Asian And Pacific Economic Review
ISSN: 1000-6052

EXPLORE THE ROLE OF PROACTIVE CHANGE MANAGEMENT FOR RESILIENCE ENHANCEMENT: A STRUCTURAL EQUATION MODELLING APPROACH

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https://doie.org/10.65985/APER.2025372172

The change management process complements the resilience behaviour to pursue constant and continuous changes towards successfully combating the ambiguity, chaos, uncertainty, and unpredictability of events within the supply chain environments. Thus, facilitating the deployment of pro-active strategies promoting a positive attitude towards needful changes through anticipation and purposeful planning. Further, frameworks have been proposed within the supply chain literature to sum up the catalytic effect of proactive change management towards augmenting resilience capabilities within the supply chains. However, the frameworks proposed till date are conceptual in nature, lacking empirical validation of the relationships portrayed towards generalization of the results. Thus, this study aims at empirically exploring and validating the role of proactive change management for resilience enhancement within supply chains through structural equation modelling.

Keywords: Structural Equation Modelling; Proactive Change Management; Resilience; Supply Chains

1. INTRODUCTION

Supply chains (SC) constitute a series of integrated enterprises that share information and coordinate physical execution of the planned activities to convene a smooth, integrated flow of goods, services, and information along the pipeline to meet the end-customer requirements (CSCMP et al., 2021). Further, the SC are highly vulnerable to risks stemming from vertical complexities (increase in the number of tiers), horizontal complexities (increase in the number of members within each tier), and spatial complexities (increasing geographic distances between supply chain partners). Thus, in order to cope up, survive, and thrive against the adversities and dispersions originating from multiple sources. SC need to develop “resilience” capabilities to persist, adapt or transform to the changes imposed towards maintaining the basic identity/equilibrium of the systems in place (Ponomarov & Holcomb, 2009).

On the other hand, change management complements the resilience behaviour as it provides the needful processes, tools, and techniques to manage the supply chain transitions efficiently. Further, according to Ates and Bititci, (2011) process-oriented change management techniques stand fundamental towards enhancing resilience capabilities.

Additionally, the proactive change management strategies characterizing actions (doing something) before (pro) a disruption occurs, aids the SC to become co-creators of needful changes towards enhancing resilient behaviours. Thus, aiding the SC to anticipate and plan for the needful changes in advance to help avoid or at least reduce the negative impacts of the potential future threats/disruptions and further assist the SC to capitalize on potential future opportunities (Jackson & Ferris, 2015).

Moreover, the SC Capabilities (competencies towards forecasting the needful changes and the abilities to enact changes in a pro-active manner to perceive disruptions as opportunities for sustained growth) and SC Culture (the binding factor that determines the SC responses and behaviours to environmental changes) stand out as dominant drivers towards embracing changes in a pro-active fashion (Olaf, 2010). Further, the SC capabilities i.e., Dynamic Knowledge Capabilities DKC-capabilities to assess and anticipate the nature, magnitude, and impact of disruptive events in advance (Masteika & Čepinskis, 2015), and Advanced Digital Capabilities ADC- capabilities that facilitate the correct deployment of information processing and diffusion across the chain to thrive the disruptions through planned transitions (Nath, 2009). Along with the Cultural Assets i.e., Collaborative Culture CC-behaviours and attitudes facilitating SC partners to combat challenges in cohesion through competency sharing (Yunus, 2018). Enable the SC to orchestrate the needful transitions through pre-determined and well-planned strategies towards the realization of the desired goals and objectives.

In addition, planned transitions seeded through DKC, ADC, and CC fosters dynamic flexibility (i.e., ability to respond, adapt, survive, and thrive through the disruptions sprouting from internal or external sources), advanced visibility (i.e., ability to foresee into potential impacts and consequences of the changes induced), dynamic alignment (i.e., ability to undertake operations-reconfigurations, product-reconfigurations, logistics-reconfigurations, supply chain/network-reconfigurations, and information system assets/architecture-reconfigurations in line with the supply chain environmental dynamics), and proactive agility (i.e., ability to anticipate hidden problems, challenges, and opportunities within the planned changes for long-term survival, holistic growth, and competitive advantage by linking short-term agendas with long-term agendas). Thereupon, leading to the promotion of factors essential towards preparing, responding, and recovering successfully from unexpected events, i.e., Resilience capabilities (Umar et al., 2017).

