occupier: lack of interest and awareness in conserving energy, water, and reducing waste.

In conclusion, sustainable value management faces several challenges in construction, ranging from lack of standardized frameworks to regulatory constraints. Addressing these challenges will require a concerted effort from all stakeholders, including designers, builders, regulators, and clients, to ensure that sustainability are embedded in all aspects of construction projects.

III. RESEARCH METHODOLOGY

This chapter gives an overview of the research approach adopted in this study. For the current study, quantitative research approach was adopted and the survey research design was used for data collection in this study using a closed-ended questionnaire. The questionnaire survey method made it possible to contact more subjects in a limited time in comparison with other methods, such as interviews, would they have been employed. The questionnaire was designed in 2 sections with the first section which is a general section, collected the demographic information of respondents and their organizations, and the second section which can as well be called specific section, collected information on the current status of practices of sustainable value management as well as the application, benefits and challenges for the successful integration of SVM in the construction industry.

The population of this study includes all stakeholders especially professionals who are directly employed by various organizations in construction projects delivery and consultants working as client's representatives for the projects. The need for reliable information to be obtained from professional practitioners has influenced the choice of the population of this study. As per statistics from Institute of Engineers Rwanda [28], and Rwanda Institute of Architects [29], there are 804 Engineers (Civil Engineers and MEP Engineers), 95 individual Architects and 62 Quantity Surveyors respectively registered under those professional bodies. This leads to an estimated total population of 961 subjects for this study.

The sample size for the study was calculated using the Slovin's formula [30]:

$$n = N/(1+Ne^2)$$

Where n is the sample size, N is the population and e is the margin of error (10%), Given the population size of 961, the sample size for the study was therefore found equal to 134.

Purposive Sampling has been used for selecting participants in this study with belief that a representative sample can be obtained by using a sound judgment which will result in saving time and resources. It is in this regard that this study chose the population by profession (Engineers (Civil & MEP Engineers), Architects, and Quantity Surveyors) to ensure equal and fair representation of all respective professionals.

As earlier discussed, the data collection instrument for the study was the structured questionnaire which was divided into two sections.

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Section 1 contained the demographic data of the respondents and their organization and section 2 contained specific questions that related to the sustainable value management practice in the construction industry with focus on application, benefits and barriers. The data for this study were basically analyzed with descriptive statistics such as frequency, sums, mean item score and standard deviation. The results of the study were presented with tables and bar charts from the Statistical Package for the Social Sciences (SPSS) and Microsoft excel. A 5 – point rating scale has been used to rate the respondent's familiarity with the variables of the study with 1. being NS – not significant, 2. SS – slightly significant, 3. AS – averagely significant,

4. S – significant and 5. VS – very significant for benefits, challenges, and approaches. For the level of application of sustainable value management techniques, the study used scales of 1. being NA - not applied, 2. SA - slightly applied,3. AA - averagely applied, 4. A - applied and 5. VA - very applied. Also, the study used scales of 1. NA - not aware, 2. SA - slightly aware, 3. AA - averagely aware, 4. A - Aware, 5. VA - very aware of the level of awareness of sustainable value management techniques for construction projects.

IV. DATA ANALYSIS

Table 1. indicates the general information of the study's respondents and their organizations.

Table 1: Profile of respondents

Educational level of respondents	Masters	4	3.0
	Bachelor's	100	75.8
	Diploma A1	24	18.2
	Certificate	4	3.0
	Total	**132**	**100.0**
Category of respondents	Contractor	72	45.5
	Consultant	60	54.5
	Total	**132**	**100.0**
Work experience of respondents	≤ 5 years	40	30.3
	6-10 years	82	62.1
	>10 years	10	7.58
	Total	**132**	**100.0**
Familiarity with SVM	No	32	24.2
	Yes	**100**	**75.8**
	Total	**132**	**100.0**
Profession practise of respondents	Engineers	52	39.4
	Architects	16	12.1
	Quantity surveyor	44	33.3
	Estate valuers	20	15.2
	Total	**132**	**100.0**

