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Navigating Innovation Highways: Unraveling the Entrepreneurial Culture's Role with Knowledge Management as the Mediator in Automotive Technology Innovations

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ABSTRACT: The electric vehicle (e-vehicle) automotive sector in India has been undergoing substantial expansion and metamorphosis, propelled by reasons like governmental regulations, ecological considerations, and technological progress. The objective of this study is to determine the impact of entrepreneurial Culture on technical innovation in the e-vehicle automobile business, while also examining the role of knowledge management as a mediator. Employing a cross-sectional design, data for analysis were gathered using a questionnaire technique from managers and employees of six e-vehicle automobile industries in India. Despite distributing 500 questionnaires, the study received responses from 53 managers and 332 employees. Utilizing the PLS-SEM approach, the research reveals the positive influence of an entrepreneurial culture on technological innovation. Moreover, it highlights the partial mediation effect of knowledge management in the relationship between entrepreneurial culture and technology innovation. These findings carry substantial implications for businesses in the e-vehicle sector aiming to enhance their innovation capabilities by fostering an entrepreneurial culture and implementing effective knowledge management techniques.

Keywords: Entrepreneurial Culture, Technology Innovation, Knowledge management, E-vehicle automotive industry, PLS-SEM.

I. INTRODUCTION

Global warming has been a significant concern recently, and conventional fuel vehicles cause more environmental pollution. The depletion of our natural resources has been occurring at an accelerated rate in recent decades, necessitating the need for a solution to address these serious challenges [1]. It is essential to find an alternative to reduce traditional fuel consumption as a result of e-vehicle usage came into existence [2]. The automobile sector plays a crucial role in driving India's economy, with a significant presence in global value chains. The e-vehicle automobile industry in India has been experiencing significant growth and transformation, driven by factors such as government policies, environmental concerns, and technological advancements [3]. The growth of this sector has been bolstered by significant government support, enabling it to establish a prominent position among India's industries. India has surpassed China to become the fourth-largest car market globally, with a growing demand for Indian automobiles both nationally and universally. Manufacturers are actively embracing new technologies, digitization, and automation to stay ahead in the competitive market [4]. Technology innovation is essential in the e-vehicle automobile industry for several important reasons, such as cost reduction, environment sustainability, improved efficiency, enhanced user experience, and market competitiveness [5]. These factors are critical for the continued growth and success of the e-vehicle sector and its positive impact on the environment and society. Entrepreneurial Culture fosters an atmosphere of risk-taking, open innovation, and agility, enabling organizations to propel technological advancements, respond to market

changes, and capitalize on fresh prospects [6]. The focus on entrepreneurship has grown significantly, capturing the interest of policymakers, and administrators. State administrations are now responsible for promoting innovation, strong economic growth, and the creation of jobs [7]. The dynamic interplay between entrepreneurial culture and technology innovation has become a focal point of research and discussion, as it holds the potential to reshape the future of e-vehicle manufacturing and its broader implications for sustainable transportation[8]. The connection between these two factors plays a decisive role in driving the ongoing growth and evolution of the e-vehicle sector. Knowledge management encompasses the process of obtaining, generating, and utilizing knowledge [9][10] to bring about transformation and ultimately lead to innovation [11]. Efficient knowledge management can result in improved organizational performance through specific innovations which is required for the emerging sector [12].

The e-vehicle sector has not only revolutionized the way we think about transportation but has also prompted a shift in business strategies, organizational structures, and corporate mindsets [13]. As entrepreneurial spirit drives start-ups and established automotive giants alike, understanding the interplay between this Culture, technological innovation, and knowledge management is crucial to navigating the unique challenges and opportunities that define the e-vehicle industry [14].

While numerous studies have explored the relationship between entrepreneurial Culture and innovation, [15]. There is a deficiency of study specifically examining the role of technology innovation and knowledge management as a mediating variable in the context of e-vehicle automobiles. Therefore, it is crucial to examine the correlation between entrepreneurial culture and technology innovation, with knowledge management serving as a mediating factor. Considering the above research gaps, the objective of this study is to:

1. Examine the relationship between entrepreneurial culture and technology innovation.
2. Examine the mediation effect of knowledge management between entrepreneurial culture and technology innovation.

