

## IMPACT OF KNOWLEDGE MANAGEMENT ON OPERATIONAL EFFICIENCY OF CONSTRUCTION COMPANIES IN INDIA

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### ABSTRACT

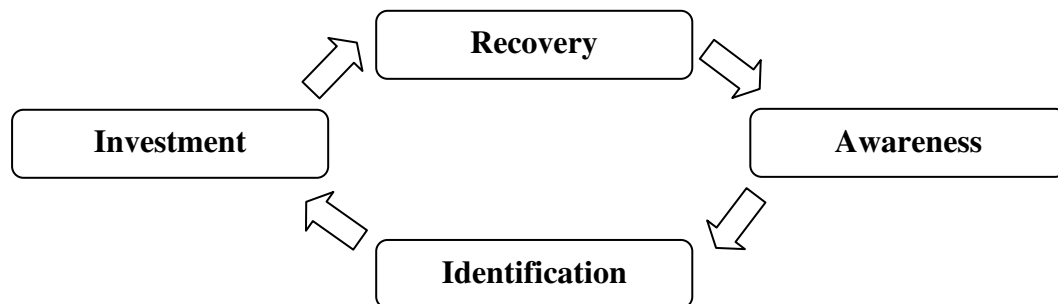
The construction business is one of the world's largest business. In India, the total revenue generation in the construction business accounts for 7.74% of GDP and valued at \$120 billion. Though small to medium-sized firms (SMEs) dominate the majority of the industry, they operate in small cities as well as larger urban areas. With new technologies emerging everywhere as a result of globalization and ease of connection via media, such as the internet, many businesses have attempted to implement Information and Communication Technology (ICT). The use of Knowledge Management System (KMS) is uncommon but well-known in Indian sectors; the construction sector lags behind. Many large enterprises utilize KMS or comparable systems; however, there is no evidence of KMS adoption by SMEs in the sector. We used statistical analysis tools to analyze the impact of Knowledge Management on operational efficiency in the SMEs from Indian construction sector. We anticipated main challenges in the sector based on the study and findings, including information and communication technology, human resources, organizational level and market level. The study revealed that the companies were having difficulty finding important knowledge to preserve or determining what they would need in the future. However, the companies who have implemented Knowledge Management System in their organization have got benefited from it by having more operational efficiency and getting more business.

**Keywords:** Knowledge Management System (KMS), Construction Industry, Organizational Performance, SMEs (small and medium enterprises), Construction Organization, Information and Communication Technologies (ICT)

### 1. Introduction

The current climate in the construction business is highly competitive as a result of pressure caused by technological innovation and modern construction technologies. To withstand the degree of competitiveness in the construction sector, knowledge is a crucial ingredient of production after capital, land, and labor (Rasula 2012). Although not all knowledge is easily transportable, an employee's departure from an organization suggests that all of engineers' knowledge is gone, particularly if it has not been transferred from tacit to explicit knowledge. Construction firms' performance is tied to their survival, given industry competitiveness. KM is regarded as an essential factor in ensuring increased and sustainable productivity and performance of these organizations (Santoso, 2020), as knowledge plays an important role in creating, developing, and maintaining a sustainable competitive advantage in both developed and developing countries (Koochakzadeh and

Behzadi, 2019). Many traditional techniques, procedures, and processes are employed by Indian construction companies as well, but nothing is kept up to date. According to Indian culture, work load and working duration are high in the development fields. However, organizations must push employees and engineers to learn more and provide adequate time for learning outside of work.