Consequently, frameworks were proposed to establish relationships between SC Capabilities, SC Cultural factors, Proactive Change Management, and Resilience Capabilities. However, the frameworks formulated were highly conceptual in nature lacking empirical data to validate the strength and nature of the portrayed relationships (Gurrala, 2021). Thus, this study aims at employing Partial Least Square-Structural Equation Modelling (PLS-SEM) a Multivariate Statistical Technique to analyse structural relationships, i.e., a statistical method to represent, estimate, and test a network of relationships between variables (Hair et al., 2010)) to empirically explore and validate the role of proactive change management for resilience enhancement within SC.

2. Conceptual Framework & Hypothesis Development

The conceptual framework reflects on the antecedents for enhanced resilience within the supply chains. Further, the framework leverages the success factors for managing and adapting changes towards promoting resilience capabilities within the supply chains. Additionally, it is formulated highlighting DKC, ADC, and CC as essential drivers towards deploying pro-active change management strategies within the supply chains fostering & enhancing resilience capabilities i.e., dynamic flexibility, advanced visibility, dynamic alignment, and proactive agility (Gurrala, 2021).

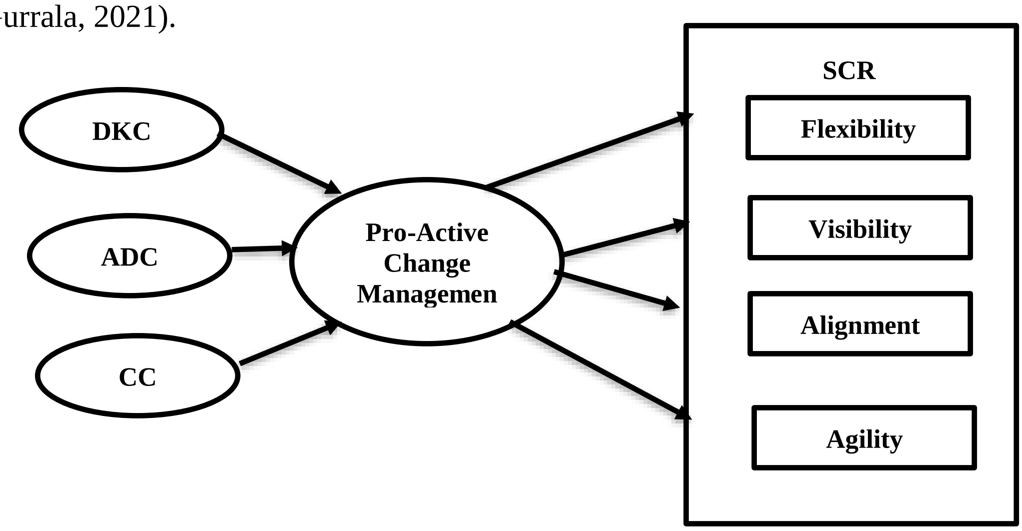

Fig 1: Pro-Active Change Management Framework for SCR, adapted from Gurrala, 2021.

Based on the above conceptual framework for resilience enhancement. The study aims at validating the strength and nature of the portrayed relationships by:

1. Investigating whether the Capability and Cultural Constructs (i.e., DKC, ADC, & CC) influence Pro-Active Change Management (PCM) processes within the Supply Chains.
2. Investigating whether the Pro-Active Change Management processes influence resilience capabilities development i.e., dynamic flexibility (FLEX), advanced visibility (VIS), dynamic alignment (ALI), and proactive agility (AGI) within the supply chains.

The following were hypothesised, in this regard.

1. **H1**: Dynamic Knowledge Capabilities significantly influences the Pro-Active Change Management processes within the Supply Chains.
2. **H2**: Advanced Digital Capabilities significantly influences the Pro-Active Change Management processes within the Supply Chains.