The article is organized in the following manner: It provides a theoretical overview followed by the hypothesis and conceptual model. Methodology in the third division. Analyzes the outcomes. Formulates the most pertinent inferences. Lastly, this study delves into the implications and limitations it entails.

II. LITERATURE REVIEW

1. ENTREPRENEURIAL CULTURE

Entrepreneurial Culture refers to a firm's inclination toward seeking out new resources, fostering innovation, and developing new goods[16, 17]. Previous research has indicated that the entrepreneurial Culture can be broken down into three distinct dimensions: innovativeness, proactiveness, and risk-taking. [18]. An essential component of cultivating an entrepreneurial culture is placing significant importance on promoting and enabling innovation, creative methodologies, and the generation of novel concepts through the process of experimentation.[19]. Organizations that have an entrepreneurial culture, in contrast to more conservative, engage in audacious and regular innovation [20]. They demonstrate a proactive approach and voluntarily embrace risks in order to implement strategies focused on generating innovative products, services, or processes [21].

Entrepreneurial Culture is closely linked to technological innovation as it determines the level of innovativeness inside a business and fosters a climate where people are motivated to generate and execute novel ideas in the workplace [22]. Institutional pressures stemming from cultural values influence the ability of entrepreneurs to learn, which in turn affects their innovation activities. This suggests that entrepreneurial learning capacities act as a mediator, allowing entrepreneurs to maximize the benefits of cultural values on their businesses' innovation [23]. The concepts of "entrepreneurship," "entrepreneurial

culture," and "innovation" are closely interconnected [24]. According to Jinini, a strong entrepreneurial culture within a company drives innovation, which in turn enhances its competitiveness and long-term viability [25].

2. TECHNOLOGY INNOVATION

The OECD (2005) defines "innovation as the introduction of a novel or substantially enhanced product (item or service) or process, a fresh marketing approach, or a new organizational strategy in company processes, workplace organization, or external relations". Technological innovation refers to the utilization of novel technology or the discovery of fresh groupings of preceding technologies to develop new products or services or enhance current ones [26]. which can lead to significant changes that either render existing competencies obsolete, requiring the development of new skills, abilities, and knowledge, or enhance present competencies by leveraging existing skills, abilities, and knowledge [27]. Technological innovation consists of product and process innovation, whereas non-technological/service innovation consists of organizational and marketing innovation [28]. In light of accelerated technological advancements and growing international rivalry, it is evident that the capacity of businesses to create groundbreaking new products and services significantly impacts their long-term performance[29].

3. KNOWLEDGE MANAGEMENT

Knowledge management encompasses a range of actions such as identifying, acquiring, creating, utilizing, sharing, and storing knowledge. These activities have been explored by various researchers [30]; [31, 32] argue that these knowledge activities are crucial for the successful implementation of innovations. Hence, the organization's function extends beyond the mere acquisition of capabilities and resources. However, it plays a crucial part in the development of organizational knowledge, where information is seen as a valuable asset and a means of distinguishing and gaining a competitive edge within the business [33]. Knowledge management can serve as an intermediary in the correlation between entrepreneurial Culture and technological innovation. When an organization cultivates an entrepreneurial culture, it promotes the generation and dissemination of information. Consequently, this has an impact on the process of innovation. Knowledge management acts as a path, enabling the exchange of information and ideas that are essential for the process of innovation [34, 35]

4. THEORETICAL BACKGROUND

The theory of Dynamic Capability, pioneered by Teece and his team, emphasizes the ability of an organization to effectively respond to and navigate through evolving circumstances by leveraging and adjusting its internal and external resources. Dynamic capability refers to the ability to generate optimal working conditions for all personnel to boost their ability to undertake risky projects through the generation of radical innovation [36]. The Culture of entrepreneurship is crucial for developing dynamic capabilities, as it promotes a proactive and risk-taking mindset that fosters innovation and ongoing learning. This cultural mindset, which encourages experimentation and calculated risk-taking, aligns well with the demands of dynamic capabilities [37]. The theory's connection to technology innovation is clear as organizations with dynamic capabilities are more prepared to detect emerging technologies, take advantage of opportunities for innovation, and adapt internal structures to support technological advancements [38]. Knowledge management acts as a vital part of this connection, enabling the exchange of information and expertise that strengthens the organization's dynamic capabilities [39]. Collectively, these components establish a holistic structure for companies to navigate through changes, promote creativity, and maintain a competitive edge in ever-changing markets. With this understanding hypotheses are framed.