Regarding the profession of respondents, Engineers accounted for the highest number 52 (39.4%), followed by Quantity Surveyors 44 (33.3 %) and Architects 16 (12.1 %) while the participants were estate valuers 20 (15.2 %), (N=132). This indicates a fair representation of key professionals in the sample size in relation to the numerical composition of the study population. Moreover, the study data on the organizational category of respondents show that the contractors personnel in the survey was the highest of 72 (54.3%) followed by the consultants 60 (45.5 %). Regarding the educational background, four participants had Master's degree (4%), a hundred of them (75.8 %) are bachelor's graduates, 24 (18.2 %) have A1 Diploma, and other four with high school certificate. This shows that almost eighty percent of the respondents are educated with bachelor's degree. Despite the educational level of the respondents, the study went further to investigate their work experience. As seen above in the table, 30.3% had 5 years or less of experience, 62.12% had between 6 to 10 years of experience, and 7.58% had between 11 years or above of work experience. This indicates that at least 70% of the respondents used for this study had more than 5 years of work experience and could provide valuable information for the study.

Table 1 again indicates that respondents had major experience in handling residential accounting 39.4%, followed by commercial projects with 36.4%, followed by road projects with 15.2%, educational facilities with 12.1%, then recreational premises with 6.1%, and finally industrial facilities with 3.0%. This explains how reliable is the information provided since the majority of respondents had once in their worked-on building construction projects and civil engineering projects. Lastly, 75.8% of the participants were familiar with the concept of sustainable value management in contrast to 24.24% who knew little or nothing about the concept. This increases the chance to reach on solid and informative outputs generated by this study.

Table 2 indicates the level of awareness of sustainable value management in Rwanda's construction industry. The level of awareness was ranked by respondents from both consultants and contractors companies on a 5-point Likert scale [31]. Observation of the results illustrates that Risk Analysis (3.33) was ranked as the most known SVM technique among the respondents; followed by SWOT Analysis (2.79); SMART Methodology (2.73); Lessons learned technique (2.64); Cost-Benefit Analysis (2.60); Functional analysis system techniques (FAST) (2.30); SCAMPER (2.00); target costing (1.88); Value benchmarking (1.82) and Function Performance Specification (FPS) (1.79).

This result indicates that Risk Analysis, SWOT Analysis, SMART methodology, Lessons learned Technique, and Cost-benefit analysis among other techniques used to measure the level of awareness of SVM techniques are the most known techniques with a minimum mean score of 2.60.

Note: a. 1 = Not Aware (NA). 2 = Slightly Aware (SA). 3 = Averagely Aware (AA). 4 = Aware (A). 5 = Very Aware (VA).

*b. NS=No significant difference between consultants and contractors in the level of awareness of sustainable value management techniques (**Sig. (2-tailed)**) where p>0.05*

*c. S= There is a significant difference in the level of awareness of sustainable value management techniques between consultants and contractors (**Sig. (2-tailed)**) where p<0.05*

Table 2: Awareness of sustainable value management techniques as ranked by the respondents

SVM Techniques	Consul	Rank	Cont	Rank	Overall mean	Rank	Decision	Sig	Decision
Risk analysis	3.67	1	3.06	1	3.33	AA	1	0.126	NS
SWOT analysis	3.13	3	2.5	3	2.79	AA		0.122	NS
SMART methodology	3.07	4	2.44	4	2.73	AA	3	0.185	NS
Lessons learned Technique	2.53	5	2.72	2	2.64	AA	4	0.694	NS
Cost Benefit Analysis	3.13	2	2.11	6	2.6	AA	5	0.017	S
Functional analysis system techniques (FAST)	2.33	6	2.28	5	2.3	SA	6	0.907	NS
SCAMPER	2.2	7	1.83	7	2	SA	7	0.46	NS
Target costing	2	10	1.78	8	1.88	NA	8	0.576	NS
Value benchmarking	2.13	9	1.56	9	1.82	NA	9	0.115	NS
Function Performance Specification (FPS)	2.2	8	1.44	10	1.79	NA	10	0.032	S

Note: a. 1 = Not Aware (NA). 2 = Slightly Aware (SA). 3 = Averagely Aware (AA). 4 = Aware (A). 5 = Very Aware (VA).

