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Modelling the Value Management Implementation Drivers for Sustainable Construction Projects

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Abstract

This study assesses the drivers of Value Management (VM) implementation for sustainable housing construction projects in Jordan, a sector facing regulatory, cost, and sustainability challenges. Drawing on 34 drivers identified from global literature, a structured questionnaire survey was performed involving 103 stakeholders in the Jordanian building industry. The data were analysed using Exploratory Factor Analysis (EFA) and validated using Partial Least Squares Structural Modelling (PLS-SEM). Results showed four critical categories of VM drivers: stakeholder engagement, knowledge, regulation, and VM adoption mechanisms. Among these, stakeholder engagement emerged as the major influential factor in enabling effective VM integration. Likewise, regulatory support and structured adoption processes were significant in strengthening implementation. The findings highlight that effective VM deployment requires not only technical competence but also proactive collaboration, informed decision-making, and policy backing. The study contributes to the body of knowledge by contextualising VM within the Jordanian building industry, a setting underrepresented in prior research, and by offering empirical proof of the unique factors shaping VM adoption in developing nations. The proposed framework provides practitioners, policymakers, and industry leaders with strategic insights into improving sustainability, reducing costs, and improving project performance. More widely, the research underscores the potential of VM to serve as a transformative tool for achieving sustainable residential development in Jordan and similar contexts.

1.0 INTRODUCTION

One of the fundamental aspects of a community that characterizes the well-being and healthy standard of living of citizens in any nation is residential construction (Chan and Adabre, 2019, Bungau et al., 2024). According to Kineber et al. (2021), residential buildings worldwide are responsible for more than 40% of global electricity usage and contribute up to one-third of greenhouse gas emissions across both developed and developing nations. However, the distribution of residential space cannot keep up with the demands of an ever-urbanizing and changing globe (Gan et al., 2017, Schwendinger, 2025). Thus, the rate of urbanization is keeping low-wage people from having access to affordable housing in both developed and developing countries (Dezhi et al., 2016, Helble et al., 2021).

In developing nations, an estimated 828 million destitute people are living in slums and subpar housing. This number is projected to increase to 1.4 billion by 2020 (Al-Saadi and Abdou, 2016, Bezuidenhout, 2019, Gan et al., 2017). Rapid development in these areas makes it abundantly evident how important residential buildings are to maintaining a simple lifestyle (Durdyev et al., 2018). Therefore, by launching various affordable housing policies, affordable housing construction has been given priority by all governments. (Chan and Adabre, 2019). Ongoing debate persists regarding whether residential developments are affordable for individuals with low incomes (Gan et al., 2017, Alemede et al., 2024).

Due to its high unemployment rate, low pay, and sustainability issues, Jordan is considered a high-risk market. Risk is influenced by limited investment models, abrupt changes in currency values (instability), and ignorance of commercial decision-making. The lack of acceptable and sufficient residential development projects is therefore one of the major problems facing Jordanian policymakers. Regarding the construction system and the realization of building projects, this industry requires a significant amount of work to handle a wide variety of challenges (Ali and Alkayed, 2019). To manage the increasing complexity and evolution of construction projects and operations, one of the main concerns is that the building sector needs to have enough skilled project managers (Al-Azhari and Al-Najjar, 2012). Thirty-nine percent of Jordan's ultimate energy consumption comes from this sector, and the building industry there had a notable increase in 2018—roughly sixteen percent (AlKhouri et al., 2022).

Jordan's construction industry requires expensive construction and operating costs in addition to consuming many resources to generate product (Ali and Alkayed, 2019). This has led to the literature highlighting the necessity of creating "sustainable buildings" that are resource- and environmentally-efficient (Kineber, 2020). More support for transforming the building industry by implementing efficient and sustainable building techniques is provided by Wolstenholme et al. (2009). The environmental effects of structures as they are constructed can also not be measured by building specialists (Russell-Smith and Lepech, 2015). Consequently, at the planning and design stages of a project, VM and the sustainability technique can be integrated (Kineber et al., 2024). According to SAVE (2007), VM is a tool that is suggested to increase a project's sustainability value.

Additionally, it is portrayed as the primary source of sustainable building (Chen et al., 2019). Historically, VM has been seen as a systematic and analytical approach designed to deliver value for money by ensuring the required functions are met at the lowest possible cost, without compromising on the necessary quality and functionality. Present perspectives, however, point to VM having a stronger role in identifying, outlining, and bolstering client preferences and goals early on in the procurement process (Bowen et al., 2009, Zhou and Salleh Hudin, 2025). Because the government is a key client for building projects, VM can increase the sustainability of the construction industry by supporting measures that aim to reduce building costs. This aligns with Tanko et al. (2017)'s proposal, which highlights the benefits of Value Management learning (VM) in terms of performance and sustainability, as well as reducing waste during project implementation.

Although VM has become a standard technique in many industrialized countries to solve construction-related problems, most developing countries—including Jordan—have not given it the same level of attention (Kineber et al., 2021). Ad hoc approaches that do not lower building costs are encouraged, such as disorganized teamwork. The implementation of the VM standard in the Jordanian building sector is necessary due to the frequent shortcomings of sustainable environmental rules, along with other standards and measures. Consequently, Jordanian residential building projects must include VM. Here is the research question we created for this empirical investigation based on our reasoning. For Jordanian residential building projects, what prerequisites must be met in order to apply value management? Consequently, a review of these specifications is necessary, and this can be done by defining the VM drivers (Mohamad Ramly et al., 2015).

According to Rockart (1979), drivers are "areas where the organization's competitive success will be ensured, if satisfactory results are obtained." In order to ensure success, drivers can be seen as a critical area for management planning and action, according to Chan et al. (2001) and Yu et al. (2006) (Saraph et al., 1989). Moreover, VM's drivers actively help and involve customers through decision-makers (Male et al., 1998). Romani (1976) is among the first people to research this subject. However, Shen and Liu (2003) are credited with finding drivers through a comparison of distinctive behaviors in the UK, USA, and Hong Kong. In spite of these meager efforts, no information about the Jordanian construction sector is available. As a result, our study complies with suggestions made by some previous research on the necessity of doing more research on value management in developing nations (Bowen et al., 2010, Kulkarni et al., 2024). Therefore, by applying causal inference techniques such as structural equation modeling (SEM), this study seeks to identify the key drivers of VM, with the goal of establishing the prerequisites for implementing VM and achieving sustainability in residential buildings.

Value management (VM) significantly contributes to sustainable housing projects' delivery by systematically enhancing cost, functions, and performance throughout a project’s lifecycle (Oke and Aigbavboa, 2017a, Kineber et al., 2022b). Within the sustainability context, VM ensures that economic, social, and environmental aspects are fully incorporated into the decision-making process by aiding project stakeholders in identifying substitute design solutions that minimise resource use, improve energy efficiency, and lessen long-term costs of maintenance (Thneibat et al., 2022, Alsolami, 2022). VM application in residential construction projects can facilitate early stakeholder engagement, which enables integration of eco-friendly materials, passive design principles, and proficient building techniques that enhance both environmental performance and habitability (Toochukwu, 2025, Ahmadizadeh et al., 2024).

Likewise, VM workshops offer an avenue for exploring innovative sustainable options, including renewable energy incorporation, waste minimisation approaches, and water recycling systems without a significant increase in project budgets (Taher, 2021, Yu et al., 2018). Additionally, VM supports lifecycle cost analysis, which captures the long-term value of sustainability-oriented results and reinforces justification for their adoption in housing developments (Rupo et al., 2018). By balancing functional requirements with sustainability objectives, VM enhances the affordability, resilience, and social acceptance of housing projects, eventually contributing to sustainable urban development.

