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Research Paper

Segmenting the Impact of Organizational Structure and Leadership on Project Resilient and Project Success in the Ethiopian Construction Industry: a FIMIX-PLS & PLS-POS Approach

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Abstract. This research looks at the vital roles of leadership and organisation design in the attainment of project resilience and success in the construction sector. Informed by contemporary theories on organisational resilience and leadership, a framework was developed and rigorously tested against data using Partial Least Squares Structural Equation Modelling (PLS-SEM) and with more advanced techniques of segmentation (FIMIX-PLS and PLS-POS) to identify and take into consideration unobserved heterogeneity. Using data collected from project professionals, resilient leadership and adaptive organisation design were shown to be critical to project resilience, but the effect of leadership and organisation design on project resilience differed from segment to segment as well as across demographics. The ex-post analysis suggested that the awareness of resilience, practical experience and higher education exacerbated the relationships between aspects of resilient leadership and project resilience, as well as between adaptive organisation design and project resilience. The analysis also showed that relationships between leadership, organisational structure, and resilience can be mediated by demographic factors, such as awareness, experience, and education. The findings highlighted the importance of fostering inclusive, participative type leadership styles and continuous forms of experiential learning to enhance resilience outcomes. The value of specific indicators such as team participation in decision making or the leader's self-confidence was also identified as being critical aspects of resilient organisational structures and effective leadership. The implications of this study were important for each group of stakeholders: organisations should encourage resilience-based leadership, experiment with multi-dimensional flexible team structures and create a culture of continued, experiential learning and communications as knowledge and industries evolve. The theoretical contributions that validated the effects of segments of latent variables and offered insight into the added value of using segmentation were positive contributions to theory. Limitations, such as sample size and sector, stimulate avenues for future work and in particular reinforce the case for longitudinal, cross-sector research to build sectors' internal and external constructs of project resilience. Future research needs to apply multi-facilitated empirical, qualitative and advanced analytics means to enable further quantification, and complexity in project survival, success and resilience.

Keywords: Organizational Structure, Leadership, PLS-SEM,FIMIX, POS , Resilience

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Introduction

Ethiopia's construction industry is on an upward trajectory in terms of growth but is burdened with threats & the limitations causing delays to projects. These threats are made worse by socio-economic factors such as economic stability and weakened by factors of investment, infrastructure, availability of skilled labour, market demand and political influences such as policies and regulations that affect one's ability to operate, corruption and inefficiencies in vital bureaucracy [1]. This means that at one level, research on construction project delivery will have already leaned and will continue to lean towards the flexibility of project management in extreme conditions, more specifically in terms of fast-tracked and large-scale projects.

With respect to resilience, adaptive leadership, and organisational structures are relevant in this instance. The construction context in Ethiopia has limited engagement on project resilience (i.e. the extent to which an organisation is able to absorb some unscheduled disruptions and remain in business) [3]. Using other contexts, research indicates there is a link between the success of a firm's project delivery and an organisation's resilience [4]; [5]; [6]. In the 21st century's dynamic business world, success is dependent on how well an organisation is resilient to withstand storms [2]. Adaptive leadership is a process that mobilises people, physical and human resources, and processes to move through obstacles and create change [7]. Hence adaptive leadership will assist construction teams to navigate risks and uncertainties with additional resilience [8].The task, reporting and authority structures impact staff performance and the extent to which goals can be met [9]. Resilient organizations are characterized by flexible and untangled structures that help facilitate timely decision making for crisis situations [4].When these structures are in place, organizations are able to look for further adaptations to create solutions to external challenges [8].
The literatures relating to organizational structure to adaptive leadership in alignment with resilience. Importantly, to have resilience at both the individual and team level requires leadership and structure [8].

Much of the research indicates a strong connection between organisational structures and adaptive leadership aligned to resilience. However, to have resilience, both individual and team resilience require both structure and leadership [8]. Particularly in Ethiopia, there is lack of literature about these issues to coalesce an understanding that contributes to project successes [3]. The study in this paper will, therefore, define project success by quality, cost, time, stakeholder satisfaction, and safety. The focus of the study is on how adaptive structures and leadership influence and mediate of project success in Ethiopia's turbulent construction sector.

The primary research question for this study is: How do organisational structures and adaptive leadership influence project resilience and success in the construction industry? Following the research question, the following hypotheses are suggested to frame the study: H1: Project resilience leads to project success. H2: Adaptive leadership influences project resilience. H3: Adaptive organisational structures support resilience. The intent is that these hypotheses will be examined in a manner that uses empirical data, clarifying the relationships between key constructs and suggesting recommendations. Thus, together through the supporting constructs, they enhance project resilience and success through leadership and organisational structures.

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Essentially, ineffective leadership and rigidity of structures collectively undermine the construction industry, limiting the industry's ability to cope with ineffective resources, bureaucratic inertia, and market uncertainty. It is essential that the usage of resilience, organizational structure, and adaptive leadership become a theoretical framework and set of actions for project development and delivery under uncertainty. For the resilient organizations, they can turn adverse shocks to their business into opportunities for growth [10], with parallels toward global interest in sustainability in the context of resilience in project management [11].

This study will employ some advanced methodological approaches, such as FIMIX-PLS and POS-PLS, for data segmentation of the effects of resilience. By using these techniques of segmentation, the study has highlighted latent heterogeneity among project professionals that allowed the identification of more nuanced relationships between leadership, organizational structures, and resilience, which would likely be masked if only using aggregate data analysis [1]. By using Ethiopia as a basis for analysis, it will provide new information and recommendations in terms of providing policymakers and other practitioners with information to help pursue project success through resilience.

The study provides a theoretical contribution by combining adaptive leadership and organizational resilience theories using advanced methodological processes, as well as practical contributions by providing recommendations for resilience building specifically to the various contexts of organizations within the Ethiopian construction sector.

1. Literature Review

This study has examined resilient organizational structure and resilient leadership as they relate to project success. Structure and leadership constitute resilient organizations in the context of working individuals adapting to challenging circumstances [12];[13]. Further, the culture of the organization, particularly its contribution to communication and to adaptability and decision making, also influences project outcomes inclined towards project success [14]. The relationship between the various dimensions in producing synergy to promote project resilience and outcomes is, on the whole, not well understood, especially with effort undertaken for projects in the construction industry in Ethiopia. This review attempts to bring existing knowledge together to identify gaps that this study will fill, particularly the relationships between leadership, organizational structure, and resilience in uncertain project environments.

It is important to note that in this study of resilience, the term "resilience" is taken to mean "the capacity of a person, or thing, to return ultimately to its own original shape after an unpleasant happening" (Oxford English Dictionary, 2024).

An organisation which has a flexible structure permits quick and effective decision making in uncertain situations through role, responsibility, and authority contingencies [4]. Leaders who are resilient are flexible and decisive and lead their teams to find ways through the obstacles [7]. Ogbu Edeh et al. [15] concluded that flexible structures are essential in environments where uncertainty is prevalent. This research was designed to attend to two specific questions: (1) How does an organisation's structure affect project resilience and project success? and (2) is resilient leadership an important tool that influences developments of resilience and project success in Ethiopia? By clarifying these focus questions, this research clearly associated earlier literature with the aim and research questions of the study.

1.1. Organisational Structure

T. O. M. Burns and G. M. Stalker [16] distinguished an organic organizational structure highlights flexibility and motivated workers with shared authorities to respond accordingly and quickly to chaotic or unstable environments that require immediate performance [17]. Organizational structure has a favourable influence on employee performance [25]. For an organization to be resilient, its employees must be capable of self-administration, and for this reason, a well-established organizational structure is essential [18].Both structural elements, such as formalization, centralization, and integration provide a basis for a structured environment, yet their effectiveness is contingent on the context [19]. In volatile contexts, decentralization and resilience will be important [37], as too much formalization can impair the organization's ability to adapt and innovate. Performance is also determined by specialization and their social relations, which must be aligned to organizational goals and represent imitation [20]. Nowadays, organizational arrangements are fluid, and reliance on constant structural elements can inhibit agility. Centralization and integration have implications for organizational learning [21]. All of these elements need to be balanced to provide stability, whilst still having the ability to adjust.

