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The Role of Agile Project Management in Driving Innovation: Exploring the Impact of Knowledge Management and the Moderating Effect of Organizational Culture.

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Abstract:

Innovation performance is a vital determinant of organizational competitiveness, particularly in environments marked by rapid technological change and uncertainty. This study examines how knowledge management (KM) influences innovation performance, with agile project management (APM) acting as a mediator and organizational culture (OC) serving as a moderator. Drawing on dynamic capability's theory, the research proposes an integrative framework in which innovation emerges from the interplay between knowledge processes, agile execution, and supportive cultural contexts. A quantitative, cross-sectional research design was applied, targeting engineers in the construction sector of Punjab, Pakistan. Engineers were selected due to their dual roles as knowledge creators and project executors. Using stratified random sampling, data were collected from 376 respondents through a structured questionnaire. SmartPLS 4.0 was employed to conduct structural equation modeling (SEM), assessing the reliability, validity, and hypothesized relationships within the model. The empirical results revealed a significant direct relationship between KM and innovation performance, indicating that effective knowledge practices enhance an organization's ability to innovate. APM was found to significantly mediate this relationship, demonstrating that agile methodologies facilitate the transformation of knowledge into innovative outputs. However, the moderating effect of OC was not statistically significant, suggesting that cultural influence may vary across contexts or industries. The study offers both theoretical and practical contributions.

Keywords: Agile Project Management, Innovation, Knowledge Management, Organizational Culture and Dynamic Capability Theory

Introduction

The capacity to innovate constitutes a fundamental pillar of sustained organizational success, shaping the competitiveness and adaptability of firms in increasingly complex and volatile environments. Innovation, regarded as the responsibility of research and development departments is now widely accepted as a organizational endeavor influenced by numerous factors. As global markets become increasingly competitive and disruptive technologies continue to reshape industries, organizations are under mounting pressure to enhance their innovative performance to remain relevant and competitive (Cillo et al., 2022; Kamis & Ferrell, 2023). This demands an

integrative understanding of the internal mechanisms that drive innovation and the conditions that amplify or impede these mechanisms.

Knowledge management (KM) is one such internal mechanism that plays a pivotal role in fostering innovation. By enabling the systematic creation, sharing, and application of knowledge, KM helps organizations leverage their intellectual assets to generate novel ideas and solutions (Akbari & Ghaffari, 2022). Effective KM supports learning and collaboration, ensures continuity in decision-making, and reduces redundancies and inefficiencies (Zaim et al., 2023). Despite its widely acknowledged benefits, the impact of KM on innovation is not always straightforward or guaranteed. Several contextual variables, such as organizational culture and management practices, may moderate or mediate this relationship. While KM is a necessary condition for innovation, it may not be sufficient in isolation.

One such contextual factor is organizational culture, which encompasses the shared values, beliefs, and norms that shape behavior within an organization. Culture significantly influences how knowledge is created and shared, how projects are managed, and how innovation unfolds (Alavi et al., 2023). A culture that encourages experimentation, tolerates failure, and promotes open communication is more likely to harness the potential of KM to foster innovation. Conversely, hierarchical or risk-averse cultures may stifle the creative and collaborative processes essential to innovation (García-Morales et al., 2022). In this regard, organizational culture serves as a vital enabler or barrier in translating knowledge into innovative outcomes.

Agile project management (APM) represents another critical mechanism for enhancing innovative performance, especially in volatile and complex environments. Rooted in the principles of flexibility, customer-centricity, and iterative progress, APM allows organizations to respond swiftly to changing demands and incorporate feedback into product or service development cycles (Hoda & Murugesan, 2023). The agility provided by such approaches complements KM efforts by providing a structured yet flexible platform for knowledge application. In an agile environment, cross-functional teams work in short cycles, frequently reflecting on performance and adjusting actions, thus reinforcing both organizational learning and innovation (Denning, 2023). However, the effectiveness of APM is also shaped by cultural and knowledge-related factors. For instance, agile principles thrive in cultures that value empowerment, trust, and adaptability, and their success depends on the continuous flow of actionable knowledge (Misra et al., 2022).

While extant literature recognizes the individual contributions of KM, organizational culture, and APM to innovation, few studies have explored their interdependencies and joint impact on innovative performance. Particularly lacking is a comprehensive model that examines how these variables interact in tandem to influence innovation outcomes. Some researchers have called for more integrative frameworks that consider the mediating or moderating roles of culture and management practices in the KM-innovation relationship (Popa et al., 2022; Wang et al., 2023). Most existing studies focus either on technology-intensive industries in developed economies or adopt a single-level perspective, thereby neglecting the complex, multi-level nature of innovation processes in diverse organizational contexts. There remains a substantial gap in understanding how these dynamics unfold in non-Western, resource-constrained, or culturally distinct environments, where knowledge flows and project practices may differ significantly. Addressing this gap is crucial for several reasons. Innovation is a key driver of economic resilience and competitiveness, especially in emerging economies where firms must leapfrog traditional development stages (Gonzalez & Martins, 2023). Organizations increasingly recognize that technological investments are insufficient for innovation without supportive cultural and managerial ecosystems (Liao et al., 2023). The proliferation of hybrid work models and digital transformation post-COVID-19 has amplified the need for agile and knowledge-based responses to change (Ahmed & Sharma, 2023). These shifts necessitate updated, empirically grounded models that account for the changing nature of work and innovation.

