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DETERMINING THE CRITICAL SUCCESS FACTORS OF PROJECT RISK THAT AFFECT THE SUSTAINABLE DEVELOPMENT OF MUD ARCHITECTURE BUILDING IN YEMEN

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Abstract

This paper aims to determine the critical success factors (CSFs) of project risk that affect the sustainable development of mud architecture buildings in Yemen. A review of the related literature established the relationship between CSFs and project risk Management; the relationship was further contextually tailored using a pilot study and presented as a hypothesized template. The targeted population in this study was 260 projects of mud buildings implemented in three selected areas of Wadi Hadramout city, namely Seiyun, Tarim, and Shibam. This study utilized a stratified sampling method and divided the population into three strata as represented by the geographical location within the main cities in Wadi. The modelling aspect of the study was performed using the structural formula of partial least squares (PLS-SEM, v3.2.7). The outcome of this study supported the hypotheses that suggested a significant relationship between two CSFs (leadership and resources) factors and Project Risk Management of mud architecture building in achieving sustainable development. A direct relationship was also found between leadership factors and resources factors while the other two factors (technical factors and project management factors) do not have these relationships. This study encourages companies in Wadi Hadramout to recognize the importance of CSFs of Project RM to be creative and achieve sustainable development.

Keywords: CSFs; Risk Management; Sustainable Development; Mud Architecture Building; Yemen

1. INTRODUCTION

It is agreed that most of the mud architecture buildings in Wadi Hadhramaut, Yemen have survived many years; however, these structures have recently been affected by different risks that threaten them at the international, regional, and local levels [1]. According to Baeissa [1], in recent times, re-establishing the architectural practice of mud architecture building in Wadi Hadhramaut in Yemen is becoming more challenging and there is a need to mitigate the risks arising from the modern, social, political, and economic changes. A study by Petzet and Koenigs [2] indicated that more than 550 mud buildings in Shibam city in Yemen are in very bad condition, and some houses have already collapsed; they issued an alarm that Yemen's heritage is at risk. Furthermore, the destruction of many mud buildings in the catastrophe of October 2008 in Hadhramaut highlighted many concerns and questions about mud buildings and their sustainability in the future. Hence, it is crucial to investigate ways of managing project risks of mud architecture buildings to attain sustainable development. There are a couple of risk factors impacting the sustainability of mud architecture buildings; so, there is a need to identify and manage these risks and recognize the critical success factors (CSFs) for project risk Management of mud building to achieve sustainable development. According to the recommendation by Darko & Chan [3] for future studies, it would be of interest to explore and examine risks affecting sustainable construction in developing countries. Therefore, the examination of risk management for sustainable construction projects in developing countries may be considered a promising research direction. On the other hand, there are inadequate empirical studies on project risk Management of mud architecture buildings. Although few researchers had studied the issue of mud architecture buildings and most of them have considered the technical issues [4, 5, 6, 7 & 8], these studies are not related to project risk management because standardization and research in this type of mud architecture building remain a complex field [9]; furthermore, there is currently no accurate design code for mud architecture building [10].

2. LITERATURE REVIEW ON CSFS OF PROJECT RM

There has been a plethora of studies on CSFs for construction projects during the last few decades. These studies garnered interest because they show how CSFs help practitioners focus their limited resources on a select few, manageable criteria that result in successful project execution [11]. For instance, the study by De Silva and Weerasinghe [12] highlighted 5 independent factors of project performance in Sri Lanka's construction industry which included contractor experience, project team motivation, project planning, project control systems, and project management capabilities. Furthermore, Thi and Swierczek [13] identified the CSFs in building projects in Vietnam using a sample comprising 239 project members and managers under three categories of factors: manager competencies, member competencies, and external stability. These factors were found to have a significant positive association with the successful completion of the projects. Gudienė et al. [14] found seventy-one success factors under seven categories for Lithuanian construction projects. These CSFs are of great importance both to industry practitioners and scholars. Furthermore, Garbharran et al. [15] found some CSFs influencing project risk in the construction industry in South Africa and categorized them according to the four COMs model (comfort, competence, communication, and commitment). Gunathilaka et al. [16] critically examined some of the conceptual and empirical research articles on project success relating to project success factors and project success criteria published in construction management journals with the purpose of examining the relationship between them.In additions, Aziz et al. [17] identified CSFs of sustainability RM practices among environmentally sensitive industries in Malaysia. In their study, risk culture, leadership, emerging risk governance, and compliance were identified as CSFs in successful sustainability risk management practices. Furthermore, compliance was found to be the most important factor in successful sustainability risk management practices and was found to have a high effect on corporate survival [17]. A research carried out by Chileshe and John Kikwasi [18] studied the perception of construction professionals on the CSFs of risk assessment and management practices in Tanzania. The outcome of the study showed that knowledge of the risk management process, teamwork, communications, and management style are the three most important CSFs while cooperative attitude, customer requirements, and positive human dynamics were seen as the least important. In respect of construction projects in Arabic states, Barakat et al. [19] explored the factors that seem to contribute to project RM success using a local development project in Taroudant province (located in the southern part of Morocco) as a case study. Elsewhere, Esmaeili et al. [20] found the CSFs for diverse construction operations for different project results, different project delivery techniques, and for partnering processes. The study found top-level support by management, constructability reviews, commitment, teamwork, trust building, and communication emerged as the shared key elements of success in most construction activities. The study's findings also showed that there is a lot of room for further research into CSFs for particular approaches and the relationship between CSFs and project performance. Banihashemi et al. [21] looked at the