Divisional, projectized, and functional organisational structures are common organisational structures [9]; [22]. Functions are only partially effective because although staff can gather around their skills and collaborate, they start deteriorating in terms of relevance to the project. Product or market bias leads to higher efficiency for divisional structures and less employee involvement, while projects provide employees the chance to collaborate with their colleagues but less often act on collaboration beyond their projects.

Organic structures are more structurally flexible and facilitate managing negative externalities easily [16]. When in crises, mechanistic and bureaucratic structures can be more effective and more efficient under stable conditions, but they administrate slow response times and diminished innovations [23]. In the uncertain environment of the Ethiopian construction sector, organic structures can represent a necessary condition to work in [24] and has an impact on the performance with which an organization uses its operational and strategic resources, as well as its ability to collaborate across departments [25]. Overall organizational flexibility is required in today's business environment to respond to uncertain environment[26].

1.2. Leadership

Leadership is the capacity to affect others regarding similar goals [2]. Good leadership has positive impact on project success, while negative leadership has negative impact on project success [27]. Leadership styles such as transformational, transactional, and democratic leadership are related to team effectiveness [28]. Transformational leaders can ignite the enthusiasm and creativity of the team. Transactional leaders are beneficial, as they can effectively, during crises, execute previously constructed planned strategies and get the job done on a day-to-day basis, while being unable to be

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beneficial with regard to innovation [41]. Resilient leaders can create honest, achievable goals and act as an inspirational guide to the team during times of challenge [30].

The type and level of adaptability of resilient leadership can influence both the culture of the organization and the resilience of the project environment [31]. Creative, adaptable, and resilient leaders are needed not only to remain competitive, but also to be able to be innovative in both fast-moving and VUCA (Volatility, Uncertainty, Complexity, Ambiguity) global environments [32]. Resilient leadership helps develop and structure the organizational culture consistent with the organization. All these areas will impact upon project success both directly and indirectly. Between and outside of teams and organisations, project leadership can enhance resilient project results for the long term [31].

1.3. Theoretical Framework

1.3.1. Organisational Structure Theories

The classical and neoclassical theories explain about organisations. In general,[33] classical theorists characterised organisations as mechanical systems, whereby they believed organisations are mechanistic systems that apply hierarchy and formalisation to the extent that they can demonstrate they are efficient. Neoclassical theory focuses on interpersonal behaviour through a historical perspective; classical theorists then explain mechanistic structures as a basis for organic structures which favour these behaviours which allegedly allow stakeholders to respond adaptively to the conditions [16]; [34]. Organic structures include fostering behaviours such as freedom, teamwork and creativity. Mechanistic structures reflected behaviours such as formalisation, standardisation, centralisation and rigid hierarchy [35]; [23]. A Mechanistic organisational structure works best in defined and stable environments, whilst an organic organisational structure works best in ambiguous and dynamic environments. For the Ethiopian construction projects, the organisation will not only demonstrate resilience from their adoption of the mechanistic and organic forms of structure by stage, but they are also operating within the particular environment, making them aware of their agency.

Contingency theory was developed (by Fred Edward) in 1964 and explores the relationship between structure and environment in terms of organisational effectiveness [36]. Since construction companies are expected to alter their structures to manage and work effectively in environments of VUCA [37], their structures will evolve, and hence, it also endorses the notion that resilience and project success in Ethiopia are related to structures that are environmentally friendly.

1.3.2. Leadership Theories

As per the 'Great Man' theory, leaders are born leaders with inherent leadership qualities that have fallen by the wayside in favour of the behavioural and contingency leadership theories that encapsulate the learnt skills and effectiveness and individual or group context [38]; [39]. Behavioural theories are the theory that leadership is dependent on strategies, not traits [40].Situational and contingency theories assume that the effectiveness of leadership is context-driven but do not address such organisational processes as the interactional or collective types [41].

Transformational leadership involves motivating and challenging followers in a dynamic set of circumstances; transactional leadership is hierarchical and predictable with rules of method and order in a stable environment [41]. Inclusive leadership affords better collaboration and an impetus for knowledge sharing, which is essential for dealing with complexity in contexts like the construction industry and resilience [41]. In summary, this study interrogates how adaptive leadership behaviours mediate organisational structures to build resilience and improve project performance in the construction industry in Ethiopia. The integrated theoretical framework adds to the rigour of the study.

2. Conceptual framework

This conceptual framework looks at the role of resilient organisational structures and leadership in improving performance in construction projects in Ethiopia through theory and empirical evidence. Figure 1 shows a conceptual framework that illustrates how resilient organizational structure and leadership affect project performance in Ethiopian construction projects.The framework was developed by reviewing previous literature on organizational resilience, leadership, and project success in construction management (e.g.,[4]; [8]). Construct validity and relevance to the context of Ethiopia were ensured by adapting measurement items that had been drawn from their original scales.

The framework posits that resilient organisational structures and project leadership contribute to project performance individually and in combination. Specifically, H1) Project resilience positively contributes to project success; H2) project leadership positively contributes to resilience; and H3) flexible organisational structures positively contribute to resilience. Based on contingency theories , resilience theories and adaptability in leadership, the framework provides an opportunity to engage with uncertainty meaningfully [8], while flexible structures improve the potential for timely decision making [4]. Resilience therefore mediates the effect of leadership and structure on success.

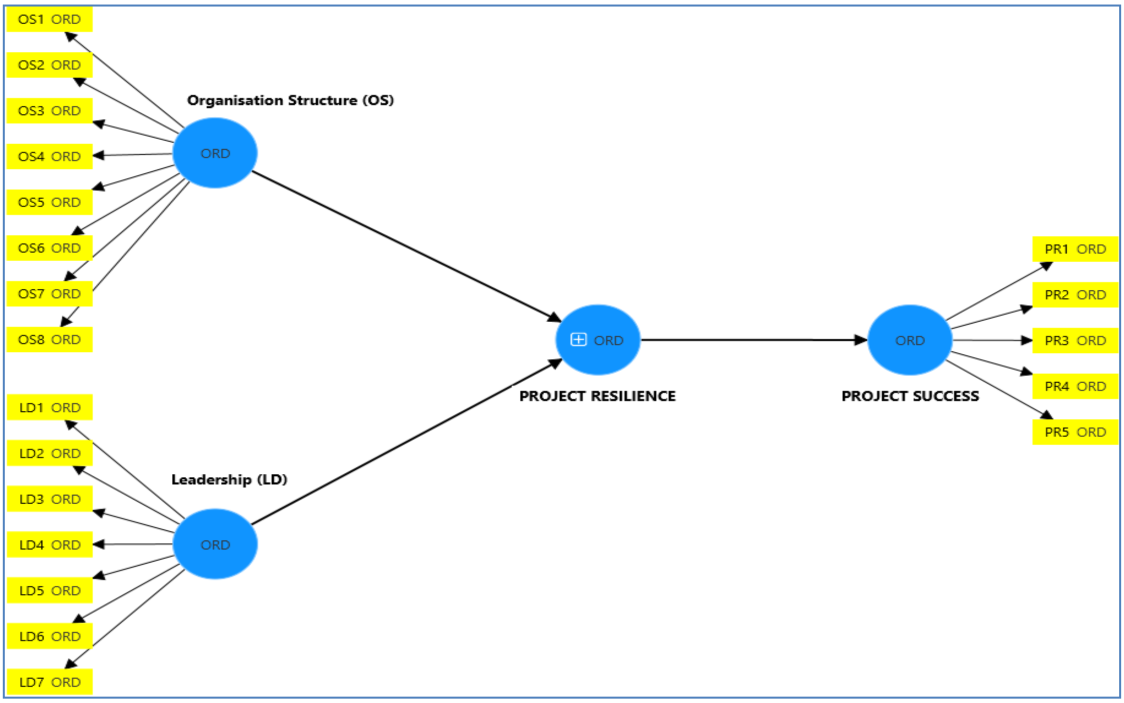

Figure 1. Conceptual research model

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LEADERSHIP		
No.	**Description**	**Code**
1	The leader has flexibility during management decision.	LD 1
2	The project leader is learning from his subordinates.	LD 2
3	The leader is willing to share his/her knowledge to his subordinates.	LD 3
4	The leader is sharing part of his responsibility to team members.	LD 4
5	The leader has high level of self-confidence on his knowledge, instruction and management decision.	LD 5
6	The project leader takes risks during management decisions.	LD 6
7	The team members are empowered by the team leader.	LD 7
ORGANISATIONAL STRUCTURE		
1	Team members manage one project activity only.	OS 1
2	Teams can establish their own reward and incentive systems.	OS 2
3	Job rotation enhances employee versatility.	OS 3
4	Leaders supervise a limited number of subordinates.	OS 4
5	Leaders have direct reports.	OS 5
6	Teams participate in decision-making processes.	OS 6
7	Fewer standard operating procedures are used for monitoring.	OS 7
8	Employees respond quickly to changing circumstances without waiting for procedures.	OS-8
PROJECT SUCCESS FACTORS		
No.	**Description**	**Code**
1	Quality	PR 1
2	Cost	PR 2
3	Time	PR 3
4	Safety	PR 4
5	Satisfaction	PR 5

Table 1. Indicators code

In the table 1, all the specific measurement items (indicators) utilized to measure the main constructs of the study are listed.