2.0 LITERATURE REVIEW

Enhancing the value obtained from building projects necessitates precise tools and methodologies (Kineber et al., 2021). The concept of VM entails employing tactics that motivate to achieve a higher return on investment (Kineber et al., 2021). Achieving the objectives of VM is essential to have a thorough understanding and awareness of VM techniques, which encompass lifecycle costing, creative and thinking (Ilayaraja and Eqyaabal, 2015, Kineber et al., 2024). When comparing Sri Lanka's construction industry to industrialized nations, Perera and Karunasena (2004)’s examination of the application of VM and found relatively low VM usage.

In the same vein, lack of awareness and information about value management has been blamed for this. Owners also have a major role in how building projects are carried out. Therefore, it is important to note that they are involved in the application of VM in their project (Kineber et al., 2021). Training in VM is essential to promote VM uptake and application in underdeveloped nations (Oke and Aigbavboa, 2017b). Complete coverage of all the steps necessary to apply VM must be included in this course. For instance, Oke and Aigbavboa (2017) opined that this practice needs to be incorporated into the responsibilities and skill set expected of technical participants in the building industry. As a result, VM will be used more quickly in the building industry (Kineber et al., 2021).

Similarly, Olawumi et al. (2016) contend that in order for construction professionals to use value management, training is essential. One such training mode may involve bringing in VM experts from wealthy countries to supply all the VM tools and methods (Kineber et al., 2021). The lack of VM expertise in the building business will be reduced by VM training for professionals in the field (Kim et al., 2016a, Kineber et al., 2023). Hence, rewarding participants in VM studies might promote the use of VM in building projects. There is a clear barrier to the widespread use of value management in Sri Lanka: a professional split within the building business. This suggests that overcoming this obstacle will require the collaboration of all building partners (Kineber et al., 2021).

The traditional construction procurement approach does not support a solid alliance amongst construction experts (Alhusban, 2018). This is acknowledged by Hayatu (2015), who suggests that by working together to adopt VMs, these professionals can improve working relationships and reduce unethical behavior amongst stakeholders. In order to maximize value for clients' money, VM organizations are recognized for promoting options for collective procurement that align with the goals of several construction partners (Kineber et al., 2021). Research by Oke and Aigbavboa (2017b) has demonstrated that adequate VM education improves indigenous building practitioners, as well as encourages its widespread use. According to Hayatu (2015), project owners who are aware of VM will be more likely to employ it widely in building projects.

Additionally, he argues that one cannot undervalue the role played by the government in enacting new laws and rules like VM. In light of this, the US government's and its parastatals' initiatives are assisting in expanding the use of VM in the country's building industry (Kineber et al., 2021). By mandating VM approval as a requirement for all government construction projects, Ahmad (2011) further emphasizes the efforts made by the Malaysian authorities. According to Yue (2005), construction projects for the US and Australian governments need to follow comparable VM approval guidelines. The extensive usage of VM among building stakeholders has been encouraged by government measures (Kineber et al., 2021).

One of the main issues preventing the adoption of VM is the unwillingness of project owners to cooperate, according to Perera and Karunasena (2004). For this reason, the client's commitment and involvement are crucial to enhancing the VM implementation. Construction firms' policymakers ought to be open to integrating this practice into their corporate ethos as well (Kineber et al., 2021). In his examination of the use of VM in Malaysia's private sector, Abd-Karim (2016) emphasizes that VM adoption and use should not be restricted to particular social groups. Instead, the entire community of building professionals needs to be enlisted in support.

Information technology use is one possible strategy to improve the effectiveness of VM research, according to several studies (Kineber et al., 2021). This contribution is in line with what Coetzee (2010) says about how an electronic VM exercise can be used to improve VM training in the South African construction industry. This approach is characterized by Coetzee (2010) as employing technology breakthroughs, including video conferencing, and is very different from the workshop conducted by the typical physical team (Kineber et al., 2021). The VM team exercises using new technologies and operates on the internet. A previous work by Fan et al. (2008) also supports this.

The literature has identified a number of VM drivers. Aghimien et al. (2018b), for example, note seven perceived drivers of value management. These include the interest of the government in the deployment of Value Management (VM), preparedness, client engagement, and public awareness of VM's advantages. Others have developed a value-added group support system, employed an electronic VM study method, and have a firm grasp of VM techniques (Kineber et al., 2021). However, Shen and Liu (2003) list 34 reasons in a thorough analysis of the available literature on the motivations behind VM studies in the building industry. These drivers are appraised and graded into 15 factors using questionnaire surveys; these characteristics are thought to be essential to the success of VM investigations. The value management drivers sourced from the latest literature are showcased in Table 1, adopted from Kineber et al. (2021).

2.1 VM's Impact on Project Sustainability and Efficiency in Resource-Constrained Environments

Recent literature on VM in developing nations underscores both its promise and the persistence of adoption challenges, especially within sustainable and resource-limited construction contexts. A study by Ojo et al. (2025); Kineber et al. (2022a), and Kineber et al. (2023) applies a multi-criteria assessment to identify the most critical barriers to VM in sustainable residential projects. Through fuzzy synthesis and surveys, they discover that stakeholder engagement and awareness-particularly decision-makers' participation in VM workshops, are the most significant barriers. In Nigeria, Oke et al. (2022), using case studies, show the VM benefits in lessening costs and eliminating unnecessary materials or tasks, particularly after a targeted VM workshop or training practice. This calls for wider survey results that moderate VM awareness exists, though the readiness to implement remains low, with barriers clustered around stakeholders' education, attitudes, client engagement, and support by government.

Further, Ojo et al. (2022) developed a conceptual VM adoption framework in Nigeria, using a Delphi study with VM experts. The framework underscores training, supportive regulations, and coordinated effort between professional bodies, academics, and government to enhance limited resources and optimise project performance. Using mixed methods, Kineber et al. (2020) examined VM in Egypt: interviews and surveys in Giza and Cairo show that 64% of professionals were aware of VM, 85% had not implemented VM or received VM training. The EFA revealed five major VM phases-data/information, function, creativity, evaluation, and presentation/development- essential for increasing sustainability and value for money in construction projects. Another Egypt-based research works reinforces these findings: VM is critical for increasing sustainability in construction, though formal awareness and structured adoption remained low (Othman et al., 2020a, Ghareeb and Sameh, 2022). The studies' sequential mixed-methods approach identifies actionable VM activities and highlights their potential to guide policy makers toward sustainable project delivery

Along Belt and Road construction corridors, a focus-group assessment identified three clusters of critical success factors (CSFs) for VM in developing nations: Technical process efficiency, positive team behaviors and project outcomes (Leung et al., 2023). These studies collectively highlight the gap between awareness and practical adoption in developing nations. They underscore that inadequate training, low stakeholder commitment, policy limitations and feeble teamwork often hinder VM's potential in promoting efficiency and sustainability. However, structured frameworks, mixed-methods assessments, and attention to both social and technical dimensions-particularly in resource-constrained housing projects-show promising paths towards broader, more efficient VM adoption.

