Knowledge Management and its Impact on Innovation: Empirical Evidence from the Ferro Chrome Manufacturing Industry in India

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Abstract: *In today's swiftly evolving business landscape, organizations incessantly strive to maintain competitiveness and drive innovation. Central to this endeavour is the role of knowledge management, which facilitates the synthesis and dissemination of knowledge throughout the organization. This study probes the influence of knowledge management on innovation within the ferrochrome manufacturing organisation in eastern India, utilizing an empirical methodology. Data were amassed via a meticulously constructed survey, targeting managerial, technical, and officer-level respondents across diverse departments. Employing simple random sampling to determine the sample size, the study leveraged factor analysis and regression analysis, processed through SPSS 21.0, for data examination. The results elucidate the discrete impacts of knowledge acquisition, creation, sharing, application, and organization on both product and process innovation. While temporal limitations curtailed the breadth of the survey, this research augments the extant literature by scrutinizing the nexus between knowledge management and innovation within a distinct organizational context. The insights garnered from this inquiry offer strategic value for analogous entities in the ferrochrome sector, guiding the formulation of innovation-centric strategies. The study's outcomes further posit that knowledge management is a pivotal determinant of innovation success, underscoring the imperative for organizations to prioritize investments in knowledge management initiatives to fully capitalize on their innovation endeavours.*

Keywords: *Knowledge Management, Innovation, Ferrochrome, Manufacturing, Regression analysis*

Introduction

The modern world is getting increasingly competitive every day due to the advancement of science and technology. The new generation's views on dealing with life have shifted from orthodox to heterodox. The work culture of industries demands multi-skilled human resources, which involves de-skilling and re-skilling their employees. The only weapon to cope with this rapid environmental change is to embrace innovation. "Innovation is a multi-phase process in which organizations convert ideas into new or enhanced products, services, or processes, enabling them to grow, compete, and stand out effectively in their market." (Baregheh et al., 2009). The growth-oriented industries have their R&D laboratories striving to stand out. The Global Innovation Index report published each year shows the concern of the entire world for innovation. The economies of different parts of the world have invested much of their GDP in innovation in different sectors over the years. India's rank has developed over the years, and it was declared the 57th most innovative nation in the world in 2018. Its position in India has improved steadily, as evident in its 60th rank in 2017. The credit for improving the ranking lies in the contributions of its different sectors, especially in manufacturing industries. The industrial sector's contribution to India's GDP is 31%, while its primary sector is only 17% (Economic et al., 2017–18). Knowledge Management (KM) is a vital contributor to business performance and an important innovator of new ideas (Santhose & Lawrence, 2023; Liu et al., 2005). Different businesses use a variety of KM strategies to develop new skills and ensure the progression towards higher performance (Hussain et al., 2010; Ashok et al., 2021).

From making kitchen utilities to surgical equipment, stainless steel has engraved its existence everywhere. The manufacturing of highly used stainless steel and special steels, which are of high quality and generally distinguished by strong corrosion resistance and a low propensity to magnetization, depends on the ferrochrome alloy. Due to the high power cost, the ferroalloy industry has yet to operate at its full capacity in India. Still, the prevalent manufacturers need innovation continuously to keep the industry a primary fuel source for human utilities. A correct KM strategy and effective KM process implementation can ensure innovation readiness. The current study is set to identify the impact of knowledge management on innovation in Ferroalloys manufacturers. Specifically, the study is designed to answer the following research questions:

I. Whether knowledge management leads to innovation in ferro alloy manufacturing organisations?

II. What is the impact of individual element of knowledge management process on product and process innovation?

Literature review and Hypotheses

Knowledge Acquisition and Innovation

Knowledge acquisition can be understood as the process of gathering, absorbing, and utilizing new knowledge within an organization. firms investing in acquiring knowledge and environmental initiatives maximize their green innovation potential. Environmental efforts provide the framework and resources required to apply new information successfully, while knowledge acquisition informs and develops them. Green innovation is accelerated by this synergy, which makes significant progress in both product and process innovation possible Awan, Arnold, and Gölgeci (2021). Knowledge acquisition is key to boosting a company's capacity for process and product innovation, especially when internal resources are limited. It strengthens innovation efforts by providing essential external insights, enabling successful innovation regardless of internal conditions (Chang and Li, 2015). Effective knowledge acquisition from external sources is vital for SMEs to enhance flexibility in product innovation. By engaging in collaborative efforts with suppliers, such as joint problem-solving and continuous improvement programs, SMEs can access valuable tacit knowledge that supports strategic resource allocation and rapid, cost-effective innovation (Khraishi et al., 2023; Liao and Marsillac, 2015; Ko et al., 2018). These processes not only help firms understand market trends and technological shifts but also emphasize the importance of social capital in driving innovation within supply chains (Liao and Barnes, 2015).