The present research contributes to this discourse by proposing and empirically testing a model that links knowledge management, organizational culture, and agile project management with innovative performance. Specifically, the study investigates the direct influence of KM on innovation, the mediating role of APM in this relationship, and the moderating effect of organizational culture. This integrative approach offers a more nuanced understanding of the pathways through which knowledge is transformed into innovative outcomes and the conditions under which such transformation is optimized. The value of this research lies in its ability to inform both theory and practice. Theoretically, it advances current knowledge by combining perspectives from knowledge-based theory, dynamic capabilities, and cultural frameworks to offer a comprehensive view of innovation drivers. It moves beyond isolated variables to uncover the synergistic relationships that facilitate or hinder innovation. The findings provide actionable insights for managers and policymakers seeking to enhance organizational agility, foster innovation-friendly cultures, and optimize knowledge flows. By identifying the levers through which KM translates into innovation under varying cultural and managerial conditions, the study equips organizations to design more effective strategies for innovation management.

The impacts of this research are multifaceted. For scholars, it sets the stage for future empirical investigations into the interplay of knowledge, culture, and agility in innovation ecosystems. For managers, it emphasizes the importance of aligning KM initiatives with agile methodologies and cultural values to drive sustainable innovation. For policymakers, the findings may inform capacity-building efforts aimed at strengthening innovation capabilities in key economic sectors. By shedding light on the contingent factors that shape the innovation process, this research contributes to the broader goal of fostering resilient, adaptive, and forward-looking organizations in a rapidly changing world.

Dynamic Capabilities Theory

The proposed research model, which links knowledge management, organizational culture, agile project management, and innovative performance, can be comprehensively underpinned by the dynamic capability's theory. Some school of thought provides a more detailed analytical framework of explaining how firms step by step integrate, develop and reorganize internal capabilities in an effort to adjust to quickly changing environments (Teece 2018). Unlike the prescriptive but firm resource-based view, the evidence on dynamic capabilities highlights the ability of an organization to renew its resources and to redesign routines and particularly in the innovation and technological turbulence. It is a suitable frame through which the interdependence between the knowledge processes, cultural orientations, agile practices and their integrated effect on innovation should be investigated.

The most common way to group dynamic capabilities is sensing, seizing, and transforming capabilities (Teece et al. 2016). Sensing refers to the ability of an organization to acknowledge and analyze the environmental chances and challenges. In the current research, knowledge management acts as an enabling component of such a capability. By acquiring, sharing, and using knowledge, organizations create cognitive and informational capabilities that increase the effectiveness of identifying emerging trends and discovering innovation opportunities (Wang et al. 2023). Sensing is not sufficient, the organizational ability to capture opportunities based on expedient decision making and action is also important. This dimension is all about project management which is agile. The use of agile approaches allows flexibility of resource use, speed of team mobilization and feedback specific cycle processes, which enables the application of the dynamic capabilities required to exploit the potentials of innovation (Denning 2023). Organizational culture itself is an overlying infrastructure and influences and strengthens these abilities. It decides how knowledge can be freely shared and whether failing to achieve innovation is acceptable, or agility is welcomed or not. Organizational cultures that support team spirit, innovation, and lifelong learning present good grounds where the dynamic capabilities can thrive.

On the other hand, hierarchical and strict cultures and cultures can suppress the knowledge flow and prevent the adaptive practices. Organizational culture, therefore, cannot be viewed as a contextual variable; it is also an essential part of the dynamic capabilities framework as it shapes the extent of knowledge and agility-to-innovation conversion.

The third dimension of dynamic capabilities is transforming; this process entails reconfiguration of assets, resources, and routines within an organization to preserve its fitness in the long-term. It manifests itself through an ability of the organizations to institutionalize the learning that occurs in agile projects and integrate it with the operations of the organizational strategy and systems (Kamis & Ferrell 2023). It also takes the form of cultural adjustments before rebalance or strengthen organizational-wide values and conduct to modify to the strengths of emerging information to attain new knowledge and innovation aspirations. It is based on this that the dynamic capabilities perspective provides a comprehensive insight into the process of organizational development in terms of interconnection of organizational knowledge processes, cultural patterns, and agile performance to maintain innovative performance. Using such theoretical premise makes the model stronger in the sense that it puts more weight on interdependence than causal effects. It therefore imagines innovative performance not as a cumulative outcome of independent variables but a dynamic product of organizational capabilities that are developed, integrated and reconstituted with time. This is the right direction being currently framed in the literature according to its demand of more integrative and more context-sensitive innovation management models, especially when in environments where technological and institutional change is high (Helfat & Peteraf 2023; Liao et al. 2023). In that sense, the dynamic capabilities theories not only contribute to the conceptual consistency of the suggested model, but also enhance its explanatory value and applicability.