Leadership: Measured based on seven indicatos (LD1-LD7). The indicators discussed the leadership style (flexibility), willingness to learn, share knowledge, delegation, self-confidence, risk-taking capabilities, and empowerment of team members.

Organizational Structure: Measured to cover eight items (OS1-OS8). The items discussed project assignment, reward systems, job rotation, supervisory structure, team participation in decisions, procedures in regards to flexibility, fewer standards procedures and adaptability to change.

Project Success Factors: measured with five indicators (PR1-PR5) quality, cost, time, safety, and stakeholder satisfaction.

Each code (e.g., LD1/OS3/PR2, etc.) outlined a specific item that was used to collect data for the analysis of the research model.

Table 1 presents the indicators that operationalize the constructs. For example, constructs such as adaptive leadership [7], and resilient organisational structure [3] were used to measure these concepts

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on a 4-point Likert scale. The proposed hypotheses will be tested using structural equation modelling to understand whether, and to what extent, the theoretical relationships hold and to explain project success.

3. Methodology

The following chapter details research methods for investigating the impact of organizational structure and leadership on resilient construction projects within Ethiopia including the sample procedures, data collection processes, ethical considerations, and advanced statistical analyses used to provide good and comprehensive results.

3.1. Pretesting

This study evaluated the impact of organisational structure and leadership on resilient construction projects in Ethiopia. In order to ensure reliability, nine construction management experts pretested the structured questionnaires. Cronbach's alpha = 0.96 shows internal consistency above the generally accepted value of some acceptable threshold of 0.7.

3.2. Sample, population and data preprocessing

Stratified random sampling ensured proportional representation of each contractor, consultant and government representative participant .It was assumed that the three participants have equal roles in success of projects in the Ethiopian construction industry. Google Forms required participants to give a full response, which reduced the loss of missing rates. The survey identified the organisational structure, leadership styles and project performance using closed-ended questions with a four-point Likert scale rating questions (responses were recorded applying 1=strongly disagree to 4=strongly agree). The rationale for using a four-point Likert scale was to avoid neutral midpoint bias and encourage decisive responses. The leadership questions focused on flexibility, knowledge shared, empowerment, and readiness to take risks etc. The organisational structure focused on specialisation, autonomy, flexibility, supervision, and decision-making etc. Table 1 has the specifics.

The distribution statistics revealed low standard deviations and close means and medians, indicating the distribution was not skewed towards any direction, as substantiated by the low standard deviation.Using Z-scores (cut off ±3.29) in outlier detection revealed 1 abnormal response. Aburumman et al. [42] assessed the normality of the variables using skewness and kurtosis (normal conditions; all Z values fell within ±1). The Cramér-von Mises tests indicated deviations from normality ($p < 0.05$); this is a limitation often found in social science research [43].

3.3. Data collection and ethical considerations

Informed consent ensured that participants understood what the study was about and had the ability to withdraw at any time. The data was anonymised and password protected to maintain confidentiality. The University of South Africa was contacted to obtain ethical clearance. Participation was voluntary and not compensated to avoid any effect on participants within the response data. The data collection

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involved emailing a link for participation to professional networks with online survey links and sending reminders in effort to enhance participation. A Questionnaire was distributed to 203 participants. The number of responses collected exceeded the total anticipated size of 155 by sampling 192 construction professionals from various consulting firms, construction companies and government agencies.

The response rate was approximately 94,6%, with 192 responding and 11 participants declining. But the total responding participants are above the minimum sample size of 156. Data collection was conducted over a period from March to May 2024, enabling adequate time for follow-up and maximizing participation.

3.4. Statistics

Smart PLS 4.0 was used in sequence to address complexities in the data and heterogeneity by combining PLS-SEM, FIMIX-PLS & PLS-POS statistical analyses. First, PLS-SEM is used to evaluate the measurement model as well as the structural model for complex models with few samples [44]. The assumption of data homogeneity with PLS-SEM(Partial least square-structural equation modelling) is often unjustifiable when working to evaluate data sets [45].In the second phase of analytics, structural model analysis was conducted using FIMIX-PLS(finite mixture partial least squares) to segment a heterogeneous data set for the purposes of structural model analysis to account for unobserved heterogeneity in the data set [46]. In the third phase, accepting the limitation of FIMIX-PLS, here the PLS-POS(Partial least square-prediction- oriented segmentation) method was used to analyse the measurement model and structural model simultaneously while considering latent variable heterogeneity [47]. In the last step, an EX-Post analysis will be conducted to identify and understand the segments in terms of observable variables[29].The researcher used available datasets to deal with complexities and variation in terms of data sets yielding a more robust overall finding.

4. Results

In this chapter, the sophisticated statistical procedures—PLS-SEM to quantify overall relationships and validity, FIMIX-PLS to discover unobserved heterogeneity and identify latent respondent segments, PLS-POS to study heterogeneity in those groups, and ex-post analysis to examine demographic variables, such as resilience awareness, experience, and education level to contextualize the segmentation results, impacts to the results—have been employed, which provide insights into the many determinants of project resilience and success in the construction industry in Ethiopia.

4.1. PLS-SEM Analysis Results

At the initial analytical stage of the research study, PLS-SEM was used because it is appropriate for modelling complex constructs, a small sample size, and non-normal distribution of data [48]. The data consisted of reflective constructs measured on a four-point Likert scale, which justified the use of PLS-SEM given its robustness to non-normality and suitability for exploratory research. This was the appropriate method of analysis for the exploratory nature of the study and the complexities of the constructs' relationships within Ethiopian construction. The measurement model was evaluated before testing the structural model to assess hypothesised construct relationships.

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A. Evaluation of Measurement Models

Evaluations of measurement models were relatively straightforward, focusing on evaluating outer loadings, reliability and validity. Item reliability was established by relying on outer loadings and reporting a threshold of 0.70 as appropriate to retain items in the measurement model [48]. To improve construct validity and measurement precision more generally, in the case of outer loadings below the 0.70 threshold, they were deleted. This practice complies with suggested procedures to improve model rigour; however, it has the disadvantage of eliminating indicators that might be relevant to this specific context and limiting the conceptual space of the model. The resulting refined model shown in Figure 2 shows how there was a deliberation between validity and model rigour and theoretical richness and breadth or depth. Future research could show the nuances within the industry by not relying only on quantitative data but also on qualitative methods that could unveil details impossible to obtain with a quantitative method.