Knowledge acquisition is vital for product innovation, enabling firms to incorporate external insights into development processes, which drives new product creation and market success. Mergers and acquisitions (M&As) are noted as effective strategies to leverage acquired knowledge for innovation enhancement (Dunlap et al., 2016). Cefis et al. (2005) argues that knowledge acquisition impacts product and process innovation differently depending upon the different stages of technological life cycle. During the early stages of a technology life cycle, high marginal returns to innovation encourage greater investment in product R&D, whereas in more mature phases, returns diminish, affecting the balance of product and process R&D investment (Ravichandran and Han, 2017; Artz et al., 2010). Social capital enhances external R&D sourcing by facilitating knowledge acquisition, crucial for product innovation. Regional social networks provide access to valuable external knowledge, essential for developing new products (Laursen and Masciarelli, 2007).

While knowledge acquisition strategies have been well-studied in industries like pharmaceuticals, manufacturing, and IT, the ferroalloy sector may not have received comparable attention (Dunlap et al., 2016; Laursen et al., 2012). A potential gap exists in understanding how ferroalloy firms acquire external knowledge, especially from suppliers or through M&As, to drive innovation in alloy processing, energy efficiency, and environmental sustainability. Based on the above arguments, it is proposed that,

H1a: Knowledge Acquisition is positively related to Product innovation.

H2a: Knowledge Acquisition is positively related to Process innovation.

Knowledge Creation and Innovation

Knowledge creation processes can serve as enablers for innovation, emphasizing that continuous generation of new knowledge is crucial for sustaining competitive advantage in rapidly changing markets. The study Esterhuizen et al., 2012 categorizes knowledge creation into four processes as socialization, externalization, combination, and internalization highlighting their role in enhancing an enterprise's innovation capability maturity. Knowledge creation impacts innovation by requiring a supportive organizational climate and strategic alignment; without these, the learning processes that drive innovation are not effectively stimulated, hindering successful innovation outcomes. If innovation is not continuous, the innovation spiral does not hold true (Merx-Chermin and Nijhof, 2005). Product innovation is fuelled by managerial ties and organizational knowledge creation, integrating knowledge from R&D, manufacturing, and marketing. These ties offer network benefits that, combined with internal knowledge, enhance both product and process innovation, providing firms a strategic advantage in dynamic environments (Shu et al., 2012). Romanian SMEs leverage both internal best practices and external sources like market changes and expert input to drive innovation. Their learning orientation supports the application of acquired knowledge to innovate within their business models. However, constraints such as limited funds and high costs challenge their ability to fully implement these innovations (Purcarea et al., 2013). To cultivate a sustainable competitive advantage, manufacturing firms must strategically deploy knowledge creation processes and bolster their technical innovation competencies (Yin et al., 2019). Although knowledge creation processes facilitate the advancement of process innovation capabilities, they do not directly enhance product innovation capabilities. The mere implementation of knowledge creation processes is inadequate; firms must embed these processes within both process and product innovation frameworks to secure sustainable competitive advantage (Yu et al., 2017; Goh, 2005). External knowledge acquisition benefits firms in achieving product innovation through internal knowledge creation (Wuyts & Dutta, 2014). Business collaborations realize product and process innovation through the Knowledge creation process (knowledge exchange and combination). This has been proven in Jordanian small and medium-sized enterprises investigated by Alshanty et al., 2019.

Esterhuizen et al. (2012) emphasized the SECI process for innovation capability maturity, but research on its application in the highly technical ferroalloy sector is limited. While process innovation, like optimizing furnace operations, is well-explored, the role of knowledge creation in product innovation remains under-researched. Collaborative efforts within the global ferroalloy industry could be key in leveraging knowledge creation for both product and process innovation (Yu et al., 2017; Alshanty et al., 2019). Based on these arguments, it is proposed that,

H1b: Knowledge Creation is positively related to Product innovation.