3. **H3**: Collaborative Culture significantly influences the Pro-Active Change Management processes within the Supply Chains.
4. **H4**: The Pro-Active Change Management processes significantly influence the development of dynamic flexibility within the supply chains.
5. **H5**: The Pro-Active Change Management processes significantly influence the development of advanced visibility within the supply chains.
6. **H6**: The Pro-Active Change Management processes significantly influence the development of dynamic alignment within the supply chains.
7. **H7**: The Pro-Active Change Management processes significantly influence the development of pro-active agility within the supply chains.

3. RESEARCH METHODOLOGY

The study employed quantitative methods towards data collection and analysis, wherein a structured self-administered questionnaire was designed and aimed at collecting data to assess the conceptual model and test the hypothesis formulated through Structural Equation Modelling through SmartPLS Software.

3.1 STUDY CONTEXT & QUESTIONNAIRE

A questionnaire was designed to assess the indicator variables (listed within the table1 below) associated with each of the construct within the proposed framework. A total of 300 questionnaires were sent out to experts within hospitality industry using purposive sampling over a period of three months from November 2024 to January 2025. Moreover, the questionnaire was aimed at measuring the indicator variables associated with each of the construct on a five-point Likert scale ranging from 1 (Strongly Agree) to 5 (Strongly Disagree).

Table 1: Constructs and Indicator Variables

Construct	Indicator Variables	Description
Dynamic Knowledge Capabilities	**DKC1**	Integration of expertise across the whole Supply Chain (Yao & Meurier, 2012).
	DKC2	Absorption of knowledge and best practices through a continuous learning routine (Cepeda and Vera, 2007).
	DKC3	Horizontal Scanning activities to identify new trends and technological breakthroughs (Pasamar et al., 2015).
	DKC4	Generation of new knowledge and capabilities from the existing supply chain resources and capabilities through capitalization on past experiences (Masteika & Čepinskis, 2015).
	DKC5	Deliberate learning efforts, based on selection and retention of knowledge (Aslam et al., 2020a; Zolo and Winter, 2002)

Advanced Digital Capabilities	**ADC1**	Amalgamation of information, computing, communication, and connectivity technologies (Queiroz et al., 2021).
	ADC2	Correct deployment of information processing and diffusion across the chain (Nath, 2009).
	ADC3	Data Driven, real-time monitoring and visibility systems (Arkipova and Bozzoli, 2018).
	ADC4	A combination of skills in data, permission and analytics (Ritter and Pederson, 2020)
	ADC5	Rich information exchange through digital platforms (Rai et al., 2012).
	ADC6	Infrastructures enabling access to a shared pool of computing resources (Bharadwaj et al., 2013).
Collaborative Culture	**CC1**	Intention to work as a team i.e., enhanced trust (Edmonson et al., 2001; Kucharska, 2017).
	CC2	Urge for relational continuity i.e., enhanced commitment (Bstieler and Hemmert, 2015).
	CC3	Pursue Joint Decision Making i.e., digital synchronization (Idrus et al., 2010; Sanchez, 2012).
	CC4	Desire to share costs, risks, and benefits (Todeva and Konke, 2005; Zhang and Cao, 2018)
	CC5	Acknowledge to share strategic and tactical data (Kumar et al., 2016).
	CC6	Alliances and Partnerships between supply chain entities (Yunus, 2018).
Pro-Active Change Management	**PCM1**	Embracing the changes positively making space for new opportunities through anticipation and purposeful planning (Kirk, 1951).
	PCM2	A road map for transformation in advance to drive action (Hiatt, 2006).
	PCM3	Fostering the desire to change by listing out the benefits of change (Hiatt, 2006).
	PCM4	Ability to assess the risk of change (Abad et al., 2019).
	PCM5	Ability to promote a picture of resource readiness to promote change (Ates and Bititci, 2011).
	PCM6	Development of systems capable of adapting to new conditions and mandates (Greer & Ford, 2009).
Flexibility	**FLEX1**	Ability to re-configure supply chain operations, products, logistic infrastructures, network structures, and information systems/architectures based on the environmental needs (Duclos et al., 2003; Hopp et al., 2010).