*b. NS=No significant difference between consultants and contractors in the level of awareness of sustainable value management techniques (**Sig. (2-tailed)**) where p>0.05*

*c. S= There is a significant difference in the level of awareness of sustainable value management techniques between consultants and contractors (**Sig. (2-tailed)**) where p<0.05*

From Table 3, the level of application of sustainable value management techniques was in the order of; Risk Analysis (3.33); Cost-Benefit Analysis (3.18); SWOT Analysis (2.91); SMART methodology (2.67); Target costing (2.64); Functional analysis system techniques (FAST) (2.42); Lessons learned technique (2.39); Function Performance Specification (FPS) (2.30); Value benchmarking (2.30); and value benchmarking (2.30). These results show that risk analysis, cost-benefit analysis, SWOT analysis, SMART methodology and target costing are the most applied SVM techniques as their mean score is above 2.50. However, the order of the level of awareness as noted in table 2 is different from the order of the level of application as noted in table 3 which implied the need to test the relationship between the level of application and the level of awareness of SVM techniques as shown in Table 3

Table 3. The level of application of SVM techniques

SVM Techniques	Consultants	Rank	Contractors	Rank	Overall mean	Decision	Rank	Sig. (2-tailed)	Decision
Risk Analysis	3.27	2	3.39	1	3.33	AA	1	0.783	NS
Cost Benefit Analysis	3.47	1	2.94	2	3.18	AA	2	0.223	NS
SWOT Analysis	3	3	2.83	3	2.91	AA	3	0.743	NS
SMART methodology	2.8	4	2.56	5	2.67	SA	4	0.632	NS
Target costing	2.6	5	2.67	4	2.64	SA	5	0.905	NS
Functional analysis system techniques (FAST)	2.47	8	2.39	7	2.42	SA	6	0.88	NS
Lessons learned technique	2.2	10	2.56	6	2.39	SA	7	0.433	NS

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Function Performance Specification (FPS)	2.6	6	2.06	9	2.3	SA	8	0.317	NS
Value benchmarking	2.6	7	2.06	10	2.3	SA	9	0.31	NS
SCAMPER	2.4	9	2.22	8	2.3	SA	10	0.723	NS

Note: a. 1 = Not Applied (NA). 2 = Slightly Applied (SA). 3 = Averagely Applied (AA). 4 = Applied (A). 5 = Very Applied (VA).
*b. NS=No significant difference between consultants and contractors in the level of application of sustainable value management techniques (**Sig. (2-tailed)**) where p>0.05*
*c. S= There is significant difference in the level of application of sustainable value management techniques between consultants and contractors (**Sig. (2-tailed)**) where p<0.05*

The results above were subjected to an independent t-tested to determine the difference in the level of application of sustainable value management techniques as depicted in Table 4, and indications were that there is no significant difference in the level of application of sustainable value management between consultants and contractors since the P-Value of all variables (application of techniques) is greater than 0.05 (Sig. (2-tailed)). Hence this study failed to reject the null hypothesis and the alternative was rejected.

From the next table (Table 4), the relationship between the level of application and awareness of sustainable value management techniques are as follows AWR 1 and APL 1 ($r = .823$, $n = 132$, $p < .001$), AWR 2 and APL 2 ($r = .764$, $n = 132$, $p < .001$), AWR 3 and APL 3 ($r = .623$, $n = 132$, $p < .001$), AWR 4 and APL 4 ($r = .731$, $n = 132$, $p < .001$), AWR 5 and APL 5 ($r = .629$, $n = 132$, $p < .001$), AWR 6 and APL 6 ($r = .656$, $n = 132$, $p < .001$), AWR 7 and APL 7 ($r = .572$, $n = 132$, $p = .001$), AWR 9 and APL 9 ($r= .690$, $n = 132$, $p < .001$), AWR 10 and APL 10 ($r = .661$, $n = 132$, $p < .001$).