Table 1. VM adoption Drivers

Code	Drivers	Studies
D1	VM team with multiple disciplines	(Mohamad Ramly et al., 2015, Kineber et al., 2021)
D2	The VM facilitator's level of competence	(Mohamad Ramly et al., 2015, Chen and Liao, 2010)
D3	Effective interaction between participants	(Aigbavboa et al., 2016)
D4	Able to lead a value management workshop	(Tanko et al., 2018, Kineber et al., 2024)
D5	Knowledge and experience of VM participants	(Mohamad Ramly et al., 2015, Shen and Liu, 2003)
D6	All stakeholders' dedication to the VM workshop	(Hwang et al., 2014, Shen and Liu, 2003).
D7	Experience and technical knowledge in the participant's relevant sectors	(Shen and Liu, 2003)
D8	Adaptability to new ideas and modifications	(Shen and Liu, 2003)
D9	A precise description of the range and duties of several professions	(Hwang et al., 2014)
D10	Involvement of end-users	(Mohamad Ramly et al., 2015)
D11	Participant aptitude and temperament	(Shen and Liu, 2003)
D12	Participant and agency cooperation and excellent working relationships	(Aigbavboa et al., 2016, Shen and Liu, 2003)
D13	Participants' attitudes and discipline	(Mohamad Ramly et al., 2015)
D14	Participants clearly stated goals for the VM workshop	(Aigbavboa et al., 2016, Mohamad Ramly et al., 2015)
D15	Participants' organization has given them the power to make decisions	(Mohamad Ramly et al., 2015)
D16	defining and elucidating the client's value system	)Olanrewaju, 2008(
D17	Encouraging the VM team to generate VM results	)Kineber et al., 2021(
D18	A methodical, imaginative, and proactive strategy	(Shen and Liu, 2003)
D19	An examination of the components and functions of the project	(Shen and Liu, 2003)
D20	VM feedback approach	(Tanko et al., 2018)

D21	Client comprehension of VM's performance optimization feature	(Tanko et al., 2018) ,
D22	Input from the original design team	(Palmer et al., 1996)
D23	Appropriate scheduling of the VM workshop	(Shen and Liu, 2003)
D24	Collection of background information	(Mohamad Ramly et al., 2015)
D25	Introductory orientation meeting	(Aigbavboa et al., 2016, Norton and McElligott, 1995)
D26	An innovative and inspiring method for brainstorming	)Kineber et al., 2021(
D27	Accelerating evaluation and inventiveness with new technology tools	)Kineber et al., 2021(
D28	Intervention of the VM workshop in the cycle of project development	(Mohamad Ramly et al., 2015)
D29	Active involvement and client assistance	(Aigbavboa et al., 2016, Mohamad Ramly et al., 2015)
D30	contributions from the pertinent local and municipal authorities	(Chen and Liao, 2010)
D31	Consistent presence of the decision-maker	(Male et al., 1998)
D32	Implementation strategy for the VM study plan	(Chen and Liao, 2010, Kineber et al., 2024)
D33	Government commitment to implement VM	(Kim et al., 2016a)
D34	Ability of the client to enforce the criteria and inform the design team	(Shen and Liu, 2003)

The literature review highlights the significance of VM as a structured method to increase value in construction projects, though most studies concentrate on contexts, e.g., Malaysia, Sri Lanka, South Africa, and developed countries (Perera and Gunatilake, 2022, Thneibat and Al-Shattarat, 2023). The literature consistently identifies barriers, e.g., insufficient training, limited awareness, fragmented professional collaboration, and inadequate government enforcement, as major challenges to VM application (Aghimien et al., 2018a, Kim et al., 2016b). Although these insights are valuable, there is a clear gap in extending this knowledge to the construction sector in Jordan, where industry and regulatory dynamics differ considerably.

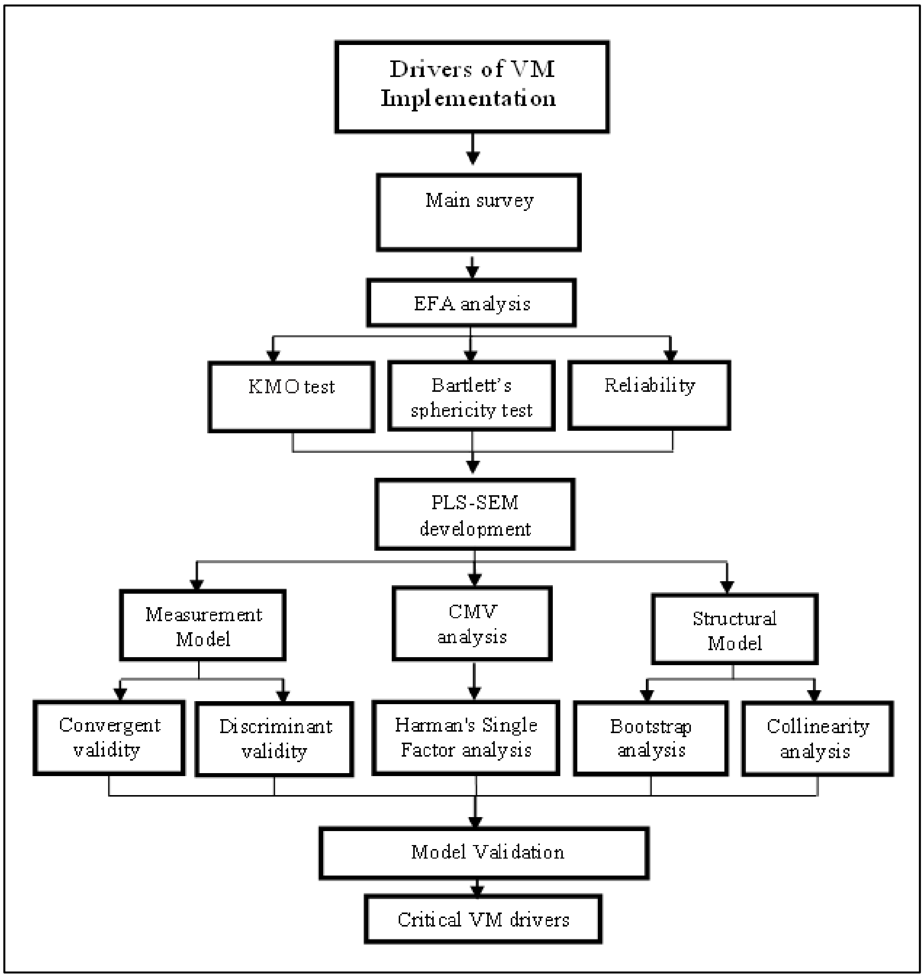
The construction industry in Jordan faces increasing pressure to offer cost-effective, high-quality, and sustainable projects (Alhusban et al., 2025a, Alhusban et al., 2025b, Nasereddin and Price, 2021, Al-Addous et al., 2023). However, there is little data on how VM adoption drivers function within the exclusive context, especially in housing projects aligned with sustainability goals. Unlike the previous research works that focus widely on adoption barriers or government policies in other regions, this research explicitly assesses VM adoption, a gap in localised knowledge, and offers empirical proof that can guide practitioners, stakeholders, and policymakers in integrating VM for sustainable construction results. This distinct focus positions the study as a critical contribution to both local and international VM discourse.

3.0 RESEARCH METHOD

Figure 1 illustrates the study process adopted from Kineber et al. (2021). Starting with an extensive literature review on the drivers of Value Management (VM), identifying 34 key drivers suitable for VM implementation in various projects. This identification forms the foundation for ensuring that the selected drivers are not only relevant but also backed by substantial empirical evidence. The variance Common Method Variance (CMV) test was then modified (Kineber et al. 2022). Additionally, the Kaiser-Meyer-Olkin (KMO) test, the Bartlett's test of sphericity, and a reliability test are used to make sure the data is acceptable and consistent.