	FLEX2	The extent and ease with which supply chain operations can be changed in advance –range and response flexibility (Kumar & Shankar, 2007).
	FLEX3	Ability to spontaneously respond to sudden problems or opportunities –micro flexibility and ability to easily change supply chain structures, strategies, programs, and policies in alignment with market changes-macro flexibility (Gilmore, 2010).
	FLEX4	Contingent resources to rapidly handle uncertainties (Stevenson & Spring, 2007).
	FLEX5	Derived from top management commitment, strategy development, technology deployment, information sharing and trust enhancement within the supply chain members (Singh et al., 2017).
Visibility	**VIS1**	Ability to panoramically view the flows, activities, processes, and resources across the chain in real time (Grzesińska, 2017).
	VIS2	Availability of right quality and quantity of internal and external information (Messina et al., 2018).
	VIS3	Real-time deployment of well-planned and simulated strategies to reduce information asymmetry and complexity (Lechaptois, 2020; Wei & Wang, 2010).
	VIS4	Trust and quality of information shared between the supply chain partners (Nikookar et al., 2016).
	VIS5	Deployment of IOT based platforms and block chain technologies (Anitha et al., 2021; Pikington, 2016).
Alignment	**ALI1**	Strongest fit between objectives, structures, strategies, and processes of different supply chain functions and partners (Gattorna, 1998).
	ALI2	Ability to design change strategies in the wake of the sensed opportunities (Aslam et al., 2020b, Baker, 2008).
	ALI3	Organisational structures, internal relational behaviours, customer relational behaviours, top management support, information sharing and business performance measurement systems stand out as the most prominent enablers for alignment within supply chains (Wong et al., 2012).
	ALI4	Deployment of block chain technologies towards the supply chain processes of member partners (Korpela et al., 2017).
	ALI5	The ability to provide information connections across the supply chain to foster knowledge sharing on plans, requirements and status (Zhang et al., 2006).

Agility	**AGI1**	Can be measured in the form of six dimensions: strategic alertness, strategic response capability, operational alertness, operational response capability, episodic alertness, and episodic response capability (Li et al., 2009).
	AGI2	Enhancement of cognitive and physical capabilities i.e., alertness, accessibility, decisiveness, swiftness, and flexibility (Al Humdan et al., 2020).
	AGI3	Alertness to internal and external disturbances and abilities to deploy the capabilities in a collective fashion (Sangari et al., 2015).
	AGI4	The ability to see and capitalize on new opportunities (Setili, 2014).
	AGI5	Ad Hoc use of Big-Data Analytics (Hosoya and Kamioka, 2018).

3.2 PLS SEM ANALYSIS

The study employs a Structural Equation Modelling (SEM) utilizing Partial Least Squares Structural Equation Modelling (PLS-SEM) analysis to explore the intricate interrelations among ADC, CC, PCM, FLEX, VLS, AL, and AGI. The PLS-SEM approach used within the study significantly surpasses the methodologies employed within prior studies, which predominantly relied on linear regression, multiple regression, or multivariate regression analysis (Dao *et al*., 2022; Kulkarni *et al*., 2024). The method facilitates the examination of intricate causal relationships thereby fostering a more refined comprehension of the fundamental mechanisms at play.

Furthermore, the model elucidates the intricate interactions among advanced digital capabilities, collaborative culture, and pro-active change management, particularly concerning their influence on flexibility, alignment, and agility, thereby offering significant contributions to both scholarly discussions and practical applications within industry settings.

Two metrics, specifically Cronbach's α and Composite Reliability (CR), were employed to ascertain the reliability of the gathered data, which pertains to the assessment of the internal consistency of indicator variables associated with a particular construct. Moreover, Spearman correlation analysis to analyse the relationships between the constructs.