Hypotheses Development

This study indicated strong positive dependence of knowledge management (KM) and innovative output thus leading to an increasing drive in empirical and theoretical studies emphasizing on strategic relevance of KM in stimulating organizational creativity. KM is essential in generation of ideas, solving of problems, and development of new products, processes or services by facilitating systematic acquisition, and sharing, and use of knowledge (Zaim et al., 2023). It therefore follows that firms which take responsibility to develop and share knowledge have a greater advantage in identifying possibilities of innovation and responding to environmental issues. The results are in line with the theories that KM accelerates exploitative and explorative innovation by promoting recombination of the existing knowledge, cross-functional coordination, and life-long learning (Wang et al., 2023). KM practices become an internalized part of daily activities, organizations get to experience the benefits of group knowledge and institutional memory, thus favoring innovation on two levels: incremental and radical (Akbari & Ghaffari, 2022). Combinedly, these findings confirm that KM is not only an engineering resource but also a weapon of strategic advantage due to its capacity in boosting the level of innovation when it is aligned with organizational processes and culture.

The results also assert the opinion that knowledge is a hard-valued intangible asset, and its appropriate management is central to emergence of innovation capacity and performance. Such a correlation is especially noticeable in dynamic industries associated with knowledge-intensive activities in which fast innovation is tantamount to the requirements of competing effectively (Cillo et al., 2022). The ability to codify tacit and explicit knowledge and transform that knowledge into actionable form, further empowers the organization with the capacity to innovate perpetually (Muhammad et al., 2025) . The consideration of applying KM in the strategic decision-making process enhances the firm flexibility and responsiveness two critical factors in maintaining innovation in the turbulent market (Ahmed & Sharma, 2023). Collectively, these empirical findings confirm the case of theoretical literature supporting the idea that knowledge-based

resources, when managed in a systematic manner, lead to development of the absorptive capacity that encourages innovation (Popa et al., 2022). The paper reconfirms the fact that organizations should invest in knowledge infrastructures, build a learning-based culture and an open communication system to keep a high-level of original operations.

H1: Knowledge Management has significant impact on innovation performance

The relationship between knowledge management (KM) and innovative performance is well established in contemporary literature; although there are numerous indications of the synergy between knowledge management (KM) and innovation, the way in which this nexus is achieved attracts the attention of modern researchers. In spite of the fact that KM provides the digitized assets (information, professional know-how, and shared experience) needed to drive innovation, it hardly ever has any direct or linear impact. Instead, time, time and again organizations rely on internal governance and managerial processes to move knowledge into tangible innovative products. A rather noticeable system here is project management, and, to be more particular, agile project management (APM), a paradigm that has significantly expanded in the dynamic environment. Being characterized by repetitive cycles, cross-functionality teams, and adaptability to changes, APM casually matches the needs of innovation-oriented settings (Denning, 2023). Agile methodologies are known to provide a flexible framework that can be used as a process through which resources of knowledge can be mobilized in an efficient and effective manner. As a result, KM facilitates innovation indirectly by using agile execution practices.

The empirical results confirm that APM mediating relationship between KM and innovation performance is significant. These findings denote that the strategic potential of KM is not used as long as it does not have proper means of its operationalization. APM can therefore be regarded as a living pipeline that transforms the KM resources to tangible and innovation boosting actions. Organizations can more easily flexibly and effectively deploy their knowledge when they have been using the principles of agility such as a fast feedback loop, iterative development, and team independence. Also, the project forms of agile tend to promote experimentation as well as continuous improvement which are two main elements of the innovation processes. Such congruence with the past literature indicates that agile settings enhance the usefulness of knowledge through the guaranteed quick testing, validation, and improvement of insights into the innovative solutions (Misra et al., 2022). All these findings indicate that APM does not just simply exist, amidst KM and innovation, but as a focal intermediary mechanism that enables the organizational knowledge to change. Such consequences can be consequential both at the theoretical and practical levels: it is not the presence of knowledge but its swift implementation that defines high performance in the domain of innovation.

H2: Agile project management mediates between knowledge management and innovation performance

The influence of knowledge management (KM) on innovation performance has been widely acknowledged, yet its effectiveness often varies significantly across organizational contexts. This contradiction stimulates the need to differentiate the circumstances under which knowledge management (KM) becomes innovative. Organizational culture is one of such conditions, and it is a widespread phenomenon shaping the perception and application of knowledge in the firms. Culture is the collective values, norms and activities, which influence interaction of employees and how they make decisions. Researchers explain that KM systems, however well-developed, are doomed to fail in case they are introduced in the framework of the culture that discourages openness, collaboration, or experimentation (García-Morales et al., 2022). On the other hand, cultures that are friendly to positive changes in terms of trust, learning and innovation could serve as a booster and so it can convert any stagnant knowledge to dynamic

abilities. It, therefore, necessitates an investigation of the manner in which the KM to innovation relationship is moderated by cultural orientations as opposed to the blanket effect that KM has.