5. HYPOTHESES

H1: Entrepreneurial Culture Influences Technology Innovation.

H2: EC has a positive effect on knowledge management.

H3: KM has a positive effect on Technology Innovation.

H4: Knowledge management mediates the relationship between entrepreneurial culture and technology innovation.

Based on the four assumptions mentioned earlier, a conceptual model is given for conducting an empirical study to determine the major impact on Technology innovation, (as shown in Figure 1).

III. MATERIAL AND METHOD

1. CONCEPTUAL MODEL

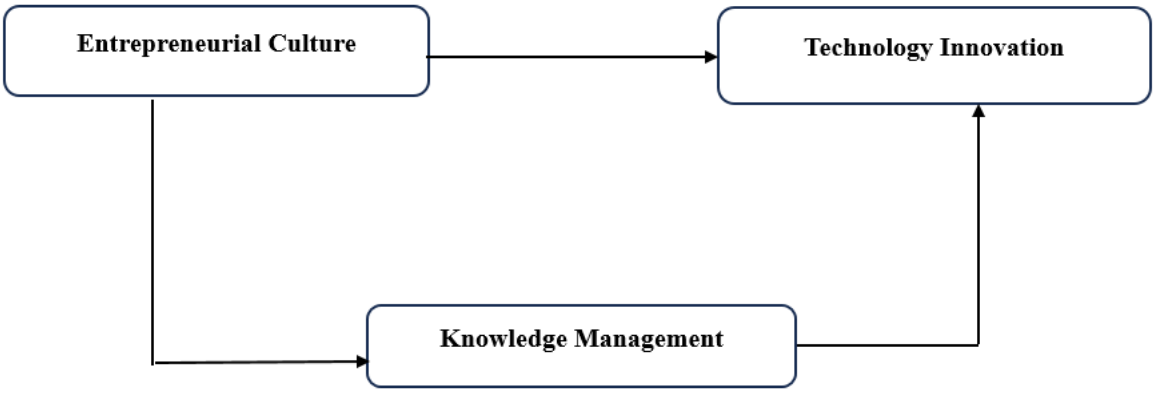

FIGURE 1. Research Model

2. MEASUREMENT

In order to put this paradigm into practice, all three constructions are considered to have a single dimension. Every metric is a reflection of an individual's view of these things. According to the literature review, the measurements of the three components in our research model are as follows:

- EC: Using a six-item scale adopted from[40]
- KM: Adopted from [41- 43]. The instrument contains seven items.
- TI: A five-item scale adopted from[44].

All constructs were measured on a five-point Likert scale, in which 1= “strongly disagree” and 5= “strongly agree”.

3. DATA COLLECTION

A questionnaire technique has been used to collect the data from managers and employees of six e-vehicle automobile industries operating in India. Out of 500 questionnaires, only 53 managers and 332 employees responded. The table presents a demographic overview of the respondents, highlighting intriguing patterns in gender, age, marital status, and work experience. Most of the participants are male, making up 75% of the group, with females comprising the remaining 25%. The age distribution is quite varied, with 35% of individuals falling within the 31-40 age group. Additionally, there are roughly equal

proportions of people in the 18-30, 41-50, and above 51 categories. The data shows that the majority of respondents, 66%, are married, while the remaining 34% are single. When it comes to work experience, the majority of individuals have 11-15 years of experience, making up 35% of the group. Following closely behind are those with 6-10 years of experience, accounting for 27%. This demographic snapshot provides valuable insights into the composition of the surveyed population, showcasing trends in gender, age, marital status, and professional experience.