Spearman's rank-order [32] correlations were run to examine the relationship between the level of application and the level of awareness of sustainable value management techniques as shown in Table 4. The results of Spear-man correlations indicate that there was a strong and positive significant relationship between the level of application and the level of awareness of sustainable value management techniques. This indicates that the level of application of sustainable value management significantly depends on the level of awareness. Therefore, the null hypothesis was rejected while the alternative accommodated.

Table 4: Spear-man correlations result between the level of application and the level of awareness of sustainable value management techniques

			APL2	APL3	APL4	APL5	APL6	APL7	APL8		
		APL1	2	3	4	5	6	7	8	APL9	APL10
AWR1	Sig. (2-tailed)	0	0	0.004	0	0.006	0.002	0.065	0	0.024	0.002
AWR2	Sig. (2-tailed)	0	0	0.009	0	0	0	0.072	0	0.003	0
AWR3	Sig. (2-tailed)	0.002	0.002	0	0.05	0	0	0.066	0.004	0.059	0.067
AWR4	Sig. (2-tailed)	0	0	0.034	0	0.003	0.001	0.432	0.015	0.025	0.006
AWR5	Sig. (2-tailed)	0.079	0.005	0.022	0.203	0	0	0.006	0.028	0.087	0.44
AWR6	Sig. (2-tailed)	0.005	0	0.002	0.025	0	0	0.092	0.003	0.016	0.028
AWR7	Sig. (2-tailed)	0.039	0.001	0.003	0.023	0.001	0.004	0.001	0.056	0.007	0.038
AWR8	Sig. (2-tailed)	0.832	0.277	0.505	0.211	0.278	0.069	0.371	0.577	0	0.015
AWR9	Sig. (2-tailed)	0.462	0.334	0.443	0.05	0.115	0.058	0.926	0.38	0	0
AWR10	Sig. (2-tailed)	0.18	0.263	0.128	0.012	0.2	0.094	0.913	0.313	0	0

Note: a. AWR 1 to 10 = Awareness 1 to 10
APL 1 to 10 = Application 1 to 10
AWR 1 = Functional Analysis System Technique, AWR 2 = Lessons Learned Technique, AWR 3 = Cost Benefit Analysis, AWR 4 = SCAMPER, AWR 5 = SWOT Analysis, AWR 6 = SMART methodology, AWR 7 = Risk Analysis, AWR 8 = Target costing,

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AWR 9 = Function Performance Specification (FPS), AWR 10 = Value benchmarking
APL 1 = Functional Analysis System Technique, APL 2 = Lessons Learned Technique, APL 3 = Cost Benefit Analysis, PAL 4 = SCAMPER, APL 5 = SWOT Analysis, APL 6 = SMART methodology, APL 7 = Risk Analysis, APL 8 = Target costing, APL 9 = Function Performance Specification (FPS), APL 10 = Value benchmarking.

Moving forward to Table 5, the benefits of implementing sustainable value management were rated and ranked by the consultants and contractors in the order of; Ensures that projects are delivered in the most cost-effective way (4.15); Promotes adaptability and flexibility (4.06); Reduction of overall cost while maintaining function through identification and removal of unnecessary materials and process (4.06); Enhancing and promoting the team spirit (4.00); It enhances the competitive edge for the contractor (4.00); Eliminates unnecessary cost and achieve value for money (3.94); Use of local materials to save cost of importation and transportation (3.91); Eliminates unnecessary designs and reduces waste and defects (3.88); It identifies constraints, issues and problems which might not otherwise be obvious or have been considered (3.88); Ability to identify possible problems early in the project (3.88); Improves efficiency/effectiveness in the utilization of resources (3.85); Improves communications and enhance mutual trust, relationship and confidence in the industry (3.85); Enhanced value and benefits for end users (3.73); Future profitability can be assessed if the life cycle cost is known at an earlier stage (3.61) and Elimination of unnecessary functions and features (3.55). This indicates that all benefits are significant since their mean score is above 3.50.