The study used Partial Least Squares Structural Equation Modelling (PLS-SEM), as it emerged as the most appropriate methodology for model validation research due to several significant attributes. Primarily, PLS-SEM is an exceptionally fitting approach for the analysis of intricate research frameworks with the execution of causal-predictive evaluations (Hair *et al*., 2017; Henseler *et al*., 2009).

The study embraced an advanced research framework consisting of eight constructs that generated seven hypotheses. Consequently, the study also investigated the interplay of these variables via Partial Least Squares Structural Equation Modelling (PLS-SEM) analysis (Richter *et al*.,2016).

3.2.1 PATH DIAGRAM

The PLS-SEM analysis was initiated by generating a path-diagram as depicted within Figure 2 below.

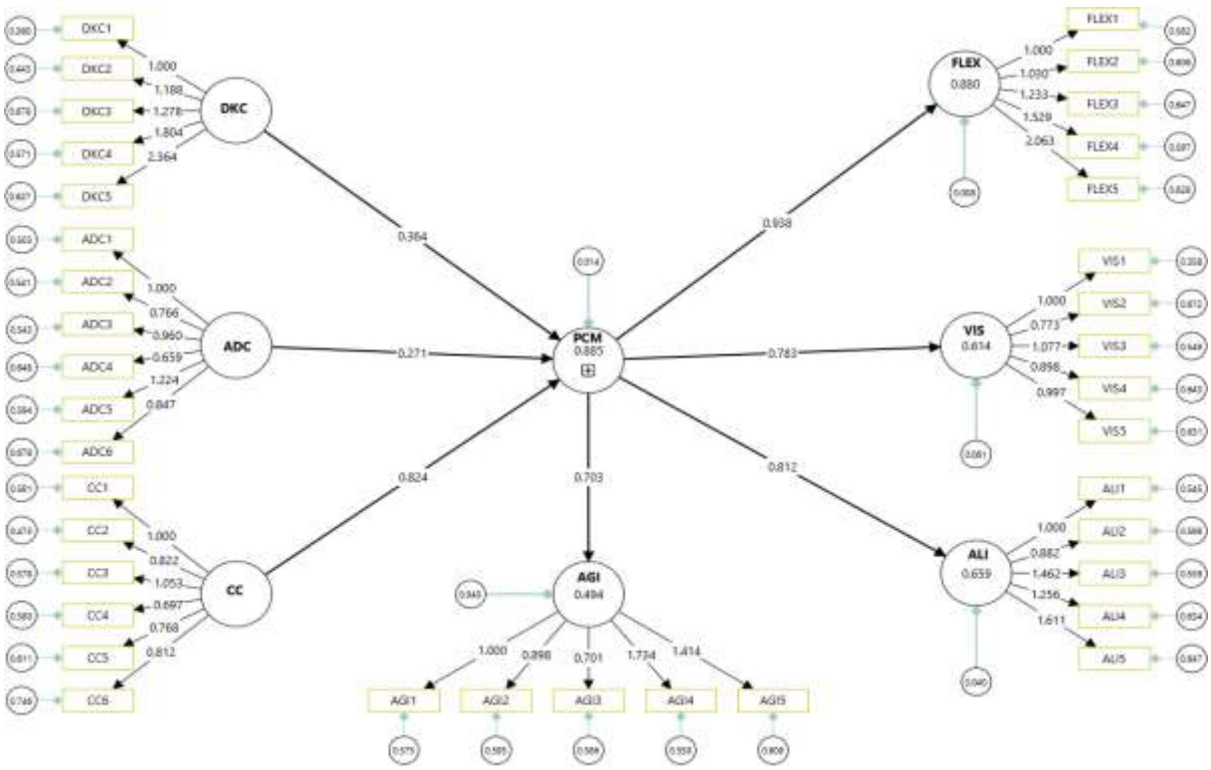

Fig. 2: Path-Diagram-PLS-SEM

3.2.2 RELIABILITY ANALYSIS

Based on the path diagram, reliability analysis was performed. The analysis of the reliability of the specified constructs revealed a moderate-to-low degree of measurement consistency (Table 2 below). Further, Cronbach's Alpha, an essential metric for assessing internal consistency, was observed to be fluctuating between 0.45 and 0.63, indicating a moderate reliability (Perry *et al.*, 2004). Likewise, Composite Reliability (rho_c) values were observed to be ranging between 0.5 and 0.7, considered as acceptable within exploratory research (Hair *et al.*, 2011).