A factor structure's underlying components are then examined through an exploratory factor analysis (EFA). After the validity of the data is established, an exploratory factor analysis (EFA) is carried out. In order to better understand how the VM drivers interact, cluster EFA aids in revealing the underlying factor structures of the drivers (Kineber et al., 2022). Conclusions from the analysis are crucial for creating a strong theoretical framework because they guide the variable grouping and classification. The structural model phase then clarifies the connections between the constructs by providing more information. This is accomplished by using bootstrap analysis to evaluate the robustness and collinearity analysis to search for any correlation between the variables. The model undergoes extensive testing and analysis before going through a rigorous validation process to ensure that it accurately and successfully identifies and ranks the primary drivers of VM. Upon completion, the process improves theoretical knowledge of VM and facilitates the efficient allocation of resources, maximizing project value in real-world project management applications.

Figure 1. Research design



The study used a structured questionnaire survey targeting construction experts directly involved in housing projects in Jordan, comprising project managers, consultants, engineers, and contractors. A purposive sampling approach was employed to ensure participants obtained relevant experience with decision-making and project delivery processes where VM might be adopted (Kineber et al., 2020). A total of 103 valid responses were obtained, aligning with recommendations for PLS-SEM, which recommends a minimum sample of 100 for reliable analysis (Hair et al., 2019). This sample size is deemed adequate statistically, as the Kaiser-Meyer-Olkin (KMO) value of 0.870 confirmed adequacy of sampling, and Bartlett's Test of Sphericity showed suitability for factor analysis (Salowi et al., 2025). Therefore, 103 responses offered a strong dataset for EFA and PLS-SEM, ensuring reliable and valid identification of the underlying drivers of VM implementation in Jordan's construction business.

3.1 EFA

It was necessary to analyze the data using EFA in order to identify underlying factors or dimensions. We discovered patterns that might not have been immediately apparent by using this statistical technique to investigate the correlations between the observed data. Using this method, we were able to identify related variable clusters in the data that are suggestive of latent constructs. Using EFA reduced the complexity of the data and improved our understanding of the main benefits and driving forces behind the application of value management techniques in Jordan's construction industry (Kineber et al., 2022). Our ability to better understand the primary factors and their effects through the application of EFA enabled us to develop focused strategies that could improve the standards and results of regional construction projects.

3.2 Model Development

PLS-SEM has attracted considerable attention across multiple fields, especially within the social sciences and business research (Kineber et al., 2024). Popular SSCI publications have lately published a number of studies that centered on the PLS-SEM technique (Kineber et al., 2022a). We evaluated the collected data and used SEM to replicate the Drivers of VM prioritizing using the latest version of the application, SMART-PLS 3.2.7. The superior predicting capabilities of PLS-SEM over covariance-based structural equation modeling (CB-SEM) were first noted (Hair Jr et al., 2017), even though there are not many differences between the two approaches (Kineber et al., 2024). The modelling analysis in this study involved the evaluation of the structural model as well as the measurement model.

Thus, it is essential to emphasize that the determination of sample size should be grounded in objective methodological and statistical analysis (Abdel-Tawab et al., 2023). As a result, the criteria for determining the sample size were set based on the selected statistical analysis methodology used to develop the VM implementation model (Badewi, 2016). Ali et al. (2023) recommend a minimum sample size of 100 for PLS-SEM model development. Considering the application of Partial Least Squares Structural Equation Modeling (PLS-SEM) in this study, the 103 responses gathered were appropriate for performing the SEM analysis (Kineber et al., 2021).

3.2.1 Common Method Variance

Common method bias (CMB) originated from common method variance, or CMV. The measurement method may be held accountable for differences in the analysis findings compared to the constructs the measurements represent, which CMB can explain (Podsakoff et al. 2003). CMV can also be described as a variance overlap that can be connected to the types of measuring tools used as well as the constructs themselves (Podsakoff et al. 2003). When data is gathered from a single source, like a self-administered questionnaire, CMV presents unique difficulties (Kineber et al., 2021).

Under some conditions, issues could occur if the self-reported data overstate or hide the scope of the connections under investigation (Strandholm et al., 2004). Given that all of the data used in this study is subjective self-reported and from a single source, this could be significant. Therefore, it is essential to address these issues in order to identify any common procedure variances. Following the steps described in the Harmans (1976) experiment, a comprehensive and systematic one-factor test was conducted (Kineber et al., 2021). The analysis of factors identified a single factor that accounted for the majority of the variance (Strandholm et al. 2004).

3.2.2 Measurement Model

The measurement structure illustrates the relationship between the individual items and the underlying latent constructs. In the subsequent sections, a comprehensive analysis was conducted, delving deeply into the model's discriminant and convergent validity to ensure the accuracy and reliability of the measurements. This thorough examination provides critical insights into how well the items capture the intended latent variables and distinguishes between different constructs within the model.

3.2.2.1. Convergent validity

Convergent validity describes how much agreement there is between multiple indicators (drivers) of the identical construct (group) (Kineber et al., 2022a). The validity of the construct is recognized to be a subset of it. “In the context of PLS, the Convergent validity test could be used to assess the convergent validity of the computed constructs: average variance extracted (AVE), composite reliability scores (ρ_c), and Cronbach's alpha (α)”. The composite's "modest" dependability criterion, according to Nunnally and Bernstein (1978), is a ρ_c value of 0.7. Values over 0.70 were considered appropriate for any kind of research, and values over 0.60 were appropriate for exploratory study (Kineber et al., 2021). AVE was the last exam, to sum up. It is a commonly used metric to assess the convergent validity of a model's constructs; values higher than 0.50 indicate a satisfactory convergent validity (Kineber et al., 2021).

3.2.2.2. Discriminant analysis

As stated by Hair et al. (2010), discriminant validity analysis requires that the phenomenon being studied be empirically distinct and that no single measurement should fully capture it within structural equation modeling (SEM). In line with Kineber et al. (2021), the degree of correlation between various constructs should not be unduly high for proper discriminant validity. Due to the interconnectedness of social and business phenomena, some degree of correlation is therefore expected; however, the measures should not be so similar as to imply redundancy. The Fornell-Larcker criterion, which contrasts the square root of the average variance extracted (AVE) for each construct with the correlations involving that construct with others in the model, is frequently used by researchers to test for discriminant validity thoroughly. Discriminant validity is ensured with such care that it improves the theoretical contributions of the study and the reliability of the research findings, offering more lucid insights and useful implications for the relevant fields.

3.2.2.3. Structural Path analysis

Modeling the Drivers of VM's priority using SEM was the study's objective. In order to achieve this, it is essential to identify the path coefficients among the measured variables. Here, between £ (Drivers of VM indicators) and μ (Drivers of VM implementation), A one-way connection was hypothesized. This is depicted in Figure 4. In this framework, a linear equation represents the structural relationship between £, μ, and €1, known as the inner relation (Kineber et al., 2021, Alkilani, 2018):

$$\mu=\beta\, £+ €1 \qquad (1)$$

At this structural stage, residual variance is anticipated within (€1), with (β) representing the path coefficient linking the Drivers of VM structures. In this context, the regression weight β is normalized and corresponds to the β weight in a multiple regression model. Its statistical significance and direction should align with the model's predictions. The challenge now lies in determining the path coefficient, β, and its significance. Similar to CFA, a bootstrapping technique from the Smart program was utilized to assess the standard errors of the path coefficients. Following Henseler et al. (2016)'s recommendation, 5000 subsamples were used to establish the t-statistics for hypothesis testing. The relationships between the constructs and the equations are represented in four structural equations for the VM Drivers constructs within the PLS Model. By rigorously modeling these relationships and validating the model against empirical data, the study offers actionable guidance that can be leveraged to enhance VM outcomes in various project environments.