Table 5: Benefits of implementing sustainable value management

Benefits of sustainable value management	Consultant	Rank	Contractor	Rank	Overall mean	Decision	Rank
Ensures that projects are delivered in the most cost-effective way	3.8	3	3.89	12	4.15	S	1
Promotes adaptability and flexibility.	3.87	2	3.89	11	4.06	S	2
Reduction of overall cost while maintaining function through identification and removal of unnecessary materials and process	3.6	10	3.61	15	4.06	S	3
Enhancing and promoting team spirit.	3.6	11	4.33	3	4	S	4
It enhances the competitive edge for the contractor	3.8	5	4	9	4	S	5
Eliminate the unnecessary cost and achieve value for money.	3.8	4	4.17	5	3.94	S	6
Use of local materials to save the cost of importation and transportation.	3.67	8	4	10	3.91	S	7
Eliminates unnecessary designs and reduces waste and defects.	3.67	9	4.06	8	3.88	S	8
It identifies constraints, issues, and							
Problems that might not otherwise be obvious or have been considered.	3.27	15	3.78	13	3.88	S	9
Ability to identify possible problems early in the project	3.73	6	3.72	14	3.88	S	10
Improves efficiency/effectiveness in the utilization of resources.	3.53	13	4.3	2	3.85	S	11
Improves communications and enhance mutual trust, relationship, and confidence in the industry.	4	1	4.11	7	3.85	S	12

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Enhanced value and benefits for end- users.	3.53	14	4.17	6	3.73	S	13
Future profitability can be assessed if the life cycle cost is known at an earlier stage.	3.73	7	4.3	1	3.61	S	14
Elimination of unnecessary functions and features.	3.6	12	4.22	4	3.55	S	15

1 = Not Significant (NS). 2 = Slightly Significant (SS). 3 = Averagely Significant (AS). 4 = Significant (S). 5 = Very Significant (VS).

Having evaluated the level of significance of the benefits of implementing sustainable value management on construction projects, the study investigated the barriers affecting the implementation of sustainable value management as depicted in Table 6.

The limited political will, legislation and enforcement at various governmental levels (4.21) being the very significant challenge since its mean score was above 4.20, followed by Lack of value management application documents (4.06); Lack of Awareness/knowledge on sustainable building (4.06); Defensive attitude of original design team (3.94); Low demand from client on sustainability measure (3.85);

Lack of support and active participation from owners and other stakeholders (3.85); Lack of contract provisions for implementation VM between owners (3.79); Lack of qualified personnel implementing sustainable value management (3.76); Lack of training and education in sustainable design and construction (3.61); Lack of investments, support policies and human resources to conduct VM in construction companies (3.58); Complexity of proposed projects to apply VM (3.55). this indicates that all challenges are significant since their mean scores are above 3.50.

Table 6: Challenges affecting the implementation of sustainable value management

Challenges affecting the implementation of SVM	Consultant	Rank	Contractor	Rank	overall mean	Decision	Rank
Limited political will, legislation, and enforcement at various governmental levels.	3.87	1	4.3	2	4.21	VS	1
Lack of value management application documents.	3.47	5	4.36	1	4.06	S	2
Lack of Awareness/knowledge on sustainable building	3.67	2	4.39	4	4.06	S	3
Defensive attitude of original design team	3.33	9	4.44	3	3.94	S	4
Low demand from client on sustainability measure	3.4	7	4.22	5	3.85	S	5
Lack of support and active participation from owners and other stakeholders	3.6	4	4.06	8	3.85	S	6
Lack of contract provisions for implementation VM between owners	3.4	6	4.11	6	3.79	S	7
Lack of qualified personnel implementing sustainable value management.	3.33	8	4.11	7	3.76	S	8
Lack of Training and Education in Sustainable Design and Construction	3.6	3	3.61	11	3.61	S	9