CSFs affecting the integration of sustainability into construction project management practices in poor countries. The study's conclusions suggested a conceptual model of CSFs for the adaptation of project management techniques for construction projects in poor nations to incorporate sustainability. Additionally, Ihuah [22] conducted research and identified the crucial project management success factors for the delivery of sustainable social (public) housing estates in Nigeria. The study employed a documentary analysis of the data, followed by an interpretive identification of categories and boundaries for many of the items and pieces of information taken into consideration. Utilizing a content analysis technique, the materials were evaluated based on four criteria: authenticity, credibility, representativeness, and significance. The study concluded that the project manager's performance, the company that owns the development project, the team members' personalities, and the project's external environment are all connected with twenty-two essential project management success criteria. The study also showed a connection between social, economic, and environmental difficulties and the three aims of sustainable development. In summary, several CSFs influencing project risk Management were pointed out following a thorough review of the literature. Based on the literature review, the CSFs were grouped into five categories which are: leadership factors, resources factors, technical factors, project management factors, policies, and regulations factors. Thus, it is imperative that these factors should be combined in the implementation of project RM of mud architecture building projects towards sustainable development.

2.1. Leadership Factors

The effectiveness of leadership is recognized as the most researched aspect of human behavior since it is so important to how individuals function in teams [23]. The literature has generally neglected the impact of the project manager, as well as his or her leadership style and competency, on project success, according to Turner and Muller’s [24] analysis of the contribution of leadership style to successful projects. They discovered that the performance of the functional manager's leadership style plays a part in the success of organizational management, as is commonly acknowledged in the general management literature [25]. Leadership factors are the characteristics of the manager guiding the organization, and are responsible for risk management in the company; they play an important role in determining the success of a project risk management in all stages of a project life cycle, including top management support, commitment to the project, and perfect competence. According to Barrantes-Guevara [26], the leadership expertise of the project manager is the most often mentioned in the extant project management literature; he concluded that there is a significant linkage between the project manager’s leadership style and the success of the project. Additionally, Toor and Ofori [27] reviewed empirical research on leadership in the construction sector and discovered that in recent years, there's been a growing understanding of the significance of leadership in completing successful construction projects and providing effective project risk management implementation. Phu [28] identified the CSFs of enterprise implementation for Vietnamese construction companies and concluded that leadership or involvement of senior risk managers has a significantly positive influence on projects risk management. Top management supportis one of the characteristics of leadership for a project that has been seen to have great importance over a long time in differentiating between success and failure [29]. Project risk management depends on high-level management for guidance, direction, and support. High-level management has to ensure that the project is worthwhile and that they support it [30]. Surprisingly, many top managers do not know how their behavior impactsthe success of projects [31]. Thus, many studies [11, 15, 14, 32, 22, 33, 34, 35, 36] have identified top management support as one of the main CSFs of projects. For an instant, Esmaeili et al. [20] determined that top management support is one of the key elements of success in most construction projects.

2.2. Resources Factors

A growing trend in recent years has been the recognition of the significance of resource considerations to the implementation success of project risk management, according to a survey of the literature. Effective risk management as per Manab et al. [37] requires the right resources, including human, material, and technological ones. One of the reasons many organizations struggle to create successful enterprise-wide RM practices has been noted as a lack of resources [38]. Resources have been found as CSFs of enterprise-wide risk management [37]; firstly, human resources have a vital role in successful risk management in construction projects. Various researchers have mentioned that human resource factors played an important role in determining the success of a project [39, 40]. According to Gudienė et al. [14], numerous people, including initiators, planners, designers, contractors, clients, project managers, and institutions, are involved in the implementation of building projects. Finding the people who can have an impact on the project and managing their varying needs through effective communication during the project's early stages is a crucial task for the project management team. For instance, Yong and Mustaffa [41] investigated the main factors that are responsible for the successful completion of a Malaysian construction project, and they recommended that more emphasis should be given to improving leadership factors to ensure the successful implementation of a project risk management in the future.