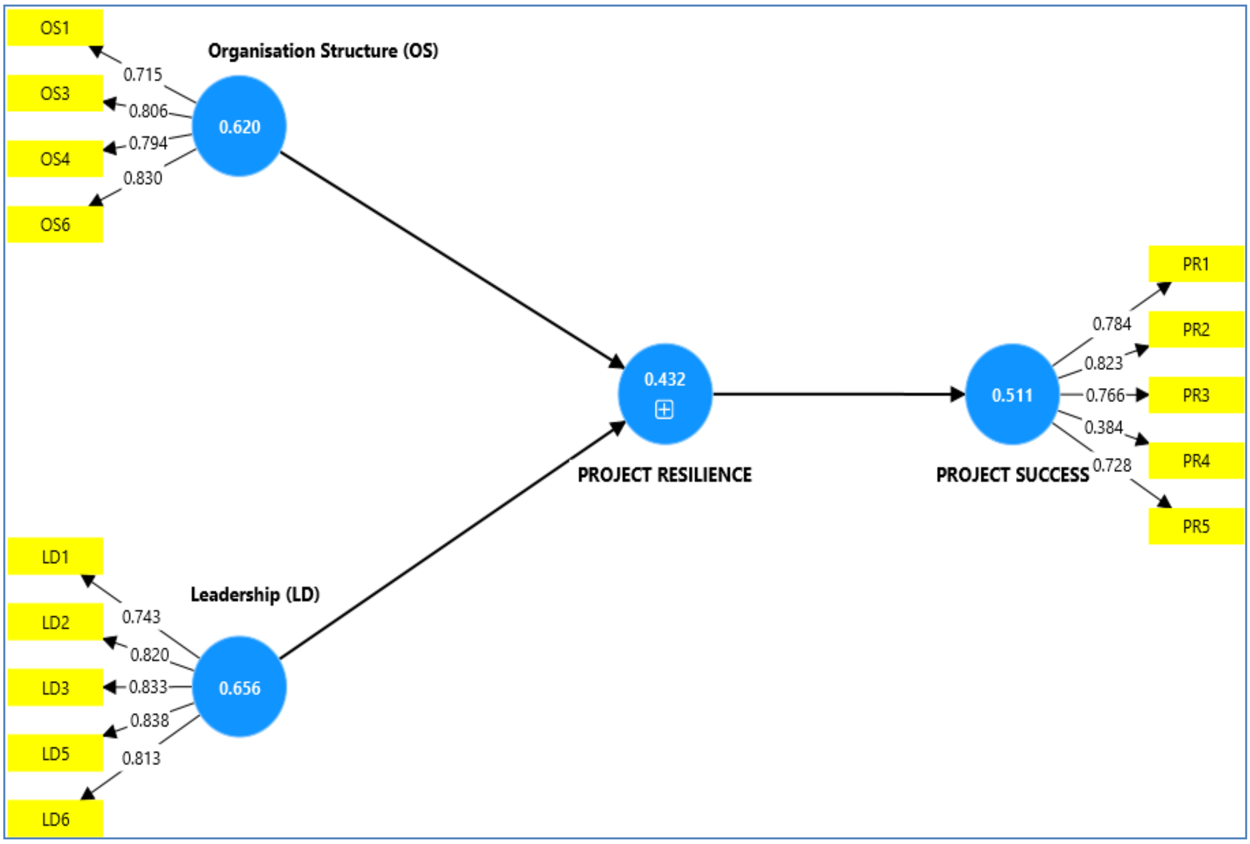

Figure 2.Outer loadings

Reflective measures require consideration of reliability and validity, as well as convergent (or construct) and discriminant validity [49]. Matthews et al. [48] specified three types of reliability that have to be taken into account after reliability, or internal consistency, is determined to be sufficient; convergent validity and discriminant validity constitute the necessary reliability estimates. All constructs were above 0.70 for both Cronbach's alpha and composite reliability (Table 2).

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	Cronbach's alpha	Composite reliability (rho_a)	Composite reliability (rho_c)	Average variance extracted (AVE)
Leadership (LD)	0.868	0.868	0.905	0.656
Organisation Structure (OS)	0.794	0.796	0.867	0.620
PROJECT SUCCESS	0.761	0.800	0.832	0.511

Table 2. Reliability statistics

In relation to convergent validity, all constructs achieved an Average Variance Extracted (AVE) greater than 0.5 (Table 2). The measures for discriminant validity were gauged using the Fornell-Larcker criterion and the HTMT ratio - PLS-SEM guidelines recommended this [50]. Fornell-Larcker states the square root of AVE must be higher than the inter-construct correlations [51], while HTMT Values lower than 0.90 indicates the measures are valid [51]. All HTMT values confirm that the models are distinct from each other (Tables 3 & 4).

	Leadership (LD)	Organisation Structure (OS)	PROJECT RESILIENCE	PROJECT SUCCESS
Leadership (LD)				
Organisation Structure (OS)	0.674			
PROJECT SUCCESS	0.682	0.355	0.628	

Table 3. HTMT

	Leadership (LD)	Organisation Structure (OS)	PROJECT RESILIENCE	PROJECT SUCCESS
Leadership (LD)	0.810			
Organisation Structure (OS)	0.560	0.788		
PROJECT SUCCESS	0.602	0.293	0.539	0.715

Table 4.Fornel-larcker criterion

Tables 3 and 4 provide a complete overview of discriminant validity through the HTMT and Fornell-Larcker criteria, respectively, indicating these constructs are distinct and valid for analysis.

VIF values

Variance Inflation Factor (VIF) values were used to assess multicollinearity among independent variables, with all values well below the threshold of 5, confirming no serious collinearity issues [52] (see Table 5). Leadership VIFs were 1.587–2.437, organisational structure VIFs were 1.224–1.845, and for success factors, VIFs were 1.143–2.111, which were all below 5 as a guideline of lack of serious collinearity (see Table 5) and this indicates model validity.

Leadership	VIF	Organisational Structure	VIF	Success factors	VIF
LD1	1.587	OS1	1.361	PR1	1.98
LD1	1.63	OS1	1.349	PR2	2.111
LD2	1.821	OS3	1.716	PR3	1.938
LD2	2.013	OS3	1.656	PR4	1.143
LD3	2.214	OS4	1.643	PR5	1.932
LD5	2.437	OS4	1.646		
LD6	2.046	OS5	1.224		
LD6	1.671	OS6	1.845		

Table 5.VIF values

B. Structural model evaluation

The structural model was assessed based on path coefficients and R^2 values using the PLS-SEM model evaluation recommended by [53]. The significant relationships ($p < 0.05$) can be seen in Table 6. Resilient leadership is taking a positive effect on project resilience, confirming that leadership has an important role in organisational resilience [31]. The effect of the organisational structure echoes the work of Coban et al. [54], who argue for structural flexibility for projects to adapt. These findings provide empirical evidence in the Ethiopian context.

	Original sample (O)	*Sample mean (M)*	*Standard deviation (STDEV)*	*T statistics (|O/STDEV|)*	*P values*
Leadership (LD) -> PROJECT RESILIENCE	0.681	0.684	0.046	14.755	0
Organisation Structure (OS) -> PROJECT Resilience	0.402	0.397	0.046	8.726	0
Project resilience -> Project success	0.543	0.554	0.055	9.845	0

Table 6. Path Coefficients

C.PLS path model and hypothesis testing

Hypothesis testing showed that resilient leadership (path coefficient = 0.630, t = 10.567, p = 0) and resilient organizational structure (path coefficient = 0.461, t = 7.666, p = 0) are significant influences on project resilience. The confidence intervals determined from the data do not include zero (t>1.96): thus, both confirmed significance at 95%. These findings confirmed previously researched studies that showed leadership and structure are clear drivers of resilience [55]; [31]; it also solidified the

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importance of leadership and structure in project management theory and practice but also contributed to knowledge by validating these relationships in the context of the Ethiopian construction industry, where prior empirical evidence was limited.

Hypothesis	**Path coefficient**	**T-statistics**	**P-Values**			**Hypothesis supported?**
				2.5%	**97.5%**	
Hypothesis H1: Resilient leadership behaviour has a positive impact on project resilience.	**0.681**	**14.755**	**0**	**0.797**	**0.778**	**Yes**
Hypothesis H2: Resilient organisational structure has significant impact on project resilience.	**0.402**	**8.726**	**0**	**0.300**	**0.483**	**Yes**

Table 7.Hypothesis testing

D. Coefficient of determination (R^2)

The R^2 values demonstrate the explanatory power of the model. Project resilience has a strong R^2 of 0.918 (high explanatory power), suggesting a complete/potentially completed capture of the determinants, while project success has a moderate R^2 of 0.295 (some explanatory power), indicating that some of the factors were captured, while others were not. These results stress the importance of leadership and organisational structure for resilience and echo studies that considered R^2 values in excess of 0.25 to be substantive [56].