H2b: Knowledge Creation is positively related to Process innovation.

Knowledge Sharing and Innovation

Knowledge sharing with external stakeholders is crucial for continuous product innovation, as demonstrated by Spanish firms. Markovic and Bagherzadeh (2018) show that firms engaging in external knowledge sharing can maintain a steady flow of innovative ideas and products. Additionally, establishing a knowledge-sharing mechanism through collaboration with competitors enhances product innovation, according to Estrada et al. (2016). Their study highlights that even among competitors, collaborative efforts can lead to significant advancements in innovation. Similarly, AI-Husseini and Elbeltagi (2018) found that information sharing promotes learning and drives innovation in both public and private Higher Educational Institutions in Iraq. Their research indicates that such exchanges encourage behavioural changes that lead to innovations in products and processes within these institutions. Knowledge sharing can be divided into two key types: **knowledge donating** and **knowledge collecting**. Additionally, the process of sharing knowledge positively influences various aspects of an organization's innovation capacity, such as innovation speed, innovation quality, green service innovation, and innovation behavior (Yesil et al., 2013; Rumanti et al., 2018). The studies put emphasis on the act of gathering knowledge is more influential than merely sharing it as the study found that knowledge donation has a minimal impact on innovation, while knowledge collection plays a more significant role in driving innovation (Yesil et al., 2013; Kamasak and Bulutlar, 2010). Leonardi, (2014) introduces a theory of communication visibility, highlighting how previously unseen interactions in an organization can become accessible to others. This visibility allows individuals to enhance their understanding of the knowledge and connections within the organization. As a result, they gain a clearer sense of who holds specific expertise and who is connected to whom. Basically social media translucency plays instrumental role in providing platform for this. Sharing knowledge among people creates affective commitment who is willing to share that further leads to innovation, Camelo-Ordaz (2011) found in the study conducted on Spanish R&D organisations. It also argues that knowledge sharing activity directly leads to innovation performance. SMEs, being responsive to social and economic shifts, have demonstrated their ability to foster an innovation culture through knowledge sharing. Adapting business strategies to current demands and cultivating a problem-solving mindset is strengthened by knowledge sharing, which drives innovation (Arsawan et al., 2022). By offering an appropriate platform and promoting communication, a strong social network fosters trust and confidence among employees to share knowledge by recognizing like-minded individuals. This process encourages diverse problem-solving approaches and the creation of new knowledge, which in turn drives innovation, particularly in unpredictable service industries (Allameh, 2018). Overall, the survival and success of organizations depend on employee collaboration, as they possess the skills and knowledge necessary to transform ideas into innovations. **Social web technologies** play a key role in enabling efficient knowledge sharing, promoting teamwork, and accelerating the innovation process across organizations (Soto-Acosta et al., 2017). These technologies are ideal for facilitating effective information and knowledge exchange, ultimately leading to greater innovation outcomes.

While knowledge sharing with external stakeholders like suppliers, customers, and even competitors has been studied in industries like R&D, education, and SMEs (Markovic & Bagherzadeh, 2018; Estrada et al., 2016), the ferroalloy industry lacks specific research on how the industry engages in joint ventures, industry consortiums, or competitor collaborations to drive technological advancements in alloy compositions and energy-efficient processes. Ferroalloy manufacturing involves highly specialized, often tacit knowledge in areas like metallurgy, energy management, and production efficiency (Balconi, 2002; Beek, 2008; Piatak and Ettler, 2021). There is limited research exploring how tacit knowledge, as opposed to explicit knowledge, is shared within and across organizations in this sector, and how this impacts innovation, particularly in optimizing smelting processes or adopting environmentally sustainable practices. The use of social media and web technologies to facilitate knowledge sharing has been widely studied in service industries (Soto-Acosta et al., 2017), but their relevance and implementation especially sharing technical innovations or environmental best practices in the ferroalloy manufacturing sector remain under-researched. Considering the findings of the above studies, it is proposed for this study that:

H1c: Knowledge Sharing is positively related to Product innovation.

H2c: Knowledge Sharing is positively related to Process innovation.