4.0 RESULTS

4.1 EFA

The EFA technique was employed to ascertain the factor structure of thirty-four items related to the Drivers of VM. Connection has been made using a number of well-known factorability characteristics. One common tool used to verify that the relative connections among variables are as low as possible is the Kaiser-Meyer-Olkin (KMO) factor homogeneity measurement (Kineber et al., 2022a). A factor analysis that is deemed successful achieves a minimum value of 0.6 on the KMO, which has a range of 0 to 1 (Tabachnick et al., 2007, Kineber et al., 2022a). According to the Bartlett's sphericity test, the identity matrix is the matrix for the relationship, where $p < 0.05$ is significant (Tabachnick et al., 2007, Kineber et al., 2022a). At the outset, Bartlett's sphericity test results show significant results [□2(561) = 5379.16, $p <0.05$], with the KMO sampling adequacy score being 0.870, higher than the advised value of 0.6.

As a result, it appears that every variable included in the factor analysis was appropriate. Each diagonal in the anti-image correlation matrix exceeds 0.5. For every variable taking into account all components, the first communalities yield estimates of variance. Variables that poorly align with the factor solution are marked by low values (less than 0.3). Every first community is above the threshold for this analysis. Every loading factor has a significance level greater than 0.5. Three factors with eigenvalues greater than one have been extracted using the findings of the exploratory factor analysis (EFA) was conducted on all thirty-four items. According to Table 2, the three components' stated eigenvalues and the total variation add up to 77.1%.

Table 2. VM Drivers Factor loadings

Drivers	Stakeholder Engagement	Regulation	Knowledge
VM team with multiple disciplines	.645		
The VM facilitator's level of competence	.575		
Effective interaction between participants	.707		
Able to lead a value management workshop	.797		
Knowledge and experience of VM participants	.704		
All stakeholders' dedication to the VM workshop	.687		
Experience and technical knowledge in the participant's relevant sectors		.	.559
Adaptability to new ideas and modifications	.725	.	
A precise description of the range and duties of several professions	.696		.
Involvement of end-users		.752	
Participant aptitude and temperament		.744	
Participant and agency cooperation and excellent working relationships		.558	
Participants' attitudes and discipline		.714	
Participants clearly stated goals for the VM workshop		.538	.616
Participants' organization has given them the power to make decisions.		.545	
defining and elucidating the client's value system			.801
Encouraging the VM team to generate VM results			.622
A methodical, imaginative, and proactive strategy	.519		.
An examination of the components and functions of the project		.672	
VM feedback mechanism		.677	.
Client comprehension of VM's performance optimization feature			.599
Input from the original design team	.628		
Appropriate scheduling of the VM workshop	.575		.646
Collection of background information	.518		
Introductory orientation meeting			.727
An innovative and inspiring method for brainstorming	.661		
Accelerating evaluation and inventiveness with new technology tools		.673	
Intervention of the VM workshop in the cycle of project development	.838		
Active involvement and client assistance	.593		
contributions from the pertinent local and municipal authorities	.598		
Consistent presence of the decision-maker	.699		
Implementation strategy for the VM study plan		.668	
Government commitment to implement VM		.628	
Ability of the client to enforce the criteria and inform the design team			.613
% of Variance	30.6	56.3	77.1

Pallant (2007), it was consequently proposed that, to test the groups, the screen plot and its matrix need to be inspected and impartially assessed. Only the portions of the screen plot above this level are kept because closer inspection reveals a shift in the plot shape. The six extracted aspects are shown in Figure 2.

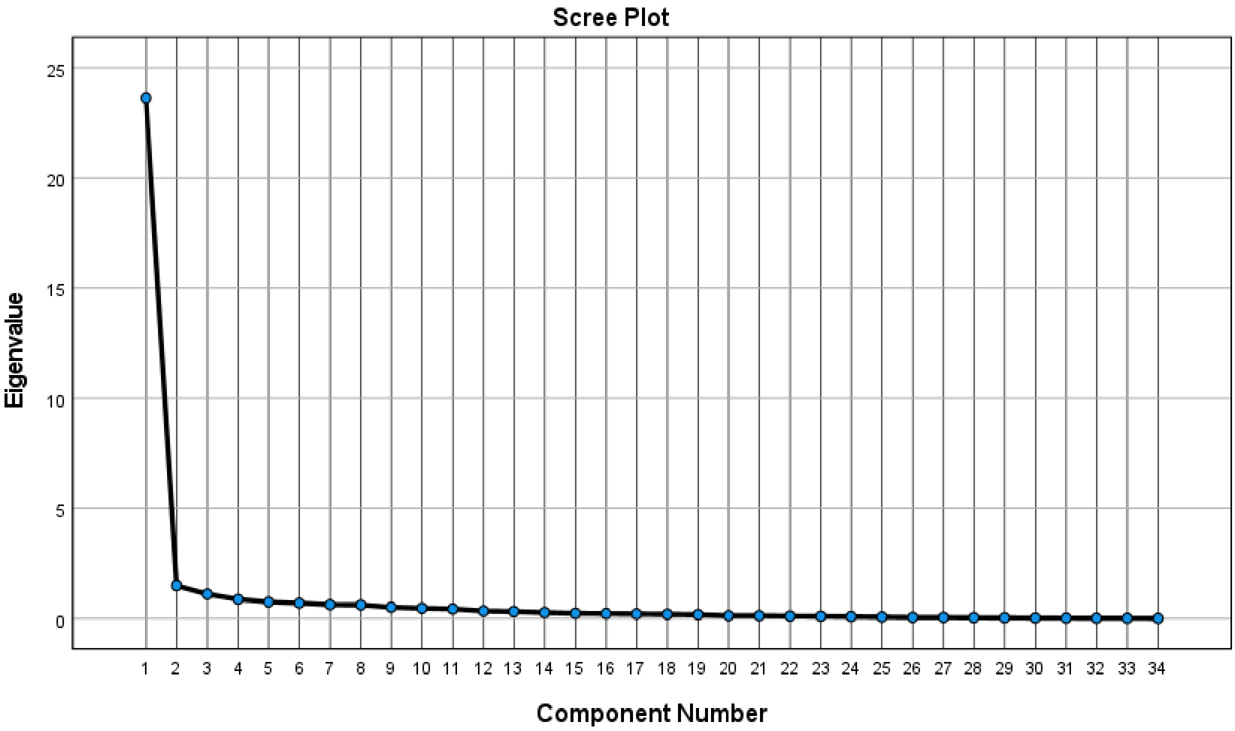


Figure 2. Screen plot.

The prioritisation of drivers in the model was achieved through EFA followed by PLS-SEM to quantify influence and validate relationships. EFA grouped the 34 identified drivers into three major categories-knowledge, stakeholder engagement, and regulation-based on factor loadings above 0.5. PLS-SEM then evaluated the relative weights and path coefficients of these constructs. Stakeholder engagement had the strongest influence (β=0.508), highlighting the critical role of stakeholder and client participation. Knowledge ranked second, emphasising technical ability and VM awareness as critical enablers. Regulation revealed a moderate influence (β=0.388), underscoring the significance of supportive policies and government involvement. Together, these drivers explain 77.1% of the variance in VM adoption, demonstrating their combined strength in shaping adoption approaches. The prioritisation offers a clear roadmap for targeting interventions to improve VM implementation in the Jordanian building industry.

4.2 Analysis of the Model

4.2.1 Common Method Bias

A kind of measurement variance known as common method bias compromises the validity of a study. In relation to the variables being evaluated and measured, it is a type of systematic error variance (Kineber et al., 2021). This bias arises when variations in responses are caused more by the measurement method itself than by the variables being measured, introducing a systematic error variance into the findings. This can be measured using several structural metrics displayed by Harman's single factor evaluation of models (Kineber et al., 2021). The single-factor test was utilized in this study to quantify the variation of the traditional method (Harman, 1967). This method helps in determining the extent to which common method variance influences the overall variance explained by the model. The common method bias has no impact on the outcomes if the components' combined variance is less than 50% (Podsakoff and Organ, 1986). As per the results, 42.75% of the total variation can be explained by the first set of components. Accordingly, it does not affect the outcomes because the common method variation is less than 50% (Kineber et al., 2022a).