The four CSFs, namely comprehensiveness, competence, commitment, and communication, which were called the critical 'COMs' of project success for human resources, are identified as the critical success factors of RM implementation in large-scale construction projects in countries like Thailand, Vietnam and South Africa [42, 15]. Kazaz et al. [43] found that financial factors arise from owners while the main contractors are the first causing delays in construction projects and the failure of projects in Turkey. Hwang and Lim [44] indicated that enough financing is required for the completion of projects because cash problems could lead to the project being encumbered by debtors. The other important factor for the success of project risk management related to material resources is the quality of building materials. According to Akadiri [45], the choice of sustainable building raw materials constitutes a vital strategy in the design and execution of a building project. Hence, government, in addition to supervising pricing and supply issues associated with building materials, should also intervene on behalf of the public in terms of environmental conservation which is considered an essential component of sustainability [46]. Technical issues are related to the characteristic of the project that has a significant impact on project RM of mud architecture building, such as safety design, quality construction methods, and new technologies. According to Gudienė et al. [14], project-related factors are the characteristics of the project which have an important effect on the successful implementation of the project risk management. Belassi and Tukel [47] stated that project characteristics are important factors and constitute one of the essential dimensions of project performance because they influence the project risk success of any project. They pointed out that such factors include the size and the worth of the project, the peculiarities of project activities, the project life cycle, and the urgency with which the project is required. In the literature, there are some CSFs that lead to the success of project RM execution, such as the safety design for the project. According to Yong and Mustaffa [41], the consultant should provide adequate design with details and specifications as it is a critical factor to the success of the project risk.

2.3. Technical Factors

Technical issues are related to the characteristic of the project that has a significant impact on project risk management of mud architecture building, such as safety design, quality construction methods, and new technologies. According to Gudienė et al. [14], project-related factors are the characteristics of the project which have an important effect on the successful implementation of the project risk management. Belassi and Tukel [47] stated that project characteristics are important factors and constitute one of the essential dimensions of project performance because they influence the project risk success of any project. They pointed out that such factors include the size and the worth of the project, the peculiarities of project activities, the project life cycle, and the urgency with which the project is required. In the literature, there are some CSFs that lead to the success of project risk management execution, such as the safety design for the project. According to Yong and Mustaffa [41], the consultant should provide adequate design with details and specifications as it is a critical factor to the success of the project risk. Clearly, it is the responsibility of the consulting engineer to provide an appropriate design for the project which can meet the requirement of the building owner, and it is also his responsibility to make sure that that design is implemented [48]. Therefore, Bin Zulkifli [49] indicated clearly that design is one of the CSFs for risk management implementation in construction projects. Moreover, choosing good construction techniques is one of the CSFs for project risk management. For instance, Lu [50] showed that the reduction of the negative effects of the environment on construction operations in the building sector of the U.S. construction industry is perceived as a significant benefit of using offsite construction methods. Further, Jaillon et al. [51] asserted that a well-organized and secure work area is encouraged by prefabrication systems in comparison to conventional construction. So, selecting the appropriate construction methods and techniques in the projects will be a CSF of project risk management. For mud architecture, Hammond [52] that the key cause of dilapidation of mud structures include shrinkage, erosion menace, wall cracking, and damage from mechanical equipment. But, the use of suitable architectural designs, structural methods, stabilization measures, and diligence in siting can enhance the successful construction of mud buildings in almost all kinds of climatic areas, and with adequate maintenance [53]. Furthermore, Gudienė et al. [14] noted that new technologies have an impact on the effectiveness of project CSF and the conditions for participation. Technology and development advancements lead to more effective project management. For instance, instead of relying solely on low-cost systems that are already accessible, Goldsmith and Flanagan [54] presented possibilities for climate resilience and sustainable development through emerging technologies (even at a higher cost and perceived risk). In this sense, better decision-making has the potential to open up hitherto untapped financial and technological sectors that are in line with sustainable development principles, guiding sustainable innovation [55]. Also, Ismail et al. [56] considered that environmentally friendly technologies for project risk management are a success factor; therefore, new technologies can be a critical success factor for the implementation of project risk management. For instance, Sri Lanka in line with many countries has been moving towards modern and newer materials and technologies as well as the ancient practices of earth architecture [57]. He also discussed how Sri Lankan traditional architecture has made use of a number of natural building materials and appropriate technologies to construct structures that are naturally sustainable, sensitive to the environment, and that support regional expertise. It showed that, given these new approaches and technology, it is reasonable to assume that the earth industry will generate more inventive building techniques in the future that will be more sustainable and place less of a burden on the planet's finite resources. Regarding mud architecture, Niroumand et al. [58] mentioned the critical parameters for mud architecture buildings which are included the styles of architecture, method of construction, materials, economic consideration, structural consideration, climatic conditions, as well as new technologies such as nanotechnology in mud buildings. Additionally, he found that related organizations and societies for mud architecture need more discussion to advance contemporary theories and technologies on mud architecture between researchers and experts as observed during the investigation of the guidelines for evaluating crucial parameters of mud architecture houses as sustainable architecture in many countries [59].