Knowledge application and Innovation

Knowledge acquisition and application have been demonstrated to significantly influence process innovation and business performance (Turulja & Bajgoric, 2018). Knowledge application, in particular, fosters process innovation by promoting risk-taking and cultivating a proactive organizational culture (Garcia et al., 2019). The practice of leveraging diverse forms of knowledge within an organization—whether explicit (documented) or tacit (experiential)—to address specific challenges is referred to as knowledge application. This ensures that the knowledge generated and shared is effectively utilized, thereby enhancing creativity, improving problem-solving capabilities, and facilitating more informed decision-making. By transforming collective knowledge into actionable insights, this approach empowers employees to apply what they have learned to real-world scenarios, thus increasing productivity and driving organizational growth (Chen & Huang, 2009; Shujahat et al., 2017; Ode & Ayavoo, 2020). Dahiyat (2015) argues that while the acquisition of knowledge strengthens an organization's innovative potential, its true value is realized only when the knowledge is actively put into practice. The practical application of acquired knowledge is the engine behind both organizational innovation and performance enhancement. The challenge of seamlessly integrating external knowledge into an organization's internal processes has highlighted a critical gap, which gave rise to concepts such as absorptive capacity and learning capability. These concepts are essential for facilitating the effective exchange of ideas, enabling individuals to comprehend and internalize valuable insights, and applying them toward the development of new products and innovations (Moreno-Luzon & Begona Lioria, 2008; Dahiyat, 2015).

One of the challenges highlighted by Dahiyat (2015) is the difficulty of integrating external knowledge into internal operations. In the ferroalloy industry, where highly specialized knowledge and technical skills are crucial, there is a gap in understanding how external knowledge—such as new technologies or sustainability practices—can be seamlessly incorporated into the internal processes of manufacturing plants to drive innovation. While it has been demonstrated that knowledge application fosters process innovation in various industries (Garcia et al., 2019), there is little research specific to ferroalloy manufacturing on how firms apply both tacit and explicit knowledge to innovate processes such as smelting, refining, and energy management. To test the relationship between knowledge application and innovation in ferro chrome manufacturing organisations, this study proposes based on the previous study arguments that:

H1d: Knowledge Application is positively related to Product innovation.

H2d: Knowledge Application is positively related to Process innovation.

Knowledge Organisation and Innovation

The sustainable utilization of newly created knowledge hinges on its secure and systematic storage. Knowledge storage extends beyond simple documentation or filing within databases or written records. Organizational memory is preserved in multifaceted forms, including personal recollections, corporate culture, operational protocols, structural frameworks, and even the physical design of work environments (Walsh & Ungson, 1991). However, in the process of simplifying these storage mechanisms, there is a risk of diluting the original depth and value of the knowledge (Storey & Kelly, 2002). When knowledge is embedded within an organization's culture, operational systems, and frameworks, it enables firms to learn from previous mistakes, thereby minimizing errors in production processes and enhancing operational efficiency (Duffield & Whitty, 2015). The organization's ability to access and internalize this stored knowledge is critical to its capacity for continuous learning and adaptation. This involves not merely retrieving past knowledge but seamlessly integrating it into day-to-day operations and strategic decision-making. Robust learning capabilities allow organizations to reinterpret and apply retained knowledge in novel ways, fostering innovation, improving processes, and facilitating the development of new products (Lumpkin and Lichtenstein, 2005). As the organization continuously evolves through learning and innovation, it establishes a competitive advantage by outpacing rivals, responding effectively to market shifts, and delivering differentiated value (Camison & Lopez, 2011; Antunes & Pinheiro, 2020). Moreover, cultivating a strong learning culture is dependent on a sound knowledge management process, particularly the effective storage of knowledge. This process strengthens the nexus between human capital and product innovation, empowering employees to draw upon stored knowledge to fuel creativity and drive the development of cutting-edge products (Martin-de Castro et al., 2013).

Storey & Kelly (2002) highlight the risk of diluting the depth of knowledge during storage processes. In the ferroalloy industry, where precise technical know-how is vital, the challenge of simplifying knowledge storage without losing critical information is particularly relevant. Duffield & Whitty (2015) emphasize that organizational memory plays a critical role in minimizing errors and improving processes. However, there is little empirical evidence on how ferroalloy firms use organizational memory to improve production efficiency and quality control (Abikenova and Daumova, 2022). Based on the above propositions, this study hypothesises that:

H1e: Knowledge Organization is positively related to Product innovation.