Findings of the given research offer some empirical evidence that organizational culture is a moderating phenomenon, as the intensity of the connection between KM and performance of innovation greatly varies with regards to cultural attributes. KM practices in such culturally focused on continuous learning, shared vision, and participative decision-making cultures have higher chances to become an essential element of everyday activities and be transformed into the behaviors promoting innovation (Alavi et al., 2023). These cultures do not just encourage knowledge diffusion, but also knowledge recombination and new creative uses which are important not only to incremental innovation, but also to radical innovation. The cultures that favor hierarchy or risk-aversion, though, do not allow open communication and knowledge sharing that blunt overall positive influence of KM on innovation (Zaim et al., 2023). Having been identified, this result corresponds to the recent evidence that culture is a social infrastructure that further empowers or restricts the mobilization of knowledge (Ahmed & Sharma, 2023). The moderating effect of culture thus is a contingent understanding of innovation capacity: KM in itself cannot morph into innovation success without benefiting of an environment welcoming and favorable with regards to cultural conditions. This lesson contributes to the theoretical content of KM by bringing out the role of socio-behavioral environment in which knowledge processes work out, and it has one practice implication, which reinstates the role of cultural audits and change programs in the deployment of KM strategies to help in boosting the performance of innovation.

H3: Organizational culture moderates between knowledge management and innovation performance

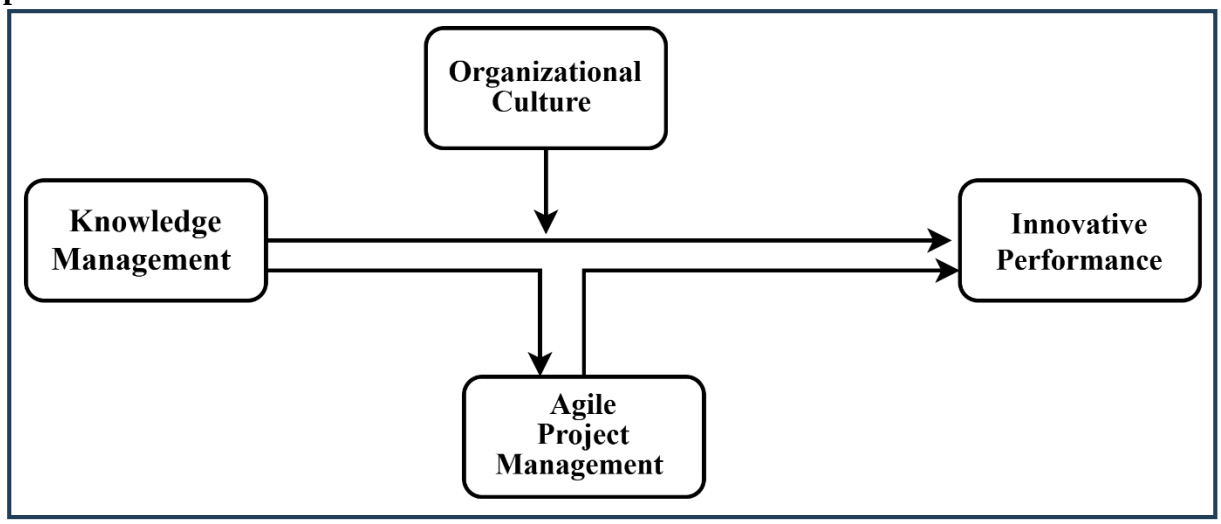

Figure 1: Research Model

Methodology

This study adopts a cross-sectional and quantitative research design, deemed suitable for investigating relationships among variables measured at a single point in time. The cross-sectional design enables exploring patterns and associations, but does not manipulate variables, which makes it especially suitable for exploratory and explanatory research in the field of organizational behaviour and management. The current study aims at identifying how knowledge management affects innovation performance, where agile project management has an intermediating role, and organizational culture moderating effect. Due to the objectivity of the tested hypotheses and the necessity to gain standardized information by several respondents, the quantitative method can be considered appropriate to draw statistically effective conclusions and generalize. The population of the study is construction sector engineers in the Punjab area in Pakistan. The relevance of this

population has to do with the sector becoming much more complicated and needing to innovate on how projects are done, how sustainable, or how they are adopted on the side of technology (Ali et al., 2022). Engineers often become those who create knowledge and work with it, balancing flows of information and executing project plans and innovative related activities thus providing a good insight into how knowledge management and agile practices interact with culture balance inside construction organizations. Punjab comprises a major portion of the construction sector in Pakistan, which is characterized by mass development of infrastructure and collaboration between the government and privately owned corporations, which is why it is chosen as a suitable research area to collect data (Ahmed & Mehmood, 2023).