2.4. Project Management Factors

Project management has essential tools that lead to the success of project risk management; this group includes managerial issues that affect the success of the project, such as effective project team formation, adequate planning, and control techniques, effective allocation of manpower, clear and detailed written contract, implementing effective quality management, effective project budget monitoring, and site management and supervision. A study by Gudienė et al. [14] identified effective teamwork in managing risk management as the main factor affecting the success of the projects and influencing the success of the implementation of project risk management. Also, good coordination between all parties in management factors plays a major role as well [56]. According to Toor & Ogunlana [42], construction projects require very good and detailed planning before the main implementation and effective supervision.

Lack of planning will result in unanticipated delays and expense overruns. Therefore, it is crucial that all project stakeholders put up an efficient project planning framework [60]. It gives the team members a clear sense of direction and project information. Sambasivan and Soon [61] found that native contractors frequently lack expertise in site planning and project monitoring, which leads to construction errors that reduce the project's effectiveness. Additionally, successful project execution is widely credited to strong communication within organizations [62, 63]. Open project communication is essential for fostering trust among project stakeholders, which will lead to productive and long-lasting working relationships, according to Andersen et al. [64]. Bin Zulkifli [49] indicated clearly that communication is one of the CSFs for risk management implementation in construction projects. Similarly, Hwang and Lim [65] highlighted the significance of planning for the implementation of project risk management which is still important to ensure; hence, there is a need for programs in place to address plans and scheduling. A detailed plan sets the foundation for establishing the correct budget and scheduling estimates.

A control system gathers, evaluates, and presents data concerning time, cost, and attainment of quality specifications benchmarked against the initial estimate. Therefore, project planning and control aid contractors in lowering the possibility of unforeseen events delaying project completion. Updates are just as important to contractors for a better understanding of the project status and planning as scheduled. However, multiple studies have emphasized the significance of perfect supervision and monitoring for project risk management execution. Project monitoring, overseeing the work of subcontractors, and having access to skilled laborers are only a few of the facets of supervision and quality management. Site supervision is essential to ensure the necessary attributes are being attained at building sites [66]. A variety of factors influencing the success of the building project were discovered from the earlier studies, and as a result, CSFs may be divided into four primary groups; these include leadership factors, resources factors, technical factors, and project management factors. The criteria chosen from earlier literature are listed in Table (1) along with the related citations.

Table 1: List of CSFs developed from the literature

No.	Items of CSFs	Relevant literature
	Leadership factors	[17, 18, 28, 67, 68, 69, 25, 26, 70, 71]
1	Top management support	[67, 72, 73, 20, 74, 71, 75, 26]
2	Commitment	[48, 21, 76, 20, 35, 12, 74, 69, 26, 41, 37, 77]
3	Competence	[21, 78, 26, 16, 41, 15]
	Resources factors	[28, 21, 67, 73, 32, 79, 74, 80, 37, 37, 15, 81]
4	Human	[28, 21, 19, 82, 14, 84, 37]
5	Materials	[21, 85, 35, 69, 84, 37, 81]
6	Financial	[48, 21, 85, 19, 82, 18, 14, 81, 77]
	Technical factors	[73, 85, 19, 18, 79, 69, 14, 86, 56]
7	Safety design	[9, 87]
8	Quality construction methods	[88, 32, 41, 58, 20]
9	New technologies	[20, 89, 35, 11, 58, 59, 32, 77]
	Project management factors	[21, 73, 67, 35, 18, 79, 78, 74, 41, 14, 37]
10	Effective teamwork	[80, 11, 85, 18, 69, 26, 70, 24]
11	Perfect Communication	[28, 90, 80, 91, 79, 69, 41, 37, 71]
12	Good planning and monitoring	[28, 73, 79, 74, 69, 41, 14, 80, 24]

2.5. Dimensions and Measures of Sustainable Development

Environmental, economic, and social considerations. For example, Vos [92] maintained that almost all shared essential elements of sustainable development were related to environmental, economic, and social considerations. According to Said and Berger [93], sustainable development should be all-encompassing and take into account all the following three bottom-line considerations. These three domains are usually seen as the 3 foundations of sustainable development or the Triple Bottom Line (TBL) [94, 95]. These three elements reciprocally reinforce one another. Economic growth and social well-being are supported by environmental considerations, and vice versa [96]. However, to sustain environmental and social practices, the choices must be economically sustainable [97]. Therefore, this study focuses on the measures of the three dimensions of sustainable development, including economic, social, and environmental aspects. In conclusion, Table (2) summarized the discussion regarding the dimensions of sustainable development in the context of this study and identified the measures of the three components of sustainable development that are adopted in this study since they are relevant to the focus of this study (mud architecture building).