H2e: Knowledge Organization is positively related to Process innovation.

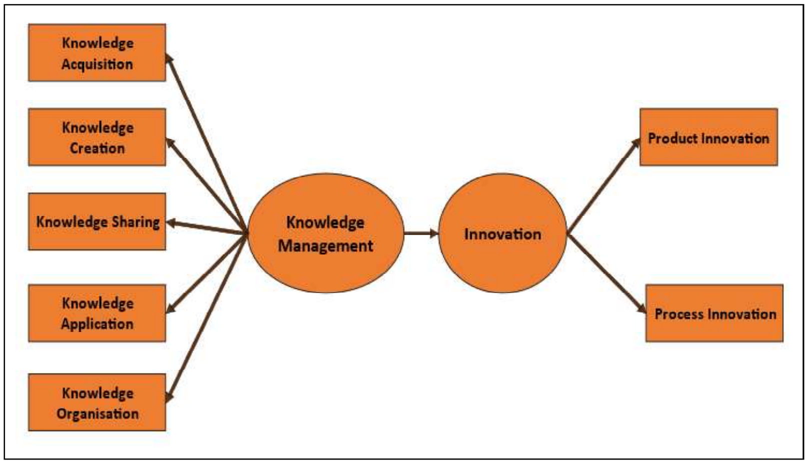

Figure 1. Theoretical model underlying empirical research

Research Methodology

Data collection and sample

The study uses the questionnaire survey method to collect data to test the hypothesis empirically. Variables in the questionnaire include five dimensions of the knowledge management process; knowledge acquisition, knowledge creation, and knowledge sharing, and two dimensions of innovation; product innovation and process innovation, as dependent variables. The study participants were of managerial, technical, and officer levels from fifteen various organizational departments. Researchers administered each questionnaire individually. A sample for data collection has been chosen by adopting simple random sampling. Initially, 140 employees were approached to fill out the questionnaire. Due to their busy schedules, 27 employees could not even attempt to fill out the questionnaire. Out of 123 filled-out questionnaires, 93 were found complete and usable. The response rate for usable questionnaires was 75.6%. The characteristics of the respondents are presented in Table 1.

Table 1: Characteristics of the respondents

Characterisation of the respondents (n=93)	Frequency	Percent
Experience of respondents		
1-10 years	15	16.1
21-30 years	51	54.8
31-40 years	27	29.0
Level of designation of respondents		
Managerial	25	26.9
Technical	60	64.5
Officer	8	8.6
Age of respondents		
20-30 years	3	3.2
31-40 years	5	5.4
41-50 years	21	22.6
51-60 years	61	65.6
61-70 years	3	3.2
Department of respondents		
Briquetting	2	2.2
IT	1	1.1

Operation	1	1.1
Project	1	1.1
QC & Sales Yard	10	10.8
Supply Chain Management	8	8.6
CSR&PR	1	1.1
Customer Relationship Management	1	1.1
Employee Relations	5	5.4
Engineering	15	16.1
Environment	1	1.1
Finance & Accounts	4	4.3
Furnace Operation	42	45.2
General Service	1	1.1

Source: Primary Data

Measures

This study uses a five-point Likert scale ranging from 'strongly disagree' to 'strongly agree.' The scale is represented numerically as follows: 1 for strongly disagree, 2 for disagree, 3 for neutral, 4 for agree, and 5 for strongly agree. Dimensions of Innovation (dependent variable of the study) are measured with seven items. Furthermore, the dimensions of the Knowledge Management process, which consists of five steps, are measured with twenty items. The first step of the Knowledge Management process is Knowledge acquisition, which is measured with four items; knowledge creation is measured with four items; knowledge Sharing is measured with five items; knowledge application is measured with three items; and Knowledge organization is measured with four items. Innovation is considered a dependent variable. Knowledge Acquisition, Knowledge Creation, and knowledge sharing are five independent variables. The researchers developed all the items in the questionnaire by doing an extensive literature review and analysis.

Factor Analysis and Hypothesis Testing

All items in the questionnaire were subjected to factor analysis to identify the relevant factors that depict the Knowledge Management process and Innovation. SPSS 21.0 was employed to carry out the factor analysis and hypothesis testing. Microsoft Excel was used to calculate the composite reliability and convergent validity. For hypotheses testing, regression analysis method was done.