The random sampling used in a stratified manner to reduce sampling bias and to increase representativeness. This stratification on basis of organizational type (e.g. public, private, consultancy or contractor-based) so that proportional representation of some critical subgroups of the population is achievable. Stratification sampling increases the accuracy of parameters estimates and makes it easier to analyze subgroups (Etikan & Bala, 2017). Cochrans formula used to determine the target sample size with a confidence level of 95 percent and the 5 percent margin error by using an estimated population size in the sector of engineers in the Punjab construction industry. Based on initial estimates in the industry and considering possible non-response, a sample size of 376 of engineers pursued, which goes beyond the lower limit required in structural equation modeling and allows one to perform exact multivariate analysis. Structured questionnaire used as a method of data collection where a questionnaire based on validated scales in previous literature used with reliability and construct validity. The data as descriptive statistics, reliability and preliminary correlation analysis under SPSS. Thereafter, the partial least squares structural equation modeling conducted using SmartPLS 4.0. SmartPLS is especially ideal when the model is multifaceted and that includes mediation and moderation effects, and it proves to be efficient in analyzing data, which are not deemed as normal based on the strict gender of covariance-based SEM (Hair et al., 2023). The synthesis of these methods allows the investigation of measurement and structural models in an inclusive manner and thus contributes to the methodological authority as well as the theoretical value of the study. The measurement model included four constructs: Knowledge Management (KM), Agile Project Management (APM), Innovation Performance (IP), and Organizational Culture (OC). The scale for KM was adopted from Akbari and Ghaffari (2022), APM from Hoda and Murugesan (2023), IP from Zaim et al. (2023), and OC from Alavi et al. (2023).

Data analysis

Measurement Model:

The measurement model in SmartPLS is a foundational component of Partial Least Squares Structural Equation Modeling (PLS-SEM), used to assess the relationships between latent constructs and their observed indicators. In the current discussion, we pay attention to how well observed variables (indicators) as measured by the unobservable variables (constructs). This measurement is also part of the process of testing the validity of the measurement model in SmartPLS, an activity that should be carried out before one attempt to draw conclusions on the structure model. Measurement model could be either formative or reflective. In the reflective design, the indicators are deemed to be a form of the latent construct, so any variation in the latter results in alteration in the former. On the other hand, there is a formative configuration where the indicators define or constitute the construct as a whole (Hair et al., 2021). The steps of the validation procedures comprise a number of processes. First of all, there is indicator reliability, proof of which requires outer loadings of at least 0.70. The measure of internal consistency reliability is also done by the Cronbach Alpha and Composite Reliability. Once reliability has been achieved, convergent validity stages are entered, of which includes measuring Average Variance

Extracted. The validation of discriminant validity based on Fornell-Larcker criterion or the ratio of the HTMT.

SmartPLS provides visual and numerical tools to analyze the measurement model and determine the reliability and validity of each construct. When dealing with Structural Equation Modeling using Partial Least Squares (PLS-SEM), the reflective models compel the need of Convergent and Discriminant Validity to be achieved, indicating that empirically measured results have grounds to converge around a construct in such a manner that they share a significant portion of variance and Discriminant thus ought to indicate that each construct is distinct in concept relative to the other (Hair et al., 2019). When formative models are used, researchers observe Collinearity (usually determined via the values of Variance Inflation Factor [VIF]) and the significance of the resulting weight coefficients, as well as the significance of indicators. Strict notation of type of model thus becomes essential, and false classification may call the results into the question, and academics suggest formal application of bootstrapping mode in SmartPLS to measure the significance of indicators and path coefficients (Sarstedt et al., 2017). The strength and validity of the analysis provided by PLS-SEM depend on checking the reliability and significance of construct measures.

Regression weights

Table 1: Factor Loadings

Variables	Items	Factor Loadings
Agile Project Management (APM)	**APM1**	0.812
	APM2	0.822
	APM3	0.819
	APM4	0.862
	APM5	0.854
	APM6	0.778
Innovation Performance (IP)	**IP2**	0.751
	IP3	0.758
	IP4	0.795
	IP5	0.848
	IP6	0.762
	IP7	0.819
Knowledge Management (KM)	**KM1**	0.858
	KM2	0.894
	KM3	0.866
	KM4	0.904
	KM5	0.841
	KM6	0.869
Organizational Culture (OC)	**OC1**	0.892
	OC2	0.871
	OC3	0.853
	OC4	0.840
	OC5	0.876
	OC6	0.902
	OC7	0.834
	OC8	0.920