Table 2: Dimensions and Measures of Sustainable Development

Dimension and measures of sustainable development	
Environmental Dimension	
Protection of the environment	[98, 9, 99, 58, 59, 100]
Reducing climate change and emissions	[98, 99, 9, 58, 59, 100]
Minimizing ecological impact of buildings	[98, 9, 58,59, 100]
Scarcity of natural resources	[98, 9, 99, 58,59, 100]
Improving indoor environment quality	[98, 9, 99, 58,59, 100]
Waste reduction	[98, 9, 99, 58,59, 100]
Economic Dimension	
Construction cost	[97, 16, 98, 101, 102, 99, 100]
Operating costs	[97, 98, 101, 102, 99, 100]
Maintenance and renovation costs	[97, 9, 101, 102, 99, 100]
Job creation for local people	[100, 101, 58, 8, 59]
Financial benefits	[44, 103, 100, 95]
Marketability	[97, 98, 101]
Social Dimension	
Enhancement of social/community relationships	[101, 98, 100, 97]

Health and comfortable	[102, 99, 58]
Improved learning and training of workers	[98, 102, 58]
Support for country's economy,	[101, 58, 8, 59]
Relevance to local culture and heritage	[101, 104, 105, 106, 100]

3.RESEARCH METHOD

The framework of the study (shown in Figure 1) was developed from the review of the literature specifically to address the problem of the study. The variables were selected based on practical and theoretical issues identified in the literature. The independent variables contain four CSFs, namely leadership, resources, technical, and project management, while the sustainable development of mud architecture building is measured by economic, environmental, and social dimensions. Moreover, the Decision-Making Theory was applied in this theoretical framework. All the dimensions and elements in this research framework were derived from previous studies and literature in this area. There are four dimensions for the research framework; the study proposed that four CSFs for Mud Architecture Buildings (MAB) (including leadership, resources, technical, and project management factors) are likely to result in higher sustainable development of mud architecture buildings in Yemen. Four hypotheses were developed and empirically tested:

H1: There is a significant relationship between leadership factors of project risk management and sustainable development.

H2: There is a significant relationship between resources factors of project risk management and sustainable development.

H3: There is a significant relationship between technical factors of project risk management and sustainable development.

H4: There is a significant relationship between PM factors of project risk management and sustainable development.

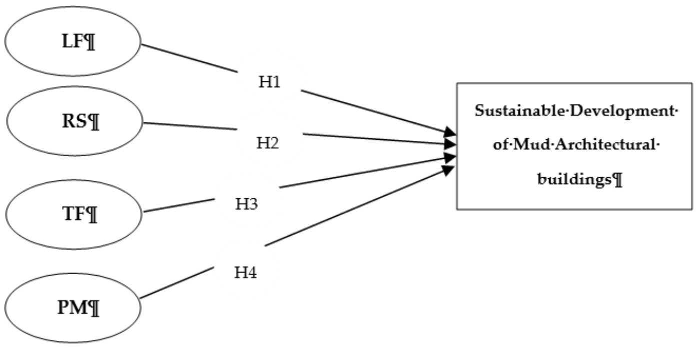

Figure 1: Conceptual framework

Note: LF= Leadership Factors, RF=Resource Factors, TF= Technical Factors, and PMF = Project Management Factors

The targeted population in this study was projects of mud buildings implemented in the three main cities of Wadi Hadramout which are Seiyun, Tarim, and Shibam located in the southern part of Yemen. These three cities were selected for this study because they are considered the major cities in Wadi Hadhramaut, as well as, they have distinct characteristics in mud architecture buildings. These three cities have structures that are designated as architectural and international heritage that can be registered as international heritage [107]. Traditionally, the predominant construction material of the 3 mentioned cities is sun-dried mud brick [108]. The sample size for this study was determined using the Morgan method in the mud architecture building projects implemented during the years 2015 to 2017 in each of the three main cities mentioned earlier. The total number of mud architecture building projects implemented in the three main cities was obtained from the offices of the Ministry of Public Works, Roads, and Urban Planning in these three cities during that specified period. Based on the record, the total number of projects considered was 807 projects (323 projects in Seiyun, 298 projects in Tarim, and 186 projects in Shibam). The researcher relied on the Morgan table for determining sample size to select about 260 projects as the sample size for this study which was proportionately divided according to the number of mud-building projects in the respective cities as shown in Table (3).

Table 3: Sample size of Mud Projects implemented during (2015-2017)

No	Districts	No. of Mud Projects implemented during (2015-2017) years	Sample Size
1	Seiyun	323	104
2	Tarim	298	96
3	Shibam	186	60
	Total	**807**	**260**

This study utilized a stratified sampling method to divide the population into three strata as represented by the geographical location within the main cities in Wadi Hadhramaut (Yemen as Seiyun, Tarim, and Shibam). These projects were randomly selected because the buildings in these cities were mostly disorganized and scattered without a proper pattern, with some huts and concrete buildings spread around the cities. As such, during data collection, attention was given to ensuring that all parts of the selected cities are represented adequately. It should be noted here that the project selection was done based on randomness. The questionnaires were structured carefully and contained questions that allowed the respondents to identify the potential risks of mud architecture building, their chances of occurrence, and the potential severity (impact) levels of the risks. Additionally, the independent variables that affect the implementation of project risk management of mud architecture buildings towards sustainable development (which include leadership factors, resource factors, technical factors, and project management factors) were also captured in the framing of the questions. The questionnaires also contained the dimensions of sustainable development as the dependent variable of this study.