4. STATISTICAL ANALYSIS

The article utilized the PLS-SEM approach to assess the influence of variables and the association among latent constructs. This was done by replicating the inner model, relationship indicators, and latent variables [45]. Indirect effects can be calculated using PLS-SEM by employing bootstrapping techniques to calculate path coefficients

Table 1. Demographic Profile

Categories		No. of respondents	Percentage
Gender	Male	289	75
	Female	96	25
Age (years)	18 – 30	80	21
	31 – 40	134	35
	41 - 50	73	19
	Above 51	98	25
Marital Status	Single	132	34
	Married	253	66
Work Experience	1-5 Years	86	22
	6-10 Years	102	27
	11- 15 Years	135	35
	Above 16 Years	62	16

Table 2. Reliability

Measurement items	Loadings	Alpha	CR	AVE
		0.908	0.929	0.687
Entrepreneurial Culture	0.749			
	0.828			
	0.829			
	0.831			
	0.871			
	0.859			
Knowledge Management		0.932	0.945	0.712
	0.843			

	0.896			
	0.881			
	0.859			
	0.882			
	0.824			
	0.708			
		0.889	0.918	0.691
	0.818			
	0.894			
Technology Innovation	0.805			
	0.818			
	0.820			

IV. DATA ANALYSIS

1. MEASUREMENT MODEL

The measurement model was evaluated to determine its convergent validity and discriminant validity. Convergent validity was assessed by examining item loadings, composite reliability (CR), and average variance extracted (AVE). According to the data shown in Table 2, all loadings exceed the suggested threshold of 0.7. The CR values passed the suggested threshold of 0.7, while the AVE for all the latent components exceeded the recommended threshold of 0.5 [46]. Furthermore, discriminant validity was assessed based on the condition established by (Fornell, 1981). Discriminant validity pertains to the degree to which a concept is genuinely separate from other concepts based on observed criteria [46]. Table 3 demonstrates that the square root of the average variance extracted (AVE) for each construct on the diagonal of the matrix was greater than the correlation between constructs (off-diagonal) in the corresponding rows and columns. This indicates that there is sufficient evidence of discriminant validity.

Table 3. Discriminant Validity

Constructs	**EC**	**KM**	**TI**
Entrepreneurial Culture (EC)	**0.829**		
Knowledge Management (KM)	0.773	**0.844**	
Technology Innovation (TI)	0.819	0.697	**0.832**

Note: Diagonal values are greater than the inter-construct correlation

V. Results

The hypothesis was tested using the bootstrapping method, with a re-sampling of 5,000. The acceptability of a hypothesis was evaluated based on the t-value, p-value, and confidence interval bias adjustment. Among the three hypotheses examined, the study discovered that entrepreneurial Culture has a significant impact on Technology Innovation ($\beta = 0.819$, $t = 40.058$, LL = - 0.775, UL = 0.855, $p > 0.05$). Consequently, the H1 hypothesis was confirmed. All hypotheses were supported. The study revealed that

there was a positive correlation between Entrepreneurial Culture and Knowledge management (β = 0.773, t = 26.192: LL = 0.713, UL = 0.830, p 0.05). H2 was supported, respectively. Knowledge management positively mediates the relationship between entrepreneurial culture and technology innovation (β = 0.123, t = 3.380: LL = 0.047, UL = 0.188, p< 0.05) Therefore, H3 was supported (Figure 2). The results have additionally demonstrated that there is a positive correlation between knowledge management and technology innovation. (β = 0.159, t = 3.275: LL = 0.059, UL = 0.248, p< 0.05). This finding, consistent with previous research (Robinson et al., 2006; Nonaka, 2007), indicates that improvements in knowledge management are linked to increases in innovation. This implies that when an organization enhances its knowledge, it may result in innovations such as changes in structures, processes, or core competencies. The significance of the standardized indirect effect of EC on technology innovation, with mediation present, is evident with a p-value of 0.000. Similarly, the significance of the standardized direct effect of entrepreneurial Culture on technology innovation, with mediation present, is apparent with a p-value of 0.001. This suggests a case of partial mediation, as both the direct and indirect paths are significant.