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Lack of investments, support policies and human resources to conduct VM in construction companies.	3.27	10	3.83	10	3.58	S	10
Complexity of proposed projects to apply VM	2.93	11	4.06	9	3.55	AS	11

Note: 1 = Not Significant, Significant (NS), 2 = Slightly Significant (SS), 3 = Averagely Significant (AS), 4 = Significant (S), 5 = Very Significant (VS)

V. DISCUSSION OF FINDINGS

The study investigated the sustainable value management practice in the Construction Industry in Rwanda. The application, benefits and barriers various were the objectives of the study. The findings revealed that sustainable value management as a concept is known on average among the participants of this study as the level of awareness and application of all techniques assessed weighted a mean score below 4. This study also found a significant positive relationship between the level of awareness of sustainable value management techniques which indicates that as the level of awareness increases so does the level of application of SVM techniques. Based on the findings, the study concludes that professionals have the average amount of knowledge as regards SVM practice (techniques), hence, the level of usage and application is also on average.

If the level of awareness of SVM is increased, then the implementation of SVM in the construction industry promises immense benefits such as Ensures that projects are delivered most cost- effectively, Promotes adaptability and flexibility, Reduction of overall cost while maintaining function through identification and removal of unnecessary materials and process, Enhancing and promoting the team spirit, It enhances the competitive edge for the contractor, Use of local materials to save the cost of importation and transportation, Eliminates unnecessary designs and reduces waste and defects and Eliminate the unnecessary cost and achieve value for money thereby giving satisfaction to the client.

Despite the benefits associated with the implementation of SVM, there are numerous barriers that hinder the proper implementation as found by this study such as Limited political will, legislation, and enforcement at various governmental levels, Lack of value management application documents, Lack of Awareness/knowledge on sustainable building, Low demand from the client on sustainability measure and Lack of contractual provisions for implementation VM between owners. If these issues were addressed, desired results which are sustainability and client satisfaction will be obtained.

Practical best practices to enable the construction practitioners in Rwanda from the perspectives of the participants of this study were Using environmentally preferable products, Exploring Conceptual Linkages between Value Engineering and sustainable Construction, developing invocative design solutions to accomplish the project goals, developing a qualified team that is dedicated to the VM process and The Value Management team be multidisciplinary.

VI. CONCLUSION OF THE STUDY

This study used literature review and questionnaire survey methods, to achieve its aim of investigating the integration of sustainable value management into Rwanda's construction industry. Through the survey of construction professionals, this study has been able to assess the level of awareness of sustainable value management techniques. It also has been able to investigate the level of application of SVM techniques. Furthermore, the benefits of implementing sustainable value management were also examined as well as the barriers and best practices to the implementation of SVM.

This study concludes that the level of awareness of SVM as a concept is below average which also affects the application of sustainable value management techniques. This is true because the study found a significant positive relationship between awareness and the application of SVM techniques.
Also, the integration of sustainable value management into construction projects promises immense benefits, especially the value for money and of client's satisfaction, not to mention the fact that the needs of the future generations will be met and ensured because of measures taken in effective and efficient use of resources in the present times. Hence, this study concludes that sustainable value management is a concept worth the efforts of all players in the construction industry.

The barriers that hinder the implementation of SVM are critical and need prompt action by all stakeholders from the academic part to professional practitioners and the government to cater for sustainability and value of the investment if the industry needs to enjoy tremendous benefits of SVM implementation. This will be achieved if the best practices aforementioned in this study are enforced, taught, monitored, and applied.

DECLARATION

We, authors of this manuscript titled: "*Adoption of Sustainable Value Management (SVM) to Building Projects in a Developing Economy*", hereby take full responsibility for the content and its accuracy. We also declare that the information provided is based on extensive research, and all sources used have been properly cited.

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