The measurement model results for the constructs Agile Project Management (APM), Innovation Performance (IP), Knowledge Management (KM), and Organizational Culture (OC) demonstrate acceptable to excellent indicator reliability, as most outer loadings exceed the recommended threshold of 0.70 (Hair et al., 2021). The present research justifies the existence of the internal consistency of the APM, KM, IP, and OC concepts using both loadings and composite reliability coefficients. The APM indicators exhibit strong internal consistency evident in the values that indicate a range of 0.778 to 0.862, and the figures for the KM indicators as well indicate strong levels 0.841 to 0.904. The IP indicators yield the loading range between 0.751 and 0.848, which is the evidence of the construct reliability measurement. Organizational Culture (OC) construct also shows exceptional reliability with loadings of all the items exceeding 0.84, but some of them OC5, OC6, OC7, OC8 have low loadings (Hair et al., 2019). The value of composite reliability is over 0.90 in all constructs, and the value of the average variance extracted (AVE) is more than 0.50, which proves convergent validity (Sarstedt et al., 2017). AVE of 0.761 is obtained of KM and 0.764 of OC which is above the standard and means that the constructs explain more than a half of the variance of their indicators. These results justify the measurement model of constructs and advocate the integrity of further structural analysis (Hair et al., 2023).

Reliability Statistics

Table 2: Convergent Validity

	Cronbach's alpha	(rho_a)	(rho_c)	(AVE)
Agile Project Management (APM)	0.906	0.907	0.927	0.680
Innovation Performance (IP)	0.879	0.882	0.908	0.623
Knowledge Management (KM)	0.937	0.939	0.950	0.761
Organizational Culture (OC)	0.956	0.958	0.963	0.764

The reliability and validity statistics of the constructs, Agile Project Management, Innovation Performance, Knowledge Management, and Organizational Culture, demonstrate strong psychometric properties. All the measures of Cronbach alpha proving high reliability in terms of internal consistency (Hair et al., 2021). Openness to Change has 0.956 is the reliability of the construct with the highest reliability followed by Knowledge Management 0.937, there is Agile Project Management 0.906, and Innovation Proneness 0.879. All these findings confirm that the items under each construct are highly significant in capturing the identified underlying concept. The construct reliability is also supported by composite reliability, adjusted by item loadings, which standardly should reach 0.70, and it exceeds this criterion, with the values equal to 0.908 IP to 0.963 OC (Sarstedt et al., 2017). All constructs meet the criterion of convergent validity since the Average Variance Extracted (AVE) scores are greater than 0.50. Indicative of this is the AVE of 0.761 recorded by KM compared to the highest value of 0.764 recorded by OC, and this implies that most of the variance in the indicators is in the latent constructs (Hair et al., 2023).

Discriminant Validity

Table 3: HTMT Ratio

	APM	IP	KM	OC
Agile Project Management (APM)				
Innovation Performance (IP)	0.463			
Knowledge Management (KM)	0.623	0.453		
Organizational Culture (OC)	0.629	0.439	0.574	

The Heterotrait-Monotrait (HTMT) ratio of correlations is a modern and robust method used to assess discriminant validity in structural equation modeling, particularly within SmartPLS. Discriminant validity construct establishes that sets of variables purported to be conceptually

different have the ability to be separated empirically. Traditionally, the HTMT criterion below 0.85, 0.90 in less conservative settings are considered sufficient to represent satisfactory discriminant validity (Henseler et al., 2015). HTMT-matrix all the values are below the conservative value of 0.85. The HTMT coefficient of Agile Project Management with Knowledge Management is 0.623 and with Organizational Culture is 0.629 meaning that there is a significant difference between the constructs. There is a similar pattern of rise and fall of IP with APM 0.463 and KM 0.453, and OC 0.439 falling short of the critical level. These findings qualify that each construct evaluates a conceptually diverse area and is not elongated to the many others, which satisfies the requirement of discriminant validity (Hair et al., 2021).

Structural Equation Modelling (SEM)

Structural Equation Modeling (SEM) is a more complex multivariate framework allowing researchers to test elaborate relationships with dependent variables and latent variables. Together with the combination of progressive focuses on factor analysis and multiple regression, SEM makes it possible to test both measurement and structural hypotheses (Hair et al., 2021). Due to this integrative character, the methodology is readily used in the social sciences, business studies, psychology, and educational research since it provides a more detailed protocol in testing theoretically focused models that consist of dependent constructs. In its core, SEM consists of two main sub-components, namely measurement model and structural model. The measurement model specifies the relationships between latent variables and corresponding observed indicators and, therefore, requires the assessment of reliability and validity (assessments of internal consistency (Cronbach alpha, composite reliability), convergent validity (average variance extracted) and discriminant validity (the Fornell-Larcker criterion, the HTMT ratio) (Sarstedt et al., 2017).

Structural model delinks a priori hypothesized causal association between latent variables. It measures both direct and indirect links by explaining how disruptions in one construct are felt through the network to have an effect on others. Theoretical assumptions are proven by path coefficients, significance test procedures, and effect-size measures in an attempt to prove or disapprove their assumptions (Hair et al., 2021). The availability of mediated and moderated effects, or, in general, the possibility to deal with complex interactions, is one of the strengths of SEM because it allows researchers to decompose the and explain the indirect effects in a systematic manner. SEM compared to the traditional regression techniques lies in its closed approach to measurement error, which improves estimation of parameters. Model fit can also be considered as a main concern and can be analyzed by using the value of Standardized Root Mean Square Residual (SRMR) in covariance-based SEM, compared to accuracy of predictions in variance-based models.