	R-square	**R-square adjusted**
PROJECT RESILIENCE	0.918	0.917
PROJECT SUCCESS	0.295	0.291

Table 8:R2 values

E. Model *fit* assessment

The model fit, assessed by SRMR, was 0.122, marginally higher than the 0.11 cut-off; however, it was nonetheless reasonable for exploratory PLS-SEM in regard to complex models and moderate samples [55]. While the fitted saturated and the fitted estimated models fit comparably, the robustness checks confirmed our estimates were stable and reliable.

	Saturated model	**Estimated model**
SRMR	0.121	0.122
d_ULS	3.761	4.003
d_G	n/a	n/a
Chi-square	∞	∞
NFI	n/a	n/a

Table 9.Model fit

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To summarize, the evaluations of the measurement and structural models indicate that the PLS-SEM model for project resilience has construct reliability and construct validity, and as such is a means by which to explore unobserved heterogeneity. The measurement model findings also support the proposition that leadership and organizational structure are valid constructs that influence both project resilience and project success.

The next subsection utilizes the FIMIX-PLS technique in an effort to further explore latent heterogeneity in the data. The analysis is thus able to identify and interpret discrete segments of respondents and provides a deeper understanding of all unobserved effects and patterns of groups.

4.2. FIMIX-PLS analysis result

FIMIX-PLS is a latent class model that outlines unobserved heterogeneity in PLS path modelling. FIMIX-PLS assessments are composed of class-model mixture regressions offering within-class parameters and probabilities of group membership, which preserve the structural model validity of the class model with latent segments and segment-specific effects in lieu of observed moderators [48]. Researchers do have more advanced examples of latent class methods, including finite mixture modelling, but FIMIX-PLS remains one of the most approachable and widely applied methods for assessing unobserved heterogeneity and building better models [57].

Analysis considered 192 valid responses comprised of reflectively measured constructs. The characteristics of independence (responses are independently drawn) and adequacy of the sample size for conducting latent class analysis were all considered adequately met. The bigger problem is determining the number of segments to uncover [58]. FIMIX-PLS attempts to determine them may never be resolved, as it involves running repeated runs of the FIMIX-PLS algorithm and comparing the models statistically and in practical and interpretive senses.

4.2.1. Number of Segments

Segmentation is about identifying one or more groups of a population that are internally homogeneous and externally heterogeneous with respect to the characteristics or response of interest to provide better targeting, strategies, and actions [29]. Using G*POWER evaluation (Figure 4) that aimed to ensure that the respondent sample size corresponds adequately with each segment size, using a 2-tailed t-test (α=0.05; power=0.8; effect size=0.20; 7 predictors) indicated that each segment should contain a minimum number of 54. The number of acceptable segments equalled that of the total response's sampled (i.e., 192/54 ≈ 3.6); thus, following best practice research protocol, the authors predetermined to use 4 segments and not risk the inclusion of segments of low respondent number, which dilutes reasonable interpretation and research efforts [48]. Figure 4. GPOWER Analysis provides the sample size calculation and the identification of appropriate segmentation and graphically demonstrates the adequacy of the distribution of respondents across segments.

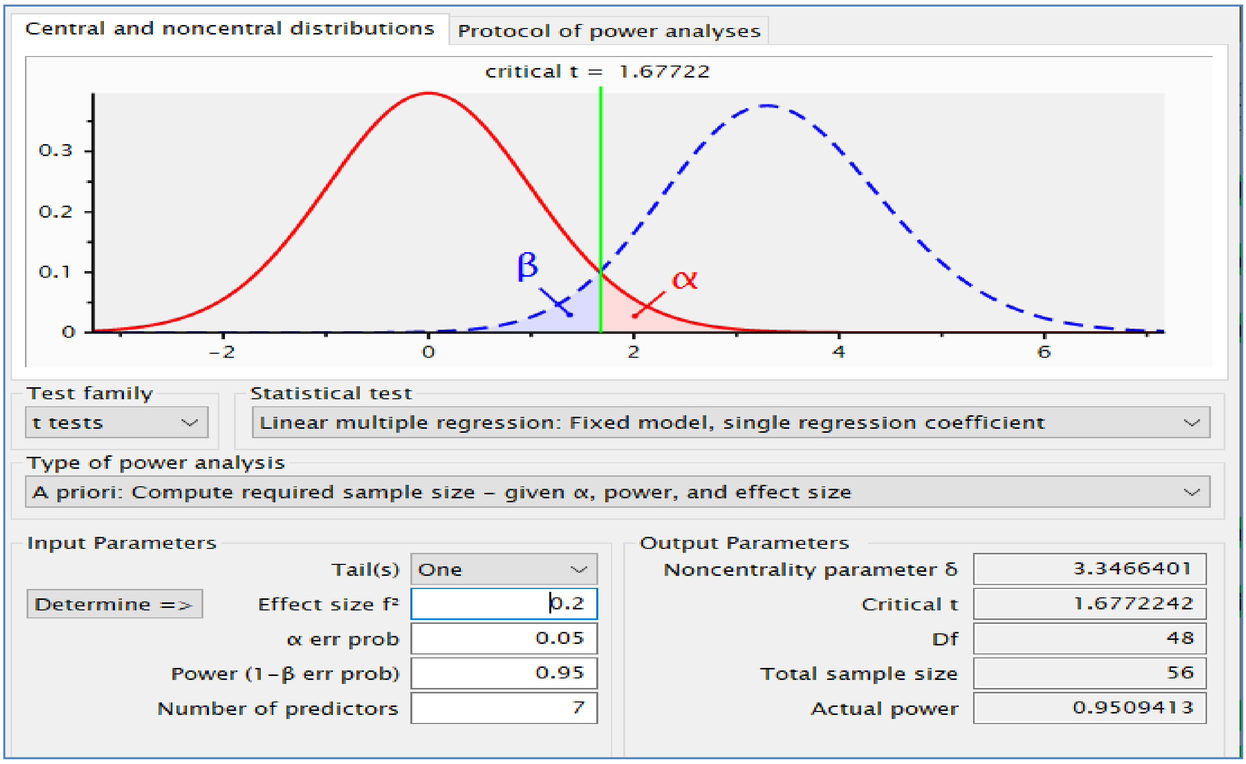

*Figure 4. G*POWER Analysis*

4.2.2. Segment identification

Based on the number of segments being determined from the G-Power analysis, here is, below, shown in table 10, the 4-segments analysis using Smart PLS-4. Table 10 presents a summary of the main model selection criteria (AIC, BIC, etc.), by segment, which can be used to identify the best-fitting segment model where a table format has been standardized for clarity. The segments (1, 2, 3, and 4) in FIMIX-PLS are classified as latent (unobserved) groups derived from the total data, indicating underlying heterogeneity in the sample. FIMIX-PLS segments are latent groups based on model fit overall.

Metric	Segment 1	Segment 2	Segment 3	Segment 4
AIC (Akaike's information criterion)	527.765	498.974	488.779	**450.396**
AIC3 (modified AIC with Factor 3)	532.765	509.974	505.779	**473.396**
AIC4 (modified AIC with Factor 4)	537.765	520.974	522.779	**496.396**
BIC (Bayesian information criterion)	544.052	534.806	544.157	**525.318**
CAIC (consistent AIC)	549.052	545.806	561.157	**548.318**
HQ (Hannan-Quinn criterion)	534.361	513.486	511.207	**480.74**
MDL5 (minimum description length with factor 5)	**649.202**	766.136	901.666	1009.008
LnL (Log likelihood)	-258.882	-238.487	-227.39	-202.158
EN (normed entropy statistic)	0	0.4	0.486	**0.622**
NFI (non-fuzzy index)	0	0.451	0.471	**0.583**
NEC (normalized entropy criterion)	0	115.286	98.644	72.492

Table 10. Segment analysis

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Based on the four segments delineated by FIMIX-PLS analyses, Segment 4 appeared to best fit the model based on the lowest AIC score of 450.396 shown in Table 10. Assessment of the fit of the models was assessed by the AIC, BIC and MDL in accordance with relevant standards in the literature [48].The lower the values for both AIC and BIC, the better the fit [59], meaning Segment 4 provides the best fit, balancing parsimony and explanatory power of the data of respondents, even though the increasing MDL indicates over fitting; of the four segments, Segment 4 provided the best log-likelihood of −202.198. Reliable metrics (EN = 0.622 and NFI) demonstrating the strength of the segment were clear for Segment 4. Notwithstanding that some of the segments did not adhere to the normalised entropy criterion regarding that the segments were mismatched in size, consideration of the goodness-of-fit favoured Segment 4; and, as the segments were defined non-deterministically observably meaningful, such unobserved heterogeneity was also present with the previous studies [60]. FIMIX-PLS accounts for the heterogeneity of reflective constructs but limits the account of formative constructs [61]. Therefore, PLS-POS was recommended to consider more distributed analysis, most often used after to develop the number of segments for analysis [61] and included best practice, highlighting something clear about the heterogeneity behind the latent.