4.2.2 Measurement Analysis

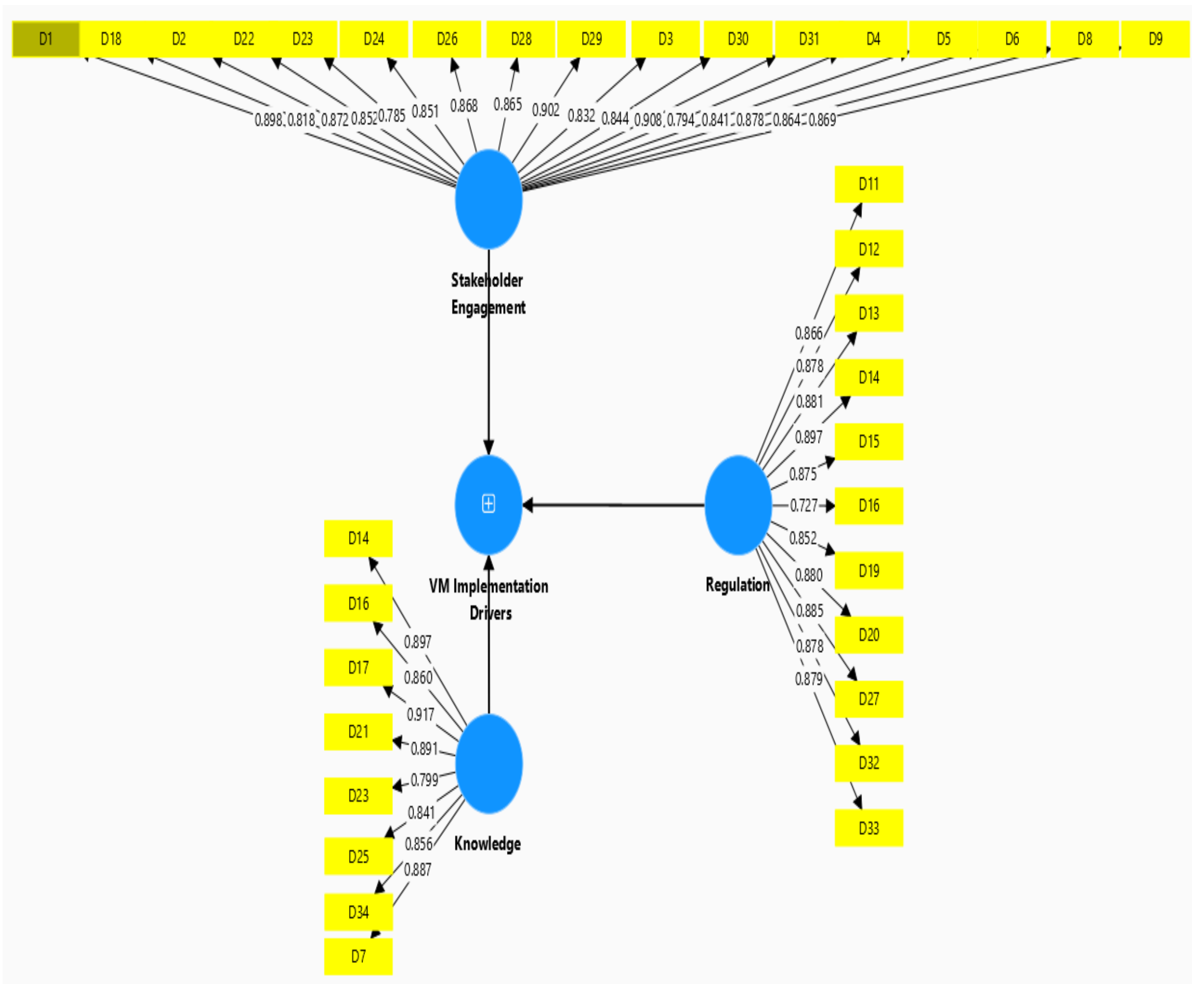
Convergent validity, discriminatory validity, and internal reliability evaluation are required when assessing reflective measurement models (Drivers) in PLS-SEM. The structural model shall be assessed upon the foundation of the measurement model's validity and reliability (Hair et al., 2006, Prasad et al., 2024). The model's constructs are all deemed acceptable since they satisfy the $\rho_c > 0.60$ and □ thresholds, as shown in Table 3 (Hair Jr et al., 2016).

Table 3. Measurement analysis results

Themes	Cronbach's alpha	CR	AVE
Knowledge	0.954	0.956	0.756
Regulation	0.966	0.967	0.748
Stakeholder Engagement	0.977	0.978	0.733

Further evidence that all constructions passed the AVE test can be found in Table 3. A value greater than 0.5 should be considered acceptable for the AVE (Fornell and Larcker, 1981). Over 50% of all the constructs in this study have estimations of their AVE values (Table 3), based on the PLS algorithm 3.0. According to these results, the measurement model is internally consistent and convergent. This demonstrates how each construct (group) is precisely captured by the measurement components, leaving no room for the study model's other constructs. Close relationships exist between the pertinent objects for each construct, as indicated by high outer loads on a construct. It is generally necessary to frequently remove objects from the scale that have very low outer loadings (below 0.4) (Hair et al., 2011, Al-Mekhlafi et al., 2023). For each item, the outer loadings of the measurement models are displayed in Figure 3. All external loads have passed the test and been approved.

Figure 3. PLS Results



a. Discriminant Validity

There may be no relationship between the two constructs because the square root of the AVEs (Table 4) was higher than their correlations with any other construct. Furthermore, according to Table 4's values, every predictor receives the highest loading for the relevant concept (Al-Mekhlafi et al., 2023). At some point, every construction can be guaranteed to have an outstanding level of one-dimensionality.

Table 4. Dimensionality results.

Themes	Knowledge	Regulation	Stakeholder _Engagement
Knowledge	0.869		
Regulation	0.832	0.865	
Stakeholder _Engagement	0.9	0.821	0.856

b. Path Model

Once the formative construct status of the Drivers of VM has been established, we calculate the collinearity among the construct's formative objects. These indicators, or subdomains, are crucial as they each contribute distinctly to the higher-order structure of the VM construct. To forecast the relevance of the path coefficients, a bootstrapping tool is also employed. There is statistical significance for each path at the 0.01 level, as shown in Figure 4 (Hulland, 1999, Mousa et al., 2022, Al-Mekhlafi et al., 2023).