Table 2: Reliability Analysis

	Cronbach's alpha (standardized)	Cronbach's alpha (unstandardized)	Composite Reliability (rho_c)
ADC	0.633	0.633	0.634
AGI	0.493	0.497	0.469
ALI	0.650	0.651	0.605
CC	0.619	0.616	0.617

DKC	0.457	0.458	0.474
FLEX	0.566	0.572	0.518
PCM	0.608	0.610	0.492
VIS	0.612	0.607	0.556

3.2.3 Model-Fit

Table 3 below presents the fit indices pertinent to a regression analysis and a classification analysis. These indices serve as critical metrics for evaluating the extent to which the models adequately correspond to the data. The observed low Root Mean Square Error of Approximation (RMSEA) value of 0.068 and high value of 0.782 for Goodness of Fit Index (GFI), indicate a good model fit. Additionally, the values of 0.573 for Comparative Fit Index (CFI) and 0.548 for Tucker-Lewis Index (TLI) indicates a moderately good fit for the model. Further, a Standardized Root Mean Square Residual (SRMR) value of 0.108 indicates an acceptable fit. In summation, the fit indices collectively imply an exceptionally good fit for the model.

Table 3: Fit Indices

			RMSEA	**95% CI**	
No of OB	**SRMR**	**RMSEA**	**Lower**	**Upper**	**RMSEA P**
326	0.108	0.068	0.065	0.072	0.000

CFI	**TLI**	**ChiSqr/df**	**GFI**	**Adj. GFI**	**Pars. GFI**
0.573	0.548	2.526	0.782	0.758	0.705

3.2.4 R-Square Prediction

The results presented in Table 4 below highlights the R-Square values (representing the proportion of a dependent (endogenous) variable's variance that might be accounted for by the model's independent (exogenous) variables) for AGI (49.4%), ALI (65.9%). FLEX (45.8%) PCM (88.5%), and VLS (61.4%), indicating a stronger explanatory power and a better model fit representing the data.

Table 4 R-Square Values

	R-square
AGI	0.494
ALI	0.659
FLEX	0.880
PCM	0.885
VIS	0.614

3.2.5 RELATIONSHIP ANALYSIS

The spearman's correlation matrix (Table 5 below) elucidates high values of associations between PCM and FLEX (0.938), CC and PCM (0.824), PCM and ALI (0.812), PCM and VSI (0.783), and PCM and AGI (0.703), thereby indicating a perfect monotonic association. Moderate to weak correlations are observed for DKC with PCM (0.364), which suggests moderate strength of the monotonic relationship between the two variables. Further, the results between ADC and PCM (0.278), indicate a weak positive correlation.

Table 5. Relationship Matrix

	ADC	AGI	ALI	CC	DKC	FLEX	PCM	VIS
ADC	1.000	0.191	0.220	0.000	0.000	0.254	0.271	0.212
AGI	0.191	1.000	0.570	0.579	0.256	0.659	0.703	0.550
ALI	0.220	0.570	1.000	0.669	0.296	0.761	0.812	0.636
CC	0.000	0.579	0.669	1.000	0.000	0.773	0.824	0.645
DKC	0.000	0.256	0.296	0.000	1.000	0.342	0.364	0.285
FLEX	0.254	0.659	0.761	0.773	0.342	1.000	0.938	0.735
PCM	0.271	0.703	0.812	0.824	0.364	0.938	1.000	0.783
VIS	0.212	0.550	0.636	0.645	0.285	0.735	0.783	1.000

3.2.6 TOTAL EFFECTS MODEL

In order to ascertain the validity and reliability of the results derived from the structural path model (SEM), it is imperative to identify and mitigate the multicollinearity present among all sets of predictor constructs within the structural equation model. This objective can be partially fulfilled by employing the Variance Inflation Factor (VIF) as a diagnostic metric. The absence of collinearity concerns is indicated when the VIF value remains below 3. Table 6 below illustrates that multicollinearity issues are non-existent as all recorded values stand below 3 (Hair *et al*., 2021).