Building on the FIMIX-PLS findings, the next subsection employs PLS-POS to explore additional forms of heterogeneity across both the measurement and structural models.The outcomes from this approach to segmentation allow for a more general understanding of the relationships among leadership, organizational structure, and project resilience. Overall it is based on the constructs relationship differences.

4.3. Analysis of PLS-POS

PLS-POS accommodates for heterogeneity associated with both the measurement model and the structured model and goes beyond FIMIX-PLS limitations regarding forms of measurement ([60]; [62]. PLS-POS complements the analyses of FIMIX-PLS segment-specific properties, including R^2 and path coefficients [61]. PLS-POS is applicable for any PLS model that has been used in provided robust segmentation and methods of comparison. This was also the case for using PLS-POS in this study of the 192 validated responses. This also confirmed other assumptions, including linearity and non-dependence from segments. PLS-POS should be considered as a next segment analysis approach because of its robustness towards non-normal data and analyses [62] .

4.3.1. Path Coefficients and Coefficient of Determination (R^2)

The heterogeneous model with respect to path coefficients assumes the existence of some defining linear links depicting leadership, organisational structure, and resilience correlations. The purpose of multi-segmentation was to provide evidence for distinct and significant heterogeneity in the conclusions for segmenting respondents who are 'uniquely' different, suggesting that project management strategies are against some generalised 'one-size-fits-all' logic [48] and further suggesting the importance of exploring the segments in terms of least winning contestant success [60]. Table 11 provides the path coefficients for each segment, and does so along with a brief summary provided for practical interpretation. The segments 1, 2, 3 and 4 in PLS-POS are explicitly derived from analyzing the

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relationships within the specific segments - they are subgroups identified on the basis of differences in path coefficients, and are context dependent.

Relationships	Original path coefficients (PLS-SEM)	PLS-POS Segment 1	PLS-POS Segment 2	PLS-POS Segment 3	PLS-POS Segment 4
Leadership (LD) -> PROJECT RESILIENCE	**0.681**	**1.025**	**0.784**	0.495	0.447
Organisation Structure (OS) -> PROJECT RESILIENCE	0.402	-0.113	0.286	**0.603**	**0.615**
PROJECT RESILIENCE -> PROJECT SUCCESS	0.543	0.71	**0.905**	-0.789	**0.939**

Table 11. Path coefficients of PLS-POS model

	Group1	Group2	Group3	Group4
%	20.31	40.104	22.396	17.188

Table 12. Segment sizes

Each segment is now explicitly defined for the purposes of practical application. For instance, Segment 1 has strong leadership effects noted, while Segment 4 places most of the emphasis on OSP's organizational structure to achieve project success. Therefore, each segment can be used to help practitioners determine which strategies might be most robust for the various organizational contexts.

The PLS-POS analysis indicates detailed indications of project resilience through the four segments. The PLS-SEM model reveals that the relationships were moderate to strong in most areas: leadership (LD) to project resilience (PR) β = 0.681; organizational structure (OS) to PR β = 0.402; PR to project success β = 0.543; therefore supporting the conceptual framework of figure 1. Table 7 indicates that Segment 1 (20.31%) shows leadership has a strong positive influence on resilience (β=1.025), while organisational structure had a negative influence (β=-0.113). The resilience to success path is positive (β=0.71), indicating the important role of leadership in creating success; when the organisation had flexible structures and leadership behaviours, these strategies appeared to matter [8].Segment 2 (40.1%) shows leadership effect (β = 0.784), although smaller; structure positively affects resilience (β = 0.286); and clearly resilience to success (β = 0.905) leads to the conclusion that a balance between each of these two otherwise very different concepts produces an incremental improvement in final outputs [4]. Segment 3 (22.40%) showed that organizational structure was the primary influence of resilience (β = 0.603) while leadership will support resilience (β = 0.495); and there is a negative pathway between resilience and success (β = -0.789). Segment 4 (17.19%) expectedly found that organizational structure was able to predict future success in greater influence (β = 0.615) than LD (β = 0.447), with also the strongest

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relation yet for resilience-success pathway (β = 0.939). This provides support for the view that structural flexibility should be the first consideration in achieving project success [24]. However, all segments of leadership and organizational structure influence of project resilience and project success, which could differ due to the variations of contexts. The author recommends these contextual management strategies to specifically consider the highlight of subgroups for action within the construction sector in Ethiopia. Table 13 provides the segments with their R^2 values, and a brief discussion should help to clarify the practical or actionable use of each segment.

	R^2 Values					
	Original sample (PLS-SEM)	**Weighted average R^2**	**Segment 1**	**Segment 2**	**Segment 3**	**Segment 4**
PROJECT RESILIENCE	0.918	0.961	0.952	**0.981**	0.937	0.958
PROJECT SUCCESS	0.295	0.722	0.504	0.819	0.623	**0.882**

Table 13. R^2 values

Segmented R^2, shown in Table 13, is greater than the overall model, suggesting that the four-segment solution is more explainable and more predictive (see [62]). This finding emphasizes the relevance of segmentation, as it becomes clear that segmentation can assist in identifying latent patterns and provide insights that afford more prescribed indications for follow-up targeting the construction industry. These results suggest segmentation has identified real variability in terms of heterogeneity that drives model fit. Leadership is the most significant factor contributing to project resilience for Segments 1 and 2, and Segment 1 particularly has the most effect. Organisational structure is significant for Segments 3 and 4, but less so for Segment 4, where success in the project is particularly related to resilience. The results highlight the importance of adaptability in both Organisational structure and leadership, in respect to the needs of each segment.

The following subsection provides an ex-post analysis of the segments contextualizing the previous sections' segments using demographic variables such as resilience awareness, type of experience and education levels. The findings illustrate how each of these demographic variables can affect the effectiveness of leadership and organizational structures in promoting and influencing both project resilience and project success.

4.4. Ex-post Analysis

Ex-post analysis utilizes demographic variables like resilience awareness, skill, and educational attainment to characterize segments identified by PLS-POS. This is helpful to elucidate the identification of the segments and bridge the gap between statistical findings and meaningful groups [48]; [60]. The demographic variables of awareness of resilience, implementation experience and education provided the evidence discussion surrounding the statistical validity and practicality of each segment, which can assist with actionable implications for practitioners looking for guidance in project management [63].

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Segments	**Number of responses**	**Coming from PLS-POS group**	**Revised segments description**
1	39	PLS-POS Group 1	Had awareness on resilience
2	77	PLS-POS Group 2	Implemented resilience concept
3	43	PLS-POS Group 3	MSC and PHD holders
4	33	PLS-POS Group 4	BSC degree holders

Table 14 . Segments relationship

Table 14 summarizes the segment profiles by common demographic properties based on prominent variables, to assist practitioners in undertaking interventions targeting certain characteristics relatable to groups.

Table 15 shows the PLS-POS or PLS pathway analysis, of the explanatory variables in Table 14, which provides at least a case for how awareness of resilience and resilience experience and education have an influence on perceptions of leadership resilience and project resilience. Awareness of the resilience concepts creates a larger leadership to resilience path coefficient (β=0.777) with perceived leadership effectiveness behind it. Also, with a significant resilience to success path coefficient (β=0.553), this cohort has great faith in the successes of resilient projects.