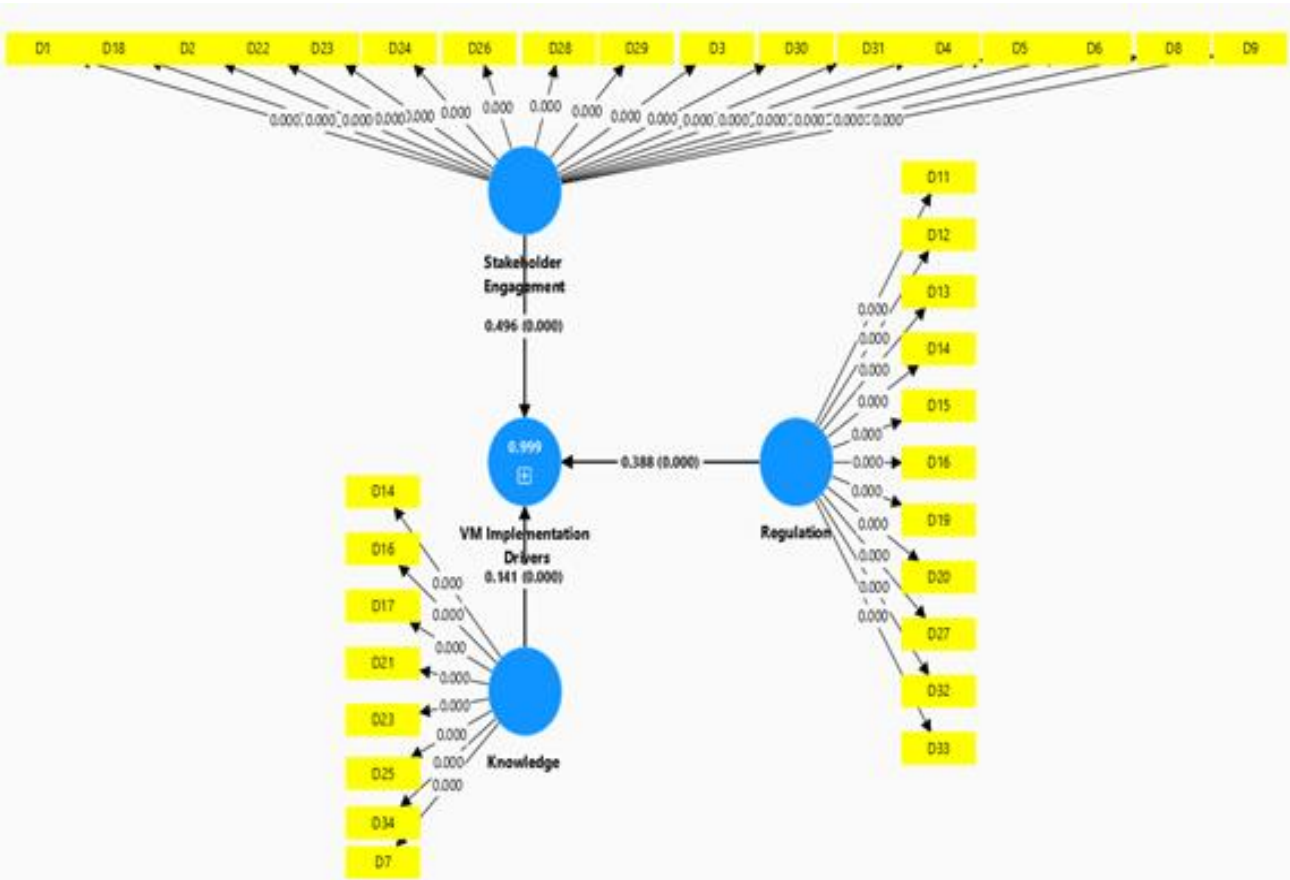


Figure 4. Path structural model, with β values

5.0 DISCUSSIONS

Though VM is heavily relied upon in many industrialized countries for building, its use is rather low in developing countries (Kineber et al., 2021). Jordan has experienced issues and inconsistencies in building standards, much like many other developing nations. This indicates that in order to overcome these obstacles, VM concepts must be put into practice. The acceptance of VM as a crucial platform or element in projects by upper management will be significantly bolstered by practitioners' acknowledgment of VM and its critical construction activities.

Each of the four VM Driver components has a significant impact on how VM is implemented, as the suggested model shows. In residential construction projects, this can improve sustainability. Accordingly, building companies can reduce costs and time while improving quality and maintaining project functionality by implementing VM (Dallas, 2008). Therefore, in order to encourage these stakeholders to embrace Value Management (VM), value management standards or drivers must be developed. How the elements of the PLS model can be utilized to rank the Drivers of VM is covered in the ensuing subsection.

Figure 4 presents a summary of the suggested PLS-SEM model and confirms the link between the value management drivers. It will take more thought from lawmakers before VM can be successfully implemented in the Jordanian construction sector if these VM Drivers are not met because the drivers of the value management application's structural models serve as validated criteria for the implementation of value management needs. “Essentially, the variables that are validated by the measurement and structural models will be included in the requirements for VM implementation specifically” (Tanko, 2018). This has led to the establishment of the measured items (factors) for this construct and the confirmation and support of all study paths, as illustrated in Figure 4.

5.1 Stakeholder Engagement

It is indisputable that stakeholders are important in construction projects (Bohari et al., 2020). Through the "Stakeholders" component, the PLS-SEM model suggests that this component has the greatest impact on the Drivers of VM implementation, with an external coefficient of 0.508. According to Tanko et al. (2018a), these findings are consistent. They reaffirm that the VM process is greatly aided by clients and other stakeholders who possess the requisite knowledge and expertise. The efficacy of VM implementation drivers is directly impacted by successful stakeholder engagement. It guarantees that all parties involved are aware of and able to comprehend VM's goals, which in turn encourages a more cohesive and cooperative approach to project management and decision-making. Members of the team and stakeholders are caught up in the intense phases, requiring their full engagement and dedication to achieving the objectives of the workshop (Leung et al., 2014, Leung et al., 2002).

Fulfilling these goals has therefore either directly or indirectly aided in the effective execution of project development efforts. The principal proponents and regulators of this approach were the government representatives and the building industry controller (Hwang and Tan, 2012). Because of this, the client's active support and engagement in implementing VM using modern construction techniques were essential (Tanko et al., 2017). When adopting Value Management learning (VM), a client's support can provide and specify appropriate aid (such as financial incentives) and the necessity (such as necessary conservation rules) to establish sustainability requirements (Kineber et al., 2022a). The VM implementation processes will therefore include documentation of advancements (Kineber et al., 2022a). Furthermore, legislators and clients should be informed about the benefits and potential applications of VM in construction projects. (Othman et al., 2020b).

5.2 Regulation

A fundamental part of the Value Management (VM) system, the regulation scale plays a major role in driving its application. This coefficient is significant (0.388). The connection between regulatory agencies and governmental entities emphasizes the importance of regulation because the government is a significant consumer as well as a large investor in infrastructure and real estate development. Government policies directly impact the scope and effectiveness of VM, as they are the largest stakeholder in capital formation. This is especially true when it comes to enforcing sustainability and technological advancements within the building industry. Furthermore, government representatives’ active involvement in VM processes encourages residential building projects to adopt these practices, demonstrating a proactive strategy for incorporating VM into standard construction practices. The government's support and active participation will be necessary for the VM to be implemented in current homebuilding practices (Tanko et al. 2017).

With the aid of this integration, the processes involved in implementing VM are improved to the point where they are not only compliant with current regulations but also maximized in terms of efficiency and effectiveness. Therefore, the "Regulation" factor, through its normative influence and strategic support, facilitates significant improvements in VM practices, aligning them with both market needs and regulatory standards, thus ensuring their sustainability and relevance in the evolving landscape of construction and infrastructure development. The Malaysian construction sector said that a major barrier to VM adoption is cultural aversion to change (Jaapar et al., 2009). As such, supporters of this approach ought to embrace new ideas and improvements. Othman et al. (2020) and this are in agreement. There was also an implication that the level of cultural obstacles to value management adoption mattered more than the scale median (3). It became clear that it was imperative to avoid the cultural obstacles.