4. RESULTS AND DISCUSSION

The data analysis in this study was done using SPSS (version 25) and smart PLS (version 3.2.7) to obtain the final results. Critical Success Factors of PRM Implementation are the independent variables and capture four major factors, namely leadership factors, resources factors, technical factors, and project management factors. The first step is the assessment of the PLS-SEM model during the is initially evaluated. Four components of an assessment are suggested by Henseler et al. [109] which include assessment of indicator reliability, internal consistency reliability, convergent validity, and discriminant validity at the indicator and construct levels (see Table 4).

4.1. Assessment of the Model Quality

The original model of the current study involved 50 reflective items (manifest variables) for five main variables (latent variables), which are (leadership factors, resources factors, technical factors, and project management factors), and one dependent variable (sustainable development). According to the proposed hypotheses of the study, there are four direct relationships between the main constructs (see Figure 2).

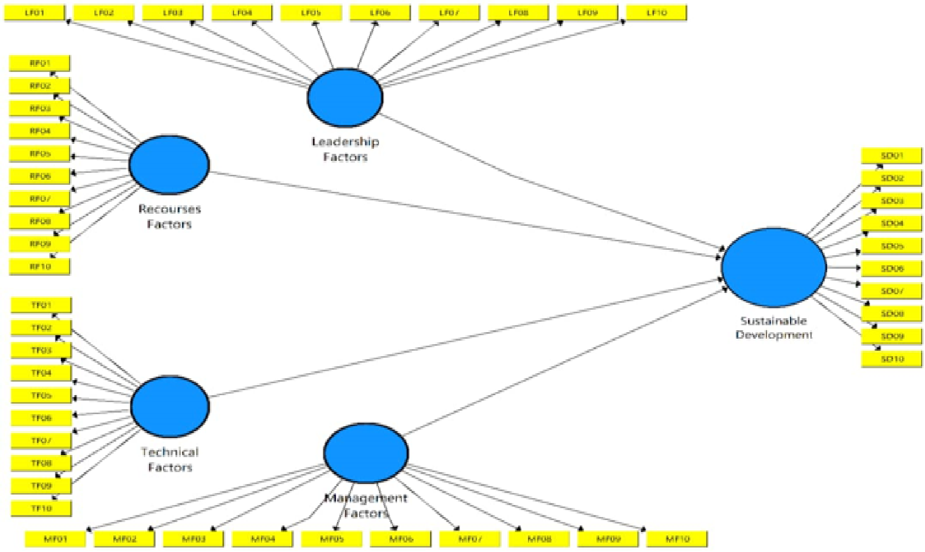

Figure 2: Hypothesized Model

4.2. Average Variance Extracted (AVE)

The obtained AVE values for the LF, Resource factors (RF), Technical factors (TF), PRM (PRM), and sustainable development were 0.811, 0.623, 0.0627, 0.825, and 0.541, respectively (see Table 4); these values exceeded the 0.5 level recommended by Hair et al. [110]. The composite reliability values shown in Table (4) were higher than the recommended 0.6 value by Bagozzi and Yi [111] for each construct. Similar to this, all the factors listed in Table (4) had Cronbach's Alpha values that exceeded the 0.7 cut off point suggested by [112]. Thus, it can be concluded that the survey's data were related to one another and that the five-point Likert scale that was employed to measure the components was accurate.

Table 4: Results of Measurements Model –Internal Consistency Reliability & Convergent Validity

Construct	Item	Loadings	Alpha	CR	AVE
Leadership Factors	LF01	0.956	0.966	0.972	0.811
	LF02	Deleted			
	LF03	0.937			
	LF04	0.866			
	LF05	Deleted			
	LF06	0.893			
	LF07	0.938			
	LF08	0.853			
	LF09	0.869			
	LF10	0.886			
Recourses Factors	RF01	0.772	0.924	0.937	0.623
	RF02	0.766			
	RF03	0.694			
	RF04	0.846			
	RF05	0.868			
	RF06	0.729			
	RF07	0.836			
	RF08	0.854			
	RF09	Deleted			

	RF10	0.718			
Technical Factors	TF01	0.751	0.924	0.937	0.627
	TF02	0.764			
	TF03	0.764			
	TF04	0.879			
	TF05	0.629			
	TF06	Deleted			
	TF07	0.69			
	TF08	0.858			
	TF09	0.873			
	TF10	0.875			
Project Management Factors	MF01	Deleted	0.957	0.966	0.825
	MF02	0.926			
	MF03	0.926			
	MF04	0.9			
	MF05	Deleted			
	MF06	0.919			
	MF07	Deleted			
	MF08	Deleted			
	MF09	0.894			
	MF10	0.882			
Sustainable Development	SD01	0.802	0.905	0.921	0.541
	SD02	0.739			
	SD03	0.612			
	SD04	0.786			
	SD05	0.727			
	SD06	0.799			
	SD07	0.737			
	SD08	0.63			
	SD09	0.775			
	SD10	0.723			

Discriminant validity (DV) is another type of construct validity utilized in PLS-SEM; it is described as the degree to which a construct does not connect with other measures except itself [113, 114]. Discriminant validity is used to determine empirically the level of discrimination between a construct in a model and the other constructs [115]. The construct correlation matrix is shown in Table (5) which demonstrates that the AVE values (in bold) on the diagonal are higher than those off-diagonal. Thus, the test confirms the DV of the discriminant's accuracy.