Table 6: Total effects model (Inner VIF)

	ADC	AGI	ALI	CC	DKC	FLEX	PCM	VIS
ADC		0.191	0.220			0.254	0.271	0.212
AGI								
ALI								
CC		0.579	0.669			0.773	0.824	0.645
DKC		0.256	0.296			0.342	0.364	0.285
FLEX								
PCM		0.703	0.812			0.938		0.783
VIS								

3.2.7 HYPOTHESIS MODEL

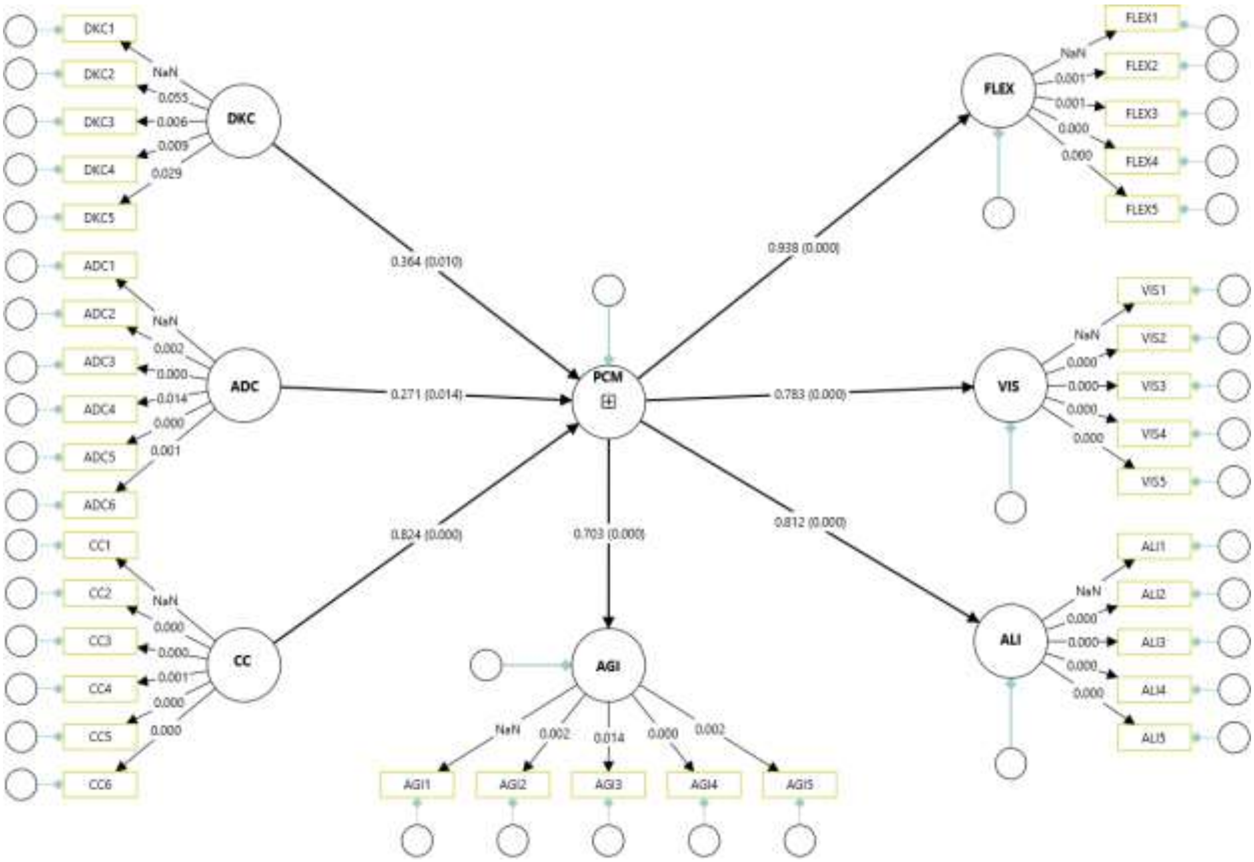

Fig. 3 Bootstrapping

The study employs Bootstrapping, a nonparametric technique that enables testing the statistical significance of different PLS-SEM results, including path coefficients. This is because PLS-SEM does not assume that the data is normally distributed, which means that parametric significance tests cannot be used to test significance of the path coefficients. Within bootstrapping, observations from the original data set are randomly selected to form subsamples (with replacement). After that, the PLS path model is estimated using the subsamples. Additionally, 95% confidence intervals (CIs) for significance testing are derived using the parameter estimates for path coefficients from the subsamples. Furthermore, bootstrapping yields the estimates' standard errors, enabling the computation of t-values to assess each estimate's significance (Becker *et al*., 2023).

Table 7 below depicts the parameter estimates for the path coefficients, the results indicate a positive significance between ADC and PCM ($\beta = 0.271$, $t = 2.210$, $p = 0.014$). Additionally, a positive significance is also indicated between CC to PCM ($\beta = 0.824$, $t = 8.342$, $p = <0.001$), DKC and PCM ($\beta = 0.364$, $t = 2.327$, $p = 0.010$), PCM and AGI ($\beta = 0.703$, $t = 6.707$, $p = 0.000$), PCM TO ALI ($\beta = 0.812$, $t = 12.298$, $p = <0.000$), PCM and FLEX ($\beta = 0.938$, $t = 10.463$, $p = 0.000$); and PCM to VIS ($\beta = 0.783$, $t = 12.565$, $p = <0.000$). The results achieved thereby support the hypothesis H1, H2, H3, H4, H5, H6, and H7.

Table 7: Parameter Estimates

	Original sample (O)	Sample mean (M)	Standard deviation (STDEV)	T statistics (|O/STDEV|)	P values	Hypothesis
ADC -> PCM	0.271	0.249	0.123	2.210	0.014	H1-Supported
CC -> PCM	0.824	0.806	0.099	8.342	0.000	H2-Supported
DKC -> PCM	0.364	0.417	0.157	2.327	0.010	H3-Supported