5.3 Knowledge

The "Knowledge" construct in the context of VM stands out as the second most critical factor, emphasizing the importance of a deep and shared understanding across all stakeholders involved in VM processes. The strong statistical relationships shown in the structural model highlight the significant role knowledge plays in influencing both stakeholder engagement and regulatory adherence, which are key to the successful adoption of VM. According to Tanko et al. (2018b), the outcome was contemporaneous. They found that in order to speed up the VM technique, knowledge of pertinent facts and expertise is essential. The many aspects of VM, therefore, need to be taught to construction workers (Kineber et al., 2022a). While working with experts who do not have sufficient facilitation abilities, it is impractical to expect clients to use VM in their projects (Othman et al., 2020b). According to Kineber et al. (2020), formal knowledge should be used to adopt VM workshops for the application of VM in the construction industry.

5.4 Theoretical and Managerial Implications

5.4.1 Managerial Implications

The findings underscore that successful VM implementation in Jordan relies on stakeholder engagement, regulatory support and knowledge development. For project managers, this means fostering early and continuous stakeholder participation via structured VM workshops and transparent communication channels to ensure shared understanding of the project goals. Thus, contractors must invest in capacity-building programs to strengthen technical knowledge of VM activities, including lifecycle costing, sustainable design alternatives and creative problem-solving approaches.

Thus, policymakers and regulatory agencies must integrate VM requirements into procurement and approval processes, creating incentives for its implementation. Practically, collaboration platforms, cross-training between stakeholders and pilot VM-driven housing projects can illustrate tangibles benefits. By embedding VM into corporate policies and aligning it with sustainability objectives, Jordanian building industry can achieve greater cost efficiency, reduce waste, and deliver more sustainable housing solutions. These steps will improve project outcomes while aligning national development goals with international sustainability standards.

The practical application of VM has revealed measurable benefits in developing nations. For instance, Nigerian Housing Projects using VM workshops achieved up to 15% cost savings by eliminating redundant design features. Similarly, in Egypt VM increased sustainability by enhancing energy-efficient materials without raising budgets. For Jordan, contractors must begin with orientation workshops to align stakeholders, trailed by functional analysis to identify cost-performance trade-offs. Project owners must mandate lifecycle costing and encourage innovative brainstorming sessions to integrate renewable energy and waste management approaches. Integrating VM into procurement policies ensures consistency, reduces delays and improves overall project efficiency and sustainability.

Although VM holds promise for enhancing sustainability, cost efficiency and reducing waste in Jordanian construction sector, its economic impact can be constrained by many factors. Limited stakeholder awareness, fragmented industry practices and feeble enforcement of rules might hinder broader adoption. In addition, cultural resistance to change and budgetary constraints faced by contractors might slow VM implementation. Therefore, while VM contribute to sustainable growth and economic efficiency, its success depends on overcoming institutional barriers, developing technical capacity and aligning policies with practice-otherwise, benefits can be uneven and slower to materialise across the Jordanian economy.

This study offers unique insights by being the first study to empirically examine VM drivers in Jordan, classifying them into stakeholder engagement, regulation and knowledge. Unlike previous studies in developed contexts, it captures the realities of resource-limited environments, where fragmented collaboration and limited awareness are common. By using PLS-SEM, this study measures the relative influence of each driver, offering a localised framework for prioritising interventions. These findings increase VM understanding in developing nations by showing how abstract principles translate into practical approaches, bridging the gap between theory and practice and guiding policymakers toward more delivery of sustainable construction projects.

5.4.2 Theoretical implications

Although the concept of sustainable concept is not unfamiliar (Baldassarre et al., 2020), it seems to be gaining spreading vital across many industries (Broccardo and Zicari, 2020). Specifically, in the area of sustainable building development, the suggested prioritization model offers a prerequisite for VM deployment. This study advances VM theory by contextualising its implementation in the Jordan's building industry, a setting mostly lacking from previous research. Although VM theory emphasises cost-functional optimisation and stakeholder collaboration, empirical validation in resources-limited environments has been constrained. By modelling 34 drivers and categorising them into stakeholder engagement, regulation and knowledge, this study extends VM theory to capture the unique institutional and socio-economic dynamics in developing countries. The use of PLS-SEM offers a rigorous framework for prioritising VM adoption drivers, providing empirical proof of their relative influence. Importantly, the study bridges theory and practice by demonstrating how abstract VM principles- including stakeholder involvement and knowledge transfer-translate into actionable approaches in contexts with low awareness, fragmented collaboration and regulatory gaps. Therefore, it only strengthens theoretical understanding of VM in sustainable construction but also establishes a localised framework to guide practical application across developing economies.

6.0 LIMITATIONS

This research has made significant contributions to both academic and practical fields, yet it also highlights several areas ripe for future exploration. This study several limitations. First, the sample size of 103 professionals, though adequate for PLS-SEM, may not adequately capture the diversity of construction industry in Jordan. Second, this study relied on self-reported survey data introduces potential bias and limits triangulation with qualitative insights. Third, the study treats clients, consultants, and contractors as a homogeneous group, which may overlook nuanced variations between stakeholders. Lastly, though the findings offer valuable insights for Jordanian building industry, their generalisability to other developing regions is limited, since socio-economic, regulatory and cultural contexts vary. Thus, future research must expand scopes of sampling, regions and employ mixed-methods for wider applicability.

7.0 CONCLUSIONS

Value Management (VM) is widely recognized and utilized across many developed countries as a potent tool for ensuring value for money, enhancing project aims, and promoting sustainability. This study has, successfully modelled the rank order of the VM drivers through the use of structural equation modeling (SEM) guided by an extensive literature review. The SEM approach applied for this study also offered elegant analytical approaches, which helped in the appreciation of the interconnectedness of the VM drivers. Exploratory factor analysis (EFA) was used to thoroughly investigate the drivers after they were first identified and SEM was used for a secondary analysis. Using information gathered from 103 professionals in the Jordanian building industry the model was empirically validated using the partial least squares SEM (PLS-SEM) technique. The findings obtained from this model highlight the essential importance of stakeholder engagement and knowledge as key factors in the effective execution of VM. These results are intended to provide direction and support to construction professionals, not only in Jordan but also in comparable environments, presenting a strategic framework aimed at minimizing costs and improving sustainability.

Implementing value management (VM) in accordance with international standards can help developing economy stakeholders achieve more sustainable outcomes and increase the efficiency and effectiveness of construction projects. This study identified prioritised major drivers of VM implementation-stakeholder engagement, regulation and knowledge- within Jordan's housing construction industry, providing both theoretical and practical contributions. The results extend VM theory by contextualising VM in a resource-constrained environment and offering empirical proof of driver influence using PLS-SEM. Practically, the study offers a framework to guide project managers, contractors and policymakers. Outside Jordan, the findings hold broader relevance for other developing nations facing similar challenges, reinforcing VM's potential as a transformative tool to align project delivery with sustainable development and economic efficiency goals.

The results further offer a strategic framework that can guide professionals in Jordan and comparable contexts toward more sustainable construction practices potentially bringing projects into compliance with international standards and enhancing overall project effectiveness. By providing developing countries with a clear framework for tailoring value management tactics to their own needs the study's findings can also guide useful policy changes and improvements to value management training programs increasing project sustainability and efficiency.

7.1 Future Directions

Future research should validate the proposed model across other developing countries to relate drivers under divers under various socio-economic and regulatory settings. Cross-country research collaborations/projects could reveal context-specific disparities in VM adoption. Longitudinal research in Jordan is likewise needed to track how VM drivers affect project success overtime. In addition, exploring the VM integration techniques, e.g., Building Information Modelling (BIM), Artificial Intelligence (AI) and blockchain into VM activities might offer new insights into improving collaboration, efficiency and sustainability. Lastly, differentiating stakeholder groups-clients, consultants and contractors-would increase understanding of their unique roles in advancing VM implementation.

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