Table 5: Discriminant Validity – Cross Loading

	LF	RF	TF	MF	SD
LF01	**0.956**	0.498	0.354	0.402	0.68
LF03	**0.937**	0.434	0.3	0.35	0.625
LF04	**0.866**	0.451	0.33	0.337	0.546
LF06	**0.893**	0.447	0.308	0.368	0.627
LF07	**0.938**	0.447	0.295	0.374	0.634
LF08	**0.853**	0.429	0.313	0.323	0.516
LF09	**0.869**	0.421	0.259	0.304	0.561
LF10	**0.886**	0.452	0.318	0.364	0.631
RF01	0.365	**0.772**	0.573	0.45	0.482

RF02	0.369	**0.766**	0.571	0.458	0.496
RF03	0.347	**0.694**	0.421	0.684	0.565
RF04	0.383	**0.846**	0.696	0.451	0.491
RF05	0.356	**0.868**	0.72	0.485	0.503
RF06	0.433	**0.729**	0.441	0.717	0.652
RF07	0.383	**0.836**	0.695	0.506	0.507
RF08	0.376	**0.854**	0.663	0.503	0.527
RF10	0.468	**0.718**	0.714	0.516	0.603
TF01	0.22	0.733	**0.751**	0.405	0.358
TF02	0.219	0.747	**0.764**	0.422	0.372
TF03	0.212	0.724	**0.764**	0.436	0.364
TF04	0.326	0.605	**0.879**	0.497	0.412
TF05	0.109	0.427	**0.629**	0.263	0.266
TF07	0.147	0.493	**0.69**	0.338	0.353
TF08	0.388	0.582	**0.858**	0.48	0.437
TF09	0.369	0.596	**0.873**	0.501	0.46
TF10	0.361	0.612	**0.875**	0.506	0.446
MF02	0.377	0.62	0.531	**0.926**	0.578
MF03	0.391	0.681	0.501	**0.926**	0.604
MF04	0.31	0.638	0.488	**0.9**	0.519
MF06	0.364	0.618	0.513	**0.919**	0.543
MF09	0.372	0.573	0.488	**0.894**	0.515
MF10	0.32	0.606	0.466	**0.882**	0.488
SD01	0.543	0.546	0.387	0.519	**0.802**
SD02	0.479	0.522	0.404	0.445	**0.739**
SD03	0.425	0.414	0.341	0.381	**0.612**
SD04	0.543	0.549	0.36	0.406	**0.786**
SD05	0.491	0.511	0.327	0.454	**0.727**
SD06	0.543	0.541	0.378	0.495	**0.799**
SD07	0.475	0.518	0.395	0.434	**0.737**
SD08	0.419	0.433	0.366	0.403	**0.63**
SD09	0.528	0.542	0.352	0.408	**0.775**
SD10	0.483	0.499	0.322	0.449	**0.723**

Another step required in this study is to calculate the path coefficient of each building's (path's) CSFs by comparing the beta (β) values of each path; the hypothesized relationships are reflected in the direction coefficient. According to Hair et al. [116], to account for the model's efficacy, track coefficients must be more than 0.10. However, the significant level of β value must be verified using a t-value check. According to Hair et al. [116], for a two-tailed test, acceptable t-values range from 1.64 (level of significance= 0.10 or 10%) to 2.58 (level of significance= 0.01 or 1%) and from 1.96 to 1.64 (level of significance= 0.05 or 5%). Accordance with [116], the results provided in Table (6) indicate that the obtained values for leadership and resources factors are significantly higher than the recommended value of 0.10. The values for the leadership factors and resource factors of the project RM are 0.389 and 0.336 respectively, which are the highest scores for the CSFs construct with the strongest relationship with sustainable development. It's interesting to note that the t-values are higher than the 0.05 or 5% minimum cut-off value. This implies that amongst the four considered CSFs in this study, two CSFs related significantly with mud architecture building in achieving sustainable development and these are leadership factors of project RM (t = 9.432), and resources factors of project RM (t = 3.836).