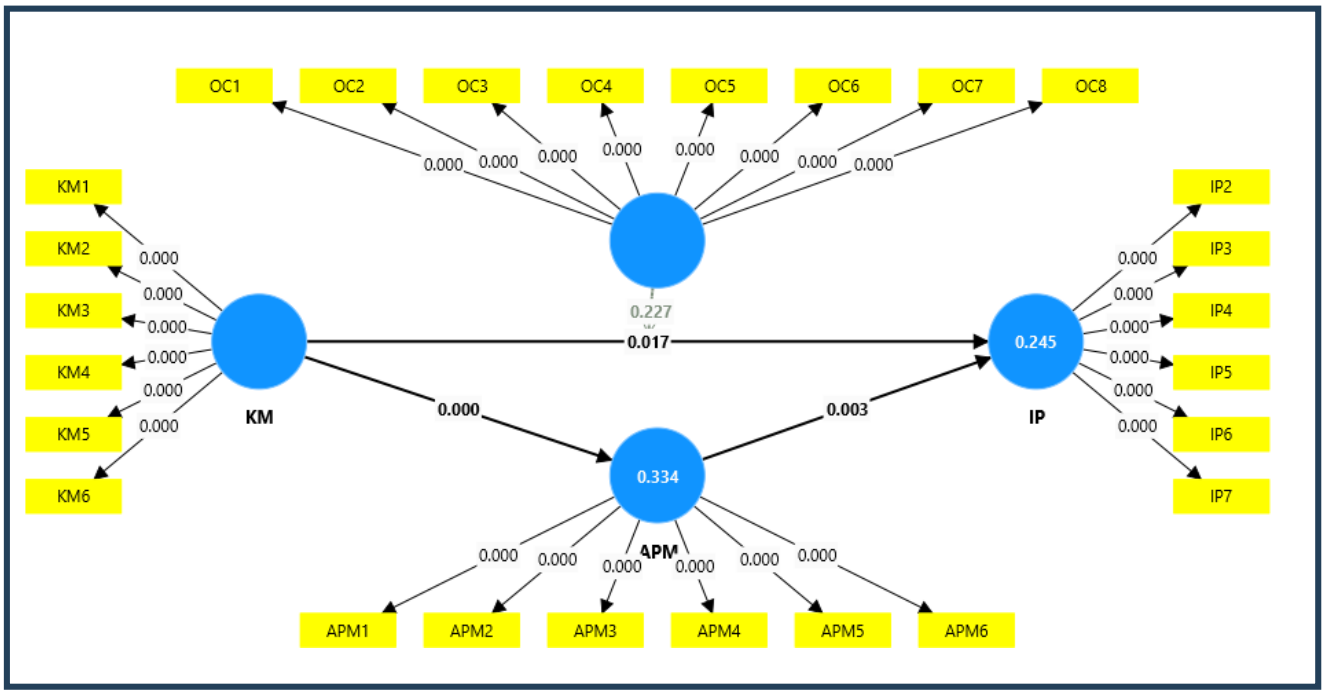

Table 4: Results

	Original sample	Sample mean	Standard deviation	T statistics	P values
KM -> IP	0.172	0.167	0.072	2.379	0.017
KM -> APM -> IP	0.111	0.113	0.040	2.812	0.005
OC x KM -> IP	-0.061	-0.062	0.050	1.209	0.227

Knowledge Management (KM), Innovation Performance (IP), Agile Project Management (APM), Organizational Culture (OC)

The structural path coefficients and significance values provide insights into the relationships among Knowledge Management (KM), Agile Project Management (APM), Organizational Culture (OC), and Innovation Performance (IP). The direct path from KM to IP (β = 0.172, p = 0.017) is statistically significant, indicating that KM has a positive and direct effect on innovation performance. The mediation effect of APM in the KM–IP relationship is also significant (β = 0.111, p = 0.005), suggesting that KM contributes to innovation indirectly by improving agility in project management. However, the moderating effect of organizational culture (OC x KM → IP) is not statistically significant (β = –0.061, p = 0.227), indicating that culture does not significantly alter the strength or direction of the KM–IP relationship in this model. While organizational culture is conceptually important, its statistical influence in this case may be limited or context-dependent (Alavi et al., 2023).