Table 4. Hypothesis Testing

Association	Beta	Mean (M)	Standard Deviation (STDEV)	t- Statistics	p- Value	LL	UL	Decision
EC- TI	0.819	0.819	0.020	40.058	0.000	0.775	0.855	Supported
EC- KM	0.773	0.773	0.030	26.192	0.000	0.713	0.830	Supported
KM- TI	0.159	0.158	0.048	3.275	0.001	0.059	0.248	Supported
EC-KM-TI	0.123	0.122	0.036	3.380	0.001	0.047	0.188	Supported

Note: LL- lower limit; UL- upper limit

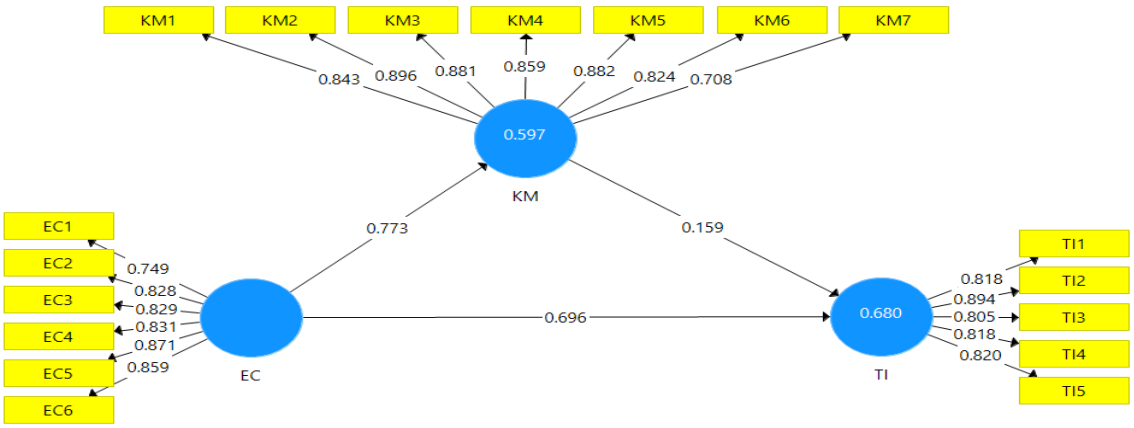

FIGURE 2. Structural model. Source: Author's compilation

VI. Discussion

Environmental sustainability is an imperative concern that needs to be addressed. There has been an increase in interest in alternate modes of transportation due to mounting concerns regarding sustainable development and the environment. Electric vehicles can significantly contribute to accomplishing this objective as they release around 90% less carbon emissions in comparison to traditional automobiles. The importance of buying electric vehicles has been emphasized due to the significant impact of technological

innovations on the automotive industry's ability to compete and thrive in the global market. This study intended to find the impact of entrepreneurial Culture on technology innovation in the e-vehicle automobile industry. Based on the available literature and the research hypotheses, the findings of this study align perfectly with the existing research and support all of the proposed hypotheses. The literature highlights several fundamental processes that emphasize the favorable indirect influence of entrepreneurial Culture on technological innovation. Entrepreneurial cultures, which are defined by open communication and the exchange of knowledge, provide an atmosphere that is favorable to innovation [47]. The propensity to undertake risks and engage in experimentation within such cultural contexts fosters innovative methods and solutions, hence propelling creativity [48]. Moreover, fostering employee participation and intrapreneurship in entrepreneurial cultures enables the recognition of novel opportunities and the creation of inventive resolutions (Urbana-Champaign, 1985). The inherent flexibility and adaptability of entrepreneurial cultures are essential for effectively navigating dynamic situations and embracing emerging technology [19]. Moreover, entrepreneurial cultures that possess strategic vision and future orientation play a significant role in promoting investments in research and development, which in turn positions firms for technological innovation [29]. These mechanisms collectively demonstrate how an entrepreneurial culture indirectly promotes technical innovation within firms.