Data analysis and Interpretations

Validity and Reliability

After identifying measures for the two constructs of this study, face validity was conducted by looking at the text in each item in the questionnaire. Further, content validity was also conducted by taking data from four respondents; two subject experts and two executives from the manufacturing industry. The values were above .50, which indicates the validity of the items representing each construct significantly.

Table 3: Convergent validity and AVE

Construct	Composite Reliability	AVE	Cronbach's Alpha
Knowledge Acquisition	0.973612546	0.637998	.877
Knowledge Creation	0.954764677	0.721041	
Knowledge Sharing	0.954764677	0.783642	
Knowledge Application	0.902536286	0.591	
Knowledge Organization	0.908098688	0.502821	
Product Innovation	0.923105843	0.648593	.807
Process Innovation	0.903679978	0.565783	

Source: Primary Data

As argued by Fornell & Larcker (1981), only Chronbach's Alpha is not sufficient to test the measures' reliability. They suggested calculating composite reliability based on each variable's factor loadings and measurement errors (Latif, 2017). In the table-3 above, the composite reliability values are above .90, indicating the reliability of the measures (Hair et al., 2012). Fornell & Larcker (1981) also suggested conducting a convergent validity test to measure the constructs' reliability for calculating Average Variance Extracted (AVE). The value of AVE for each construct is above .50, which can be seen in the table below, representing the confirmed establishment of convergent validity.

Factor Analysis (Dimension Reduction)

A factor is the same as a latent variable, also known as a construct.

Construct = factor = latent variable

A latent variable cannot be assessed directly but may be measured indirectly via several observable variables. Twenty-seven items are reduced to seven factors through factor analysis of two constructs separately. Twenty variables under the Knowledge Management process are reduced to five factors, and seven variables under Innovation are reduced to two; product innovation and process innovation, as per the factor loading. Before conducting factor analysis, it is essential to know the sampling adequacy, the patterned relationship among variables, and the possibility of loading factors adequately. For this, KMO and Bartlett's Tests have been done.

Table 4: KMO and Bartlett's Test[a]

Kaiser-Meyer-Olkin Measure of Sampling Adequacy		.690
Bartlett's Test of Sphericity	Approx. Chi-Square	701.6958
	df	351
	Sig.	.000

Source: Primary Data

a. Based on correlations

Table 4 depicts the result of the test where Bartlet's Test of Sphericity with a significant level of p<.05, a patterned relationship has been confirmed among the variables (p<.001). Furthermore, looking at the KMO of sampling adequacy (above 0.50), it is assumed that distinct and reliable factors can be produced. KMO is here at 0.690, and its significance value of .000 confirms the progress. The Kaiser Criterion is deemed reliable when: a) the average extracted communalities exceed .70 and there are fewer than 30 variables, or b) the average extracted communalities are at least .60, and the sample size exceeds 250 cases (Yong & Pearce, 2013; Field, 2009). Apart from this, it is suggested that the Bartlett method is the most easily understood and reliable (Tabachnik & Fidell, 2007). In this gamut of study, variables are less than 30, so considering the value of 0.690 closer to 0.7 of KMO, the significance of the data can be assured.

Table 5: Factor Analysis

Factors	Variables	Factor loading	Cronbach's Alpha
Knowledge Acquisition	People share their experience and knowledge willingly at workplace.	.851	.877
	Regularly acquires knowledge from public research institutions.	.824	
	Refines, organises and stores the knowledge collected.	.782	
	Regularly generates new ideas for products or services.	.733	
	Record the lessons learned through practical experience.	.724	
Knowledge Creation	Formal channels viz. meeting, courses, workshops, tours etc. are adopted for knowledge sharing.	.923	
	Information and knowledge are actively disseminated throughout all departments.	.877	
	Frequently comes up with new ideas about working methods and processes.	.845	
	Adopts partnerships or strategic alliances to acquire knowledge.	.741	
Knowledge Sharing	Freedom given to employees to experiment their innovative ideas in work.	.960	
	Employees get guidance in difficult situations faced while new strategies are implemented.	.883	
	Shares knowledge and information with strategic partners	.806	
Knowledge Application	Consistently apply gathered knowledge from industrial associations, clients, and suppliers.	.867	
	Provides training programmes for using new technologies.	.806	
	Develops a new method if the traditional method gets ineffective.	.726	
	Employees are encouraged to use new knowledge acquired to boost innovation.	.660	
Knowledge Organization	The most significant experiences gained are documented.	.868	
	Documented knowledge are stored in library or databases for easy access to everybody.	.693	
	Employees are systematically informed about the changes in procedures, instructions and regulations.	.649	
	Uses existing know-how in a creative manner of new applications.	.597	
Process innovation	Organization is able to produce increased number of new ideas over the years.	.906	.807
	The quality of ideas has improved.	.888	
	Organization achieving continuous success through product innovation.	.580	
Product innovation	Successfully implemented new ideas.	.853	
	Achieved success by implementing ideas.	.763	
	Organization achieving continuous success through technological innovation.	.714	
	Organization achieving continuous success through product innovation.	.666	