Table 6: Summary of Hypotheses Testing Results

Hypo	Relationship	Std. Beta	T-value	Remarks
H1	There is a significant relationship between leadership factors of project rsik management on mud architecture building and Sustainable development.	0.389	9.432	**Supported****
H2	There is a significant relationship between resources factors of project rsik management on mud architecture building and Sustainable development.	0.336	3.836	**Supported****
H3	There is a significant relationship between technical factors of project rsik management on mud architecture building and Sustainable development.	-0.057	0.869	Not supported
H4	There is a significant relationship between project management factors of project rsik management on mud architecture building and Sustainable development.	0.051	0.723	Not supported

5. DISCUSSION OF THE FINDINGS

The unexpected relationships between Project Risk Management Success Factors (PRMSF) as an individual construct and Sustainable development are shown in Table (4). Specifically, Leadership Factors (LF) were found to be statistically significant at the level of 0.05; therefore, hypothesis H2 (β= 0.389, t=9.432, p<0.05) is supported. This result is consistent with previous findings [28, 26 & 27] on how LF affects companies. The leadership factors considered in this work are top management support, commitment to the project, and perfect competence. As a result, the companies' MAB should adopt many strategies and must invest in their capabilities to overcome these obstacles. Again, it should be noted that not all investment and spending are beneficial, hence, LF is considered an important factor. This indicates that most leaders have considered LF an important factor for sustainable development; however, they still can channel such materials to leaders for achieving sustainable development. Sources Factors (SF) are another critical success factor that influences sustainable development. The analysis showed that SF was statistically significant at the level of 0.05, meaning that Hypothesis H3 (β= 0.336, t=3.386, p<0.05) is supported. A successful PRMSF, which depends on the existing practices of SF such as human, financial, and materials, is evident in the SF literature [37, 39, 40, 41 & 43]. On the other hand, Table (6) showed no relationships between the Technical Factors (TF) of project RM on mud architecture building and SD; therefore, Hypothesis H4 (β= -0.057, t=0.869, p>0.05) is not supported. Furthermore, Project Management Factors (PMF) and SD had no significant relationship at the level of 0.05; therefore, Hypothesis H5 (β= 0.051, t=0.723, p>0.05) is not supported as well. Table (4) also showed that the lack of highly effective equipment and skilled technical assistance are the main reasons for not achieving sustainable development. Hence, the technical factors are not supported in this study. Furthermore, Table (6) showed that the RM organizational changes, policies, and regulations are not integrated and as such, the current result is not supported.

6. CONCLUSION

This study was carried out in the Arab world to investigate the common effect of Project Risk Management Success Factors with Sustainable Development (SD) related to the SD of mud architecture buildings. Theoretically, the study contributes to the body of knowledge by examining the relationship between the CSFs of Project RM and SD. A direct relationship was found between leadership factors and resource factors while the other two factors (technical factors and project management factors) showed no such relationships. A methodological contribution is seen in the scales adopted from different models applied in the US and European contexts and few Arabian countries. Therefore, it was necessary to cross-validate the measurement scales to investigate their reliability and validity; it was also noticed that composite reliability, convergent validity, and discriminant validity were above the minimum threshold in all cases. Consequently, some modifications were made based on the PLS-SEM output and the current study contributed methodologically by empirically confirming the reliability and validity of the adapted scales in the context of MAB. Furthermore, a first-order construct was examined with regard to the multi-dimensional scales of CSFs of Project RM, which involved four dimensions. The PLS-SEM output matched the data collected using the questionnaires, and the first-order constructs were proved and found to sufficiently fit. Therefore, the first-order constructs successfully became part of the structural model and were found to sufficiently fit the empirical data. This rare use of first-order constructs is a further significant methodological contribution. Most previous studies used SPSS to test their hypotheses, but the current study used PLS-SEM to examine them, another significant methodological contribution because the predicting phenomenon is relatively new, and the structural model is complex. Practically, the findings are important contributions for policy-makers and practitioners, offering valuable information on how CSFs of Project RM can be integrated to achieve SD. The study encourages companies in Wadi Hadramout to recognize the importance of CSFs of Project RM to be creative and achieve SD. The findings of this study should also encourage senior managers and master builders of companies of MAB in Wadi Hadhramaut, Yemen to adapt and use technical factors not only to achieve a high-quality outcome but also to support and enhance their company's capabilities. Companies should focus on their employees by developing programs that help to share and increase their knowledge and experience in several areas related to the activities of the company. These findings imply that the ability of the company to apply technology refers to the company's ability to respond rapidly to stakeholders' demands (employees, customers, competitors, etc.). Therefore, this study recommends that managers confirm that the necessary systems are in place to share and use capabilities, knowledge, and experience, by offering financial, material, and moral support.Finally, companies play a key role in creating a system for coping with risks, which is critical to ensuring sustainable growth. Therefore, a strong and reliable system is the basic pillar of sustainable development through providing the required financing and resources to face risks. This means that the MAB will be more robust for facing project management risks if companies and international organizations such as Arab Regional Centre for World Heritage (ARC-WH) and UNESCO consider the findings of this study strategically.

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