Resilience experience is a form of development moderating relationships with a leadership to resilience path coefficient (β=0.771) and a resilience to success path coefficient (β=0.574), suggesting an important role of experience and/or practical knowledge. The gradation of level of education (MSc and PhD) within their data, on the same leadership to resilience and resilience to success path correlations (β=0.771 and β=0.574), led towards some engagement and more meaningful understandings of the resilience concepts. BSc holders reported lower path coefficients (leadership→resilience β=0.594; organisational structure→resilience β=0.477), from which we can assume they may have limited training to frame the variation in the resilience domain's development level when compared to the more postgraduate experienced individuals. Table 15 provides the path coefficients results for each group and demonstrates the varying degrees of influence from leadership and organizational structure on resilience and success by demographic segmentation. This response allows for some practical interpretation and recommendations.

These findings seem to reinforce the literature associating awareness, experience and education with resilience [64]. The variation of educational positions and awareness and experience with resilience moderated their development initiatives. This ex-post analysis provided the opportunity for the classification of statistical segments with situational characteristics in relation to development levels among the domains of the model, therefore expanding the pragmatism of the model for research applications and specifying the appropriate course of action [60] .

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Relation ship	Complete model(PLS-SEM)	Having awareness on resilience	Implemented resilience concept	MSC and PHD holders	Education BSC holders
	Path coefficients	Path coefficients	Path coefficients	Path coefficients	Path coefficients
Leadership (LD) -> PROJECT RESILIENCE	0.681	0.777	0.771	0.771	0.594
Organisation Structure (OS) -> PROJECT RESILIENCE	0.402	0.307	0.288	0.288	0.447
PROJECT RESILIENCE -> PROJECT SUCCESS	0.543	0.553	0.574	0.574	0.571

Table 15 . Path coefficients for explanatory variables

All are with significant level of $P<0.05$.

The strong and consistent p-values across groups indicate that these relationships are unlikely to be due to chance and that the model is valid. Table 16 displays the project resilience and project success R^2 and adjusted R^2 values examined in the different subgroups; resilience concept aware, resilience concept users, and educational attainment. Project resilience has demonstrated strong explanatory power (R^2: 0.918–0.933; adjusted R^2: 0.917–0.93). This shows that both leadership and organisational structure account for nearly all variability in project resilience. Project success, however, has demonstrated moderate explanatory power (R^2: 0.295–0.33; adjusted R^2: 0.291–0.317). This small change in R^2 for project success for project resilience concept users highlights the impact and value of an education/training component. Lastly, Table 17 reports the measurement model and shows stable outer loadings. Team participation and collective confidence in leadership were also summed up as very important aspects of effective management.

	Complete model(PLS-SEM)		Having awareness on resilience		implemented resilience concept		MSc and PhD holders		Education BSC holders	
	R^2	R^2-adjusted	R^2	R^2-adjusted	R^2	R^2-adjusted	R^2	R^2-adjusted	R^2	R^2-adjusted
PROJECT RESILIENCE	0.918	0.917	0.922	0.92	0.933	0.93	0.921	0.92	0.919	0.917
PROJECT SUCCESS	0.295	0.291	0.306	0.299	0.33	0.316	0.294	0.287	0.326	0.317

Table 16 . R^2 and R^2 adjusted

The R^2 values show that taxpayer segmentation by demographic variables increased model explanatory power, and the capacity to design interventions that can be readily tailored to group structure.

The outer loadings data (Table 17) is useful for examining the strength of links between the indicators and constructs for different groups of respondents (the total sample, resilience awareness and

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application, and education level (MSc and PhD vs BSC)). These loadings indicate how well each indicator measures the given construct in the specific context. Table 17 provides a detailed summary of the outer loading values by group, follows the format established to enhance readability, and has been prefaced with a clear explanation of its value in practice.

In terms of the overall model, the strongest indicator of organisational structure is OS6—team participation in decision-making—with a loading of $\lambda = 0.851$. This underscores the important role played by inclusive decision-making in supporting resilient structures. Leadership is best represented by LD5, leader self-confidence in their decision-making ability, with a loading of $\lambda = 0.837$. Project success is best represented by PR2 (cost control), which is also indicated by a high loading of $\lambda = 0.822$. This indicates the importance of cost management as a way to project success.

Even amongst respondents that were aware of resilience concepts, the patterns remain the same: OS6 ($\lambda = 0.851$), LD5 ($\lambda = 0.837$), and PR2 ($\lambda = 0.822$) remain the dominant indicators, which suggests that awareness does not change the fundamental motivators of resilience and success. In terms of respondents that apply resilience concepts, OS6 remains the strongest indicator ($\lambda = 0.786$), but the leadership indicator changes from LD5 to LD2—learner from subordinates—with a much greater loading $\lambda = 0.865$. This shows the increasing importance of adaptive and participative leadership in resilient teams. Project success, prior to resilience applications, was represented best by PR1 (quality), $\lambda = 0.841$, which shows that quality also becomes an important goal when resilience practices are installed.

Amongst respondents with higher levels of education (MSc and PhD), OS3 (job rotation) becomes the biggest indicator of organisational structure ($\lambda = 0.858$), which suggests that professionals with advanced academic experience appreciate a dynamic work arrangement allowing for flexibility. In terms of leadership, the indicator LD6 works best ($\lambda = 0.813$), whilst project success is primarily linked back to cost control (PR2; $\lambda = 0.803$).

Amongst respondents with BSc degrees, OS6 was still the biggest indicator of organisational structure ($\lambda = 0.862$), with LD5 (leader self-confidence) leading once again as the biggest indicator of leadership ($\lambda = 0.872$). Project success remains linked back to cost (PR2; $\lambda = 0.854$), with perhaps more emphasis based on practical concerns.

Overall, OS6 is the highest ranked across all groups, which shows that team involvement in decision-making is a core assumption of resilient organisational structures and successful projects. The most prevalent factor of leadership is LD5 (leader self-confidence) across groups, particularly with greater educational attainment, suggesting that confident decision-making is important for effective leadership. In terms of project success indicators, cost control (PR2) is the most important indicator of success, which is indicative of the overarching importance of managing budgets in construction projects.

For further clarity, below the tables, I summarized the major findings for each of the segments in bullet points, reinforcing the practical considerations for practice:

- Having awareness and application of resilience concepts produces higher leadership-to-resilience path coefficients and perceived leadership effectiveness.
- Higher education levels (MSc/PhD) relate to a greater value of flexible job arrangements and restructured forms.

- BSC indicate greater importance of leader self-confidences with cost control as being fundamental to project success, reflective of practical, hands-on consideration.

Ex-post analyses provide significant detail regarding the segmentation finding from the PLS-POS analyses, and linking existing statistical differences to situational attributes such as awareness, experience, and education is useful for creating purposeful responses to identified groups. This covers both the theoretical contributions by linking latent heterogeneity to practical ways of enhancing resilience and success for Ethiopian projects and future work efforts that can be successful going forward.

	Complete model	**Having awareness on resilience**	**Implemented resilience concept**	**MSC and PHD holders**	**Education BSC holders**
	Outer loadings	**Outer loadings**	**Outer loadings**	**Outer loadings**	**Outer loadings**
LD1 <- Leadership (LD)	0.743	0.743	0.647	0.774	0.687
LD2 <- Leadership (LD)	0.821	0.821	**0.865**	0.811	0.841
LD3 <- Leadership (LD)	0.832	0.832	0.847	0.810	0.856
LD5 <- Leadership (LD)	**0.837**	**0.837**	0.848	0.812	**0.872**
LD6 <- Leadership (LD)	0.813	0.813	0.823	**0.813**	0.823
OS3<- Organisation Structure (OS)	0.845	0.845	0.778	**0.858**	0.817
OS4 <- Organisation Structure (OS)	0.824	0.824	0.697	0.834	0.816
OS6 <- Organisation Structure (OS)	**0.851**	**0.851**	**0.786**	0.840	**0.862**
PR1 <- PROJECT SUCCESS	0.785	0.785	**0.841**	0.796	0.767
PR2 <- PROJECT SUCCESS	**0.822**	**0.822**	0.609	**0.803**	**0.854**
PR3 <- PROJECT SUCCESS	0.764	0.764	0.832	0.738	0.805
PR4 <- PROJECT SUCCESS	0.384	0.384	0.757	0.465	0.243
PR5 <- PROJECT SUCCESS	0.729	0.729	0.808	0.771	0.644

Table 17. Outer loading values

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The following section provides an overview of the highlighted key findings from the analyses, relates them to the literature and practical implications for the construction industry, considers the limitations of the study, and provides focused recommendations for practice and policy.