Source: Primary Data

Table 5 above displays the identified factors extracted from factor analysis. There are total seven (07) factors extracted having eigenvalue Ã 1 (Kaiser, 1960) from twenty-seven variables in the questionnaire. The total variance of the factors explained 73.384%. The factor loadings of each variable are above .50 and the Cronbach's alpha of two major constructs are also above .50 symbolises good for further analysis.

Results and Discussion

To test the hypothesis, a multiple regression analysis was conducted using SPSS 21.0. The aim of the research was to explore the relationships between knowledge management practices and innovation. The analysis involved regressing the dependent variable, product innovation, on the predictors: knowledge acquisition, knowledge creation, knowledge sharing, knowledge application, and knowledge organization. The regression yielded an F-value of $F(5,87) = 45.708$, $p<.001$, indicating a significant effect of the five factors on product innovation. The R^2 value of .724 demonstrates that the model accounts for 72.4% of the variance in product innovation. Additionally, the coefficients were examined to evaluate the impact of each individual factor on product innovation.

Table 6 below depicts the hypotheses testing results individually. H1a evaluates whether knowledge acquisition impacts product innovation significantly. The analysis revealed that knowledge acquisition impacts product innovation significantly and positively (B =.694, t = 28.485, p =.000). Hence, *H1a was supported.*

H1b evaluates whether knowledge creation impacts product innovation significantly. The analysis revealed that knowledge creation impacts product innovation negatively (B = .158, t = 6.470, p =.000). Hence, *H1b was supported.*

H1c evaluates whether knowledge sharing impacts product innovation significantly. The analysis revealed that knowledge sharing impacts product innovation significantly and positively (B =.592, t = 24.299, p =.000). Hence, *H1c was supported.*

H1d evaluates whether knowledge application impacts product innovation significantly. The analysis revealed that knowledge application impacts product innovation significantly but negatively (B = -.298, t = -12.248, p =.000). Hence, *H1d was supported.*

H1e evaluates whether knowledge organization impacts product innovation significantly. The analysis revealed that the knowledge organization does not impact product innovation significantly (B = -.043, t = -1.784, p =.078). Hence, *H1e was not supported.*

Table 6: Result of Hypothesis testing

Hypothesis	Regression weights	B	t-value	p-value	Hypothesis supported
H1a	Knowledge Acquisition? Product Innovation	.694	28.485	.000	Yes
H1b	Knowledge Creation? Product Innovation	.158	6.470	.000	Yes
H1c	Knowledge Sharing? Product Innovation	.592	24.299	.000	Yes
H1d	Knowledge Application? Product Innovation	-.298	-12.248	.000	Yes
H1e	Knowledge Organization? Product Innovation	-.043	-1.784	. 078	No
H2a	Knowledge Acquisition? Process Innovation	-.896	-2.499	. 004	Yes
H2b	Knowledge Creation ? Process Innovation	.428	1.325	.008	No
H2c	Knowledge Sharing ? Process Innovation	.567	7.073	.000	Yes
H2d	Knowledge Application ? Process Innovation	-.436	-1.743	.005	No
H2e	Knowledge Organization ? Process Innovation	.784	3.730	.000	Yes