The results are consistent with the Theory of Dynamic Capabilities. Entrepreneurial cultures, which are defined by an inclination towards innovation and taking risks, align with the dynamic capabilities framework's focus on an organization's capacity to identify and capitalize on opportunities. Teece [50] Entrepreneurial cultures that promote knowledge sharing and cooperation enhance the integration of diverse knowledge resources, which is a crucial component of dynamic capacities. Furthermore, the ability to adapt and be flexible which is inherent in entrepreneurial cultures is in line with the dynamic capabilities, which emphasizes an organization's capacity to dynamically reorganize resources to respond to changing surroundings. The entrepreneurial cultures promote a forward-thinking mindset that aligns well with the theory's focus on strategic vision. Overall, the Theory of Dynamic Capabilities offers a strong theoretical framework for comprehending the intricate connection between entrepreneurial Culture and technological innovation in the e-vehicle industry. Therefore, an entrepreneur with the appropriate entrepreneurial Culture can promote technological innovation. Consequently, the initial research inquiries have been addressed [38]. The findings of this study have important implications for organizations that want to improve their innovation capabilities by fostering an entrepreneurial culture and implementing effective knowledge management practices.

1. MANAGERIAL IMPLICATIONS

All of the above findings have useful implications for the managers in e-vehicle automobile firms. First, our study suggests that encouraging the employee's innovativeness, risk-taking ability and proactiveness in terms of entrepreneurial Culture will promote technological innovation. Therefore, the top management should focus more on improvising entrepreneurial Culture to foster technology innovation. Organizations should actively cultivate an entrepreneurial culture by encouraging risk-taking and a proactive mentality to stimulate innovation [51]. Second, the research results suggest that knowledge management is positively related to technological innovation. Firms should be more efficient and realistic in implementing KM which can be achieved by selecting an appropriate KM practice that will be suitable for the growth of the organization and also for the knowledge enhancement of the employees to promote technology innovation. Investing in techniques that support knowledge production, diffusion, and application inside the company becomes essential when one acknowledges the mediating role of knowledge management [52].

2. LIMITATIONS AND FUTURE RESEARCH DIRECTIONS

The applicability of the results is limited by the particular circumstances examined, necessitating prudence when extending them to diverse sectors or cultural environments. There is a need to improve the way dynamic capabilities are defined and measured to accurately portray their complex and ever-changing character. Furthermore, future investigations could explore the fundamental processes and mechanisms that are engaged in the connections between entrepreneurial Culture, knowledge management, dynamic capabilities, and technology innovation. To improve the external validity of the study, researchers could employ longitudinal designs, investigate a variety of organizational contexts, and integrate different sources of data. Potential future research directions may encompass the examination of moderating factors, the execution of comparative analyses across various industries, the utilization of qualitative methodologies, the evaluation of interventions aimed at improving organizational practices, and the exploration of global perspectives to comprehend the cross-cultural implications for innovation. To assess the feasibility of the research and determine whether it is appropriate to apply it in other areas of the Indian automobile industry, this study makes recommendations for future research to be conducted by academics, researchers, and scholars.

VII. CONCLUSION

The study sought to investigate the factors that influence technology innovation, with a particular emphasis on the impact of entrepreneurial Culture and the mediating influence of knowledge management. The results have yielded useful insights into the direct and indirect interactions among these variables. The strong correlation emphasizes the influence of an entrepreneurial culture on technological innovation, emphasizing its pivotal role in promoting technology innovation within firms. Moreover, the identified indirect correlation, facilitated by knowledge management, underscores the significance of efficient knowledge procedures in strengthening the link between entrepreneurial Culture and technological innovation. Nevertheless, it is imperative to recognize the constraints of the study, such as the dependence on a questionnaire for data gathering and the utilization of a one-dimensional scale to assess entrepreneurial Culture. Future studies could be enhanced by integrating qualitative methodologies, utilizing multidimensional measurement tools, and investigating supplementary elements that impact entrepreneurial Culture. Moreover, broadening the range of sectors under investigation and utilizing longitudinal methodologies could provide a more all-encompassing comprehension of the underlying dynamics. Although our study has certain limits, it adds to the current body of knowledge on technology innovation, establishing a basis for further investigation and improvement in this dynamic subject.

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