Discussion

This new finding bolsters the necessity of leaders developing resilience by providing training and talking through constructing agile frameworks for the formation and development of resilience at the team level. Individual autonomy, active communication, transparency, trust, organizational climate, as well as creativity and risk-taking behaviours, will cultivate cultural resilience within the organization. Moreover, resiliency awareness, previous experience, and education level significantly influence resliency training approaches and efficacy levels, indicating the need for tailored educational programs.

This research aims to reinforce an idea examined in the literature that the variables of leadership and organizational structure are essential indicators of project performance in the construction industry; however, they have varying effects according to some characteristics within segments. Certainly, this segment level variability is in line with the more recent support in project management research for approaches that are contextualized and customized as opposed to approaches that are "one-size-fits-all"[48] ; [60]. This points to the idea that strategies such as the creation of customized strategies for each segment geared toward management and human resources should be developed. Additional evaluation of the project on an on-going basis and multi-stakeholder engagement may empower management decisions while providing stakeholder input to channel additional feedback mechanisms integrated with technology to support and enhance leadership and engagement. The ex-post analysis highlights that integrating continuous learning and stakeholder involvement, particularly in terms of segment-specific needs, will improve resilience outcomes.

This reinforces the calls in the literature for dynamic feedback processes and digital tools to facilitate organizational learning and adaptive project management [55].Policymakers ought to mainstream resilience initiatives into regulation, and create incentives for stepping into adaptive structures to realise resilient outcomes in the sector [65]. Leadership programmes should explicitly refer to how to build resilience and be delivered according to education level and organizational level. This is consistent with previous recommendations to institutionalize resilience as a fundamental competency in leadership development curricula [64].This research advances the theory by establishing segment-level specific effects on resilience capacity building, elaborating on new technical advances too like PLS-POS embedding FIMIX-PLS [60].

- The analysis of measurement, structure, and segmentation led to the following conclusions: Leadership Development should be customised; leadership programs should be aimed at groups that are aware of resilience for the best results.
- Organisational improvement focused on the structure: Changing the structure of the organisation might have bigger positive effects, especially on people with more education.
- Segment-specific strategies: The negative relationship between resilience and success in Segment 3 and the use of different approaches should help us figure out what this group needs. In particular, the insight of segment groups based on demographic and educational backgrounds can help understand ways that interventions can be tailored to cultivate resilience and project success.

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This study confirms some important relationships in the Ethiopian construction industry, but it has some problems, such as relying on quantitative data and having a small sample size, which could make the results less useful for other situations. In the future, researchers could use qualitative methods like interviews or case studies to figure out the complex ways that different groups of people are able to bounce back, especially when there are negative links between resilience and success.

Longitudinal studies are also suggested to look at how leadership and organisational structure changes over time to keep projects strong and successful. This would give us a better understanding of how causes and effects work and how long these effects last.

In general, the results improve project management theory by combining latent class segmentation with research on resilience. This gives both practical and theoretical insights that can help leaders and organisations come up with specific strategies to improve project outcomes in environments that are complicated and changeable.

Limitation

This study fully captures latent heterogeneity using rigorous techniques like FIMIX-PLS and PLS-POS, although it has some important methodological issues. We acknowledge PLS has assumptions about the linear nature of relationships between variables, a large enough sample size to satisfy stability, and homogeneity of data. PLS, through FIMIX-PLS and PLS-POS, addresses unobserved heterogeneity without limits, but we accept PLS assumptions around indicator reliability and multicollinearity (as severe), and reflective measurement models do not always exist in observed real-world data. PLS-SEM does not have global goodness-of-fit indices comparable to covariance-based SEM that may somewhat undermine the depth of model validation.

Interpreting the results should account for these methodological limitations. Larger, more diverse samples, qualitative methods to deepen understanding, and alternative or complementary statistical methods to triangulate findings could address these issues in future research.

In conclusion, although this research provides important evidence pertaining to project resilience within the construction industry in Ethiopia, the implications of this research are limited by the above-stated limitations. Recognizing these limitations provides transparency and accountability to the research and provides a clear basis for future research.

This next final section summarizes the key insights from this research and provides actionable recommendations for future research and practice. Implications for the overall construction industry in Ethiopia as well as generic lessons for project management are drawn.

Recommendations and conclusion

Future studies should pursue larger and more varied samples in order to increase the significance, generalizability, and simplicity of segmentation findings across multiple projects, disciplines, and cultural contexts [60]. For example, researchers might focus on construction projects (small, medium, and large) and include public and private sector projects in a variety of areas in Ethiopia. Studies should also pursue greater variation in sample size to improve external validity and facilitate comparison of

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variation among segments. One reasonable study design might use stratified sampling to improve the representation of the different categories of projects and regions.

Longitudinal studies are also needed to understand the sustaining leadership and organisational structures, and success of project teams, sustaining success and resilience, in changing conditions. One reasonable study design would be to follow a project team or teams for a period of several years and to collect data at intervention points during that time, to understand the relationship between the changing leadership styles, organisational practices on resilience and project outcomes.

There are many other variables that should benefit from further examination of their relationship to leadership, structure, and outcomes. Examples are team attributes and processes, the environment (including lack of resources), digital transformation, stakeholder salience and engagement, social capital, and regulatory environment.

Future research could, for example, examine the relationship between team performance and the adoption of digital project management tools or conduct case study comparisons of projects that engaged stakeholders early in the project versus those that did not. Researchers could also examine the impact of resource constraints versus different resource availabilities on resilience.

Understanding the role of demographic factors, such as education, awareness, and experience on resilience can also help inform more tailored interventions.

Comparative studies should be made between urban projects and rural projects and projects regulated by different branches of government to identify best practices that can be generalized or adapted. Qualitative research can add to quantitative research by looking at resilience in action through interviews and case studies [48]. Mixed methods can also help theorising by giving us a better understanding of the context through both frameworks. For example, after quantitative data analysis has identified resilient teams, qualitative data collection could be conducted through in-depth interviews with those teams for deeper insight into the mechanisms, contextual factors, and resources that underpin resilience.

Future research can also look into how things like employee engagement, communication, professional development, and technology adoption can help people be more resilient. Researchers could use academically validated surveys to measure employee engagement and technology adoption and correlate these measures with project outcomes, with a view to identifying specific factors that predict resilience.

With more advanced techniques of analysis like machine learning, the segmentation could be enhanced, and descriptions could be improved as a stream of more nuanced patterns emerged. In particular, it would also be possible to use clustering methods to identify distinct profiles of resilient project teams, for example, and use network analysis to assess communication flows within and between teams.

Further, it is critical that studies in the future make clear connections of findings to usable conduits or tools that stakeholders can take action on to explore and reassess their resiliency and project types. This could include creating practical toolkits or checklists for project managers, based on empirical evidence, or practice piloting the potential interventions with construction firms to test their efficacy. This is

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important to improve the closure between educational academic research and applied work in the industry, where the research evidence is able to be relevant and applied from the research outcomes.

This paper's main contribution is that many resilient leaders and flexible organizations have been ratified as crucial elements of project resilience and project success in the construction sector in Ethiopia, also in relation to the importance of segmenting action options as a basis of applied education, awareness, and experience for stakeholders. In short, in future research, it should always be a consideration of how theoretical thinking and knowledge can be moved to applied thinking and useful practice, specifically to support resilient and successfully carried out construction projects in the sector, even if the resiliency approaches considered project outcomes that are intended to support continuous improvement, development, and entrenchment of prevailing sector frameworks and practices.. As both theoretical and applied outcomes are advanced, the research contributes to improving project management methods/models which can be responsive to different contexts and challenges of evolving construction frameworks and projects.

Conflicts of Interests

The authors declare no conflict of interest.

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