Source*:* Primary Data

Similarly, the dependent variable, process innovation, was regressed on the predictors: knowledge acquisition, knowledge creation, knowledge sharing, knowledge application, and knowledge organization. The analysis yielded an F-value of $F(5,87) = 46.848$, $p<.001$, indicating that these five factors significantly influence process innovation. The R^2 value of .729 suggests that the model accounts for 72.9% of the variance in process innovation. Furthermore, individual coefficients were evaluated to determine the specific impact of each factor on process innovation.H2a evaluates whether knowledge acquisition impacts process innovation significantly. The analysis revealed that knowledge acquisition negatively impacts process innovation (B = -.896, t = -2.499, p =.004). Hence, *H2a was supported.*

H2b evaluates whether knowledge creation impacts process innovation significantly. The analysis revealed that knowledge creation does not affect process innovation (B = .428, t = 1.325, p =.008). Hence, *H2b was not supported.*

H2c evaluates whether knowledge sharing impacts process innovation significantly. The analysis revealed that knowledge sharing impacts process innovation significantly and positively (B =.567, t = 7.073, p =.000). Hence, *H2c was supported.*

H2d evaluates whether knowledge application impacts process innovation significantly. The analysis revealed that knowledge application impacts process innovation significantly but negatively (B = -.436, t = -1.743, p =.005). Hence, *H2d was not supported.*

H2e evaluates whether knowledge organization impacts process innovation significantly. The analysis revealed that the knowledge organization impacts process innovation significantly and positively (B = .784, t = 3.730, p = .000). Hence, *H2e was supported.*

Discussion

In the present study, the results highlight the significant roles of Knowledge Sharing in driving both product and process innovation. Facilitating knowledge exchange both internally and externally lead to significant improvements in product development and innovative manufacturing processes. Building strong networks and fostering collaborative relationships are key to enhancing process innovation. Knowledge Acquisition significantly and positively contributes to product Innovation whereas it contributes negatively to process innovation. This implies that acquiring new knowledge such as advanced technologies, market trends, is crucial for developing new products and enhancing existing ones. However, acquiring more knowledge may lead to information overload and create complexities in applying it effectively. Continuous generation of knowledge helps new product innovation but, in this context, only knowledge creation is not sufficient for practical application of the knowledge created. Knowledge Application here is associated with reduced Product Innovation. This might indicate that the application of knowledge, possibly due to its focus on efficiency or standardization, could be limiting creativity or flexibility in product development within the ferro alloy industry. Storing, updating and facilitating accessibility of knowledge leads to process innovation, but, accessing and applying it in developing new products is not occurring. It may be due to the lack of proper application procedure.

Conclusion and Implications

The study sets out to evaluate the role of knowledge management in driving innovation within a ferrochrome manufacturing firm in eastern India. It reveals that the organization's Knowledge Management (KM) system has significantly supported product innovation, with knowledge sharing being the most impactful on both product and process innovation. However, knowledge acquisition positively influences product innovation but negatively affects process innovation, while knowledge creation only impacts product innovation. Knowledge application and organization further enhance product innovation but show no effect on process innovation. The study emphasizes the critical role of knowledge management in driving innovation within organizations (Ashok et al., 2021), offering insights into its effective implementation that aligns with the previous research (Law et al., 2021; Lin et al., 2021; Mardani et al., 2018). It demonstrates how strategic knowledge management can significantly enhance innovation processes (Kolyasnikov and Kelchevskaya, 2020), helping organizations achieve their goals. However, the research had its limitations, the most challenging of which was the time constraints. It was because all employees were occupied with their daily duties, which limited the scope of the analysis. Despite this, the researchers did their best to complete the research objectives within the limited time frame, but the results could have been more comprehensive had there been more time.

To maintain its competitive edge, the organization must continue refining its KM system and strengthening its innovation capabilities. To enhance innovation, the alloy organization should implement extensive training programs tailored to employees' competencies, encourage knowledge sharing through a supportive and trust-driven environment, and ensure new knowledge and technologies are promptly documented, updated, and accessible to all. Additionally, fostering team cohesion through recreational activities and workshops on advanced technologies will help build motivation, collaboration, and problem-solving capabilities.

Scope for Future Research

1. Further empirical study with larger number of sample size from the same industry can be undertaken for confirmation of the findings.
2. This study has considered only organization as a sample. Further study can be undertaken with multiple firms from the same industry region wise.
3. Dimensions other than product innovation and process innovation under the construct "Innovation" can be taken for further research in the field.

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