Discussion

The positive and statistically significant relationship between KM and IP reinforces the theoretical assertion that KM is a foundational driver of innovation. This current research confirms the foregoing observations that the KM activities such as acquisition, dissemination, and application of knowledge are linked to the organizational ability to produce new products, processes, and services (Zaim et al., 2023). It also supports the hypothesis that KM is capable of prompting both explorative and exploitative innovation at the same time, enhancing the recombination of internal and external knowledge bases (Wang et al., 2023). In dynamic

environments, the fit among KM strategies and business goals makes enterprises and their operations faster to respond and more adaptive to changed situations in the market (Akbari & Ghaffari, 2022). Therefore, the findings confirm the knowledge-based perspective of firm which holds that knowledge is a very important source of sustained-competitive advantage (Grant, 1996). It is worth mentioning that the study widens this aspect by showing that none of the key actors in KM functions as a simple technical infrastructure but it is strategic and encapsulated in a routine (Cillo et al., 2022). This means that organizations using KM systems that are mature have a better ability of mobilizing intellectual resources in terms of innovation to support the first hypothesis and the point on model integration of KM.

APM mediation on the KM to IP pathway proves that the influence that KM has on innovation is partially conveyed by the agile mechanisms. APM provides the framework and process foundation that is needed to implement the iterative use of knowledge in real-time project environments (Denning, 2023). This observation is in line with Dynamic capabilities school of thought, which argues that knowledge cannot be used to generate innovation by itself without being utilized by dynamic and adaptive processes (Teece et al., 2016). Agile methodologies facilitate a cross-functional collaboration, quick prototyping, and consistent feedback, which focus the practical usefulness of knowledge in the innovation setting (Hoda & Murugesan, 2023). Besides, the noteworthy mediation effect shows that providing knowledge that can transform into innovative produce requires the organizational agility not only in the implementation of projects but also in the strategic adjustment, in accordance with existing literature by highlighting the synergy between KM and APM in developing responsive and innovative organizations (Misra et al., 2022). The mediating effect indicates that companies engaging in KM have to simultaneously innovate by developing agile capacities in order to effectively leverage their knowledge resources, which reinforces the second hypothesis and provides additional empirical support of integrative models which consider innovation as the result of cross-linked knowledge and agility systems.

The hypotheses that the moderating effect of OC in the relationship between KM and IP was not significant. Despite the fact that culture has become recognized as a major factor to influence knowledge creation, diffusion, and implementation (García-Morales et al., 2022), the results reveal that in the given context, OC did not play a relevant role in affecting the level of KM-IP association. The sampled organizations could have included a lot of cultural homogeneity that constrained the variability needed to identify the moderation effects. Alternatively, KM practices have also possibly grown institutional enough, to rely less on particular cultural attributes to work effectively (Ahmed & Sharma, 2023). This difference with existing works that also mention culture as being a boom or barrier to KM performance especially the ones that focus on open communication, trust, and risk tolerance as elements of enabling innovation underline how localized is the culture impact and dependent on the nature of the industry, maturity of the organization, or regional culture (Alavi et al., 2023; Zaim et al., 2023). However, concept value of the culture is upheld in the theory and its statistical performance in the current model does not reach the level of significance and thus does not substantiate the third hypothesis.

All these findings are in match that KM practices are efficacious to improve organizational innovation with the ability to generate both explorative and exploitative innovation amid a quick adaptation to market changes. The mediating role of APM shows that the transformation of knowledge into innovative results is conditional upon the organizational agility, and this lends credence to the in tandem combination of KM and agile approaches. The non-significance of the moderating effect of OC implies that the cultural effect may not be consistent across organizations as anticipated and this further solidifies the thought that the moderating effect of OC depends on the contextual factors.

Limitations and Future Directions

Despite the fact the current study contributes to the knowledge relating to the interdependence of knowledge management (KM), agile project management (APM) and organizational culture (OC) and its effect to their innovation performance (IP), few methodological limitations are constructive to discuss. The fact that the study relied on a cross-sectional design means that it is restricted to reveal the cross-sectional relationship instead of providing longitudinal analysis of the causal development processes. Longitudinal approaches could be used in further studies to follow the course of time changes in the KM and APM practice and compare it with the existence of organizational culture in order to track the development of the future of innovation. The study is geographical specific or limited to the construction industry in in Punjab, Pakistan this limits generalizability. Distinctive regional and sectoral differences in terms of dynamics, regulatory structures, and culture dampen the idea that these regional differences tell us that this research might be generalizable across other contexts. To find out the extent of similarity of this research, the research ought to be replicated in different regions and industries. It is established that organizational culture forms the moderating variable of the research but does not play a statistically significant role. This null effect can be explained either by insufficiency of the measures or lack of enough differences in cultural profiles of the responding firms. An improved theoretical understanding could be obtained when cultural categorization is more fine-grained perhaps using multi-level modeling to reflect manifestation of culture at individual, team, and organizational levels (Alavi et al., 2023). Qualitative or mixed-methods reviews might shed light on the mechanism of agile practice mobilization and enactments, which would contribute to the existing model. All possible determinants are not considered in the study and only some of them including, digital transformation readiness, leadership styles, and employee engagement are omitted. These variables can be utilized in future to come up with more comprehensive explanations of the innovation propensity phenomenon in organizational settings.

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