PCM -> AGI	0.703	0.709	0.105	6.707	0.000	H4-Supported
PCM -> ALI	0.812	0.818	0.066	12.298	0.000	H5-Supported
PCM -> FLEX	0.938	0.926	0.090	10.463	0.000	H6-Supported
PCM -> VIS	0.783	0.783	0.062	12.565	0.000	H7-Supported

4. Conclusions, Limitations and Future Research Directions

The study empirically validates the relationships within the hypothetical framework indicating the importance of Dynamic Knowledge Capabilities (DKC), Advanced Digital Capabilities (ADC), and Collaborative Culture (CC) towards promoting Proactive Change Management (PCM) within Supply Chains. Further, the study also empirically validates the resilience capabilities such as dynamic flexibility (FLEX), advanced visibility (VIS), dynamic alignment (ALI), and proactive agility (AGI) within the supply chains fostered through Proactive Change Management (PCM). Hence, the study aids the supply chain stakeholders to capitalize on the resilience capabilities enabled through proactive change management practices driven by DKC, ADC, and CC.

The study limitations include data collection through purposive sampling from a specific industry i.e., hospitality industry. Hence, provides a scope to replicate the study within other supply chains for results validity. Further, boot strapping can also be eliminated by collecting more observations for data analysis. Besides, other sampling techniques could also be employed to assess the validity of the results.

5. Acknowledgements

We would like to express our sincere gratitude to Ms. Aasrita Kalidindi, Vamshidhar Aily, and Prasad Ainapuram, Woxsen University BBA Final Year students, who participated in executing the survey for data collection. Your commitment, diligence, and meticulousness have been crucial for gathering valuable insights for successful completion of the study. Your dedication to precisely collecting and organizing data is quite admirable. Your time and

work in making sure the survey was carried out successfully and properly are very much appreciated. Your contributions have played a vital role in enhancing the quality and reliability of the study findings.

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