**Figure 1. Four Stages of KM**

The KM tool facilitates data transfer and communication between various organizational levels as well as the transfer of information from previously completed projects. Being one of the largest sectors in the world, the construction industry has a wide range of applications and procedures with a wide range of projects. KM is an effective tool for Data transfer from previous initiatives to current and future ones is slowed down by a lack of coordination and communication (**Figure-1**). The primary deterrent to businesses applying knowledge in novel contexts is the intricacy of projects. In order to enhance the efficiency and effectiveness of KM use in construction projects, the study suggests a number of techniques for doing so in both current and future projects. This will reduce time and expense while improving quality. Because of the dynamics of technical innovation and new building techniques, construction companies now work in a fiercely competitive market. This study examined the effects of KM methods on the survival and viability of construction organizations based on their operational efficiency because knowledge is a crucial resource for businesses operating in the construction industry. The study's findings indicate that KM is not being used very well in construction companies. According to research, KM implementation has a number of important advantages, including strengthening the company's competitive position, lowering risk, fostering greater teamwork, supporting innovation and profitability, accelerating problem solving, improving project pricing, and enhancing consumer satisfaction and loyalty. In summary, KM is a tactical and strategic competitive technique that helps construction sector players survive fierce competition.

## 2. Related Study

Construction is one of the areas where KM is a developing idea. Any firm can maintain a competitive advantage through knowledge resource development by using KM strategies effectively (Nisha, 2018). Handzic&Durmici (2015) estimate that 70% of unsuccessful projects were completed over budget and behind schedule. Yeong Lim (2011) posits that the high rate of project failure can be attributed to inadequate knowledge production, acquisition, storage, and transfer from prior projects to improve performance in the present and future. The financial viability and income of construction companies are negatively impacted by excessive errors, faults, and reworks, endangering these businesses' future. Construction companies typically have a significant degree of information loss and distortion as well as inadequate record-keeping (Alhaji, 2013). Construction organizations are recommended to use KM as an appropriate strategic and tactical management strategy to reduce scope creep, schedule and cost overruns, rework, bad quality, and loss of revenues and business possibilities.

**Benefits of KM:** An organization can reap numerous advantages by using effective KM practices. Different research claims that knowledge has a variety of advantages, including increased quality, improved sharing of tacit knowledge, decreased rework, increased company performance (Robinson, 2005), and continuous improvement (Kamara, 2002). KM overviews can result in:

- *Enhanced decision – making*
- *Enriched managing of clienteles*
- *Quicker reaction to key issues*
- *Enhanced personnel abilities*
- *Upgraded productivity*
- *Enlarged revenues / Reduced costs*
- *Better sharing of best practices*

- *Innovative solutions*
- *Generate more business prospects*
- *Better staff attraction and retention*

### 3. The role of KM in decision-making

The hypothesis behind KM, a subfield of management, is that employee knowledge both individually and collectively is a resource that should be appreciated, managed, and invested in. A variety of management techniques are used, depending on how knowledge is defined.

#### Types of Knowledge:

Explicit and tacit knowledge have been widely used as categories. Both technical and cognitive components may be included in the tacit knowledge. Abstract notions like mental models, maps, beliefs, and views are all part of the cognitive aspects. Technical components can include unique knowledge and abilities that are used in a particular situation. Explicit knowledge is information that is easily expressed in formal language and can be shared both synchronously and asynchronously among people. In contrast, tacit knowledge is knowledge that is inherent to an individual's experience and includes elements like beliefs, perspective, instincts, and values. Explicit and tacit knowledge (table 1) are distinguished from one another by unique attributes. Since explicit knowledge can be expressed in words or numbers and is therefore manageable, it is simple to record, retrieve, share, and reuse. What you can verbally or in writing express and codify is known as explicit knowledge. It could refer to project-related paper work such work orders, specifications, contracts, reports, drawings, change orders, and so on. A person working in a field gains more of an individual trait known as "tacit knowledge" via their experiences both personally and professionally. Through the application of explicit knowledge and the person's use of previously acquired knowledge in the subject, implicit knowledge is created. Within the framework of a project, implicit knowledge can encompass procedures, issues encountered, issues resolved, professional recommendations, expertise, inventions, and firsthand knowledge. Organizational/collective and individual knowledge are two other common categories for knowledge. The majority of Indian customs and culture include the exchange of implicit information. It is more crucial to document the transfer of information from one culture or generation to the next through explicit knowledge.

**Table 1. Difference between Explicit and Tacit Knowledge**

<b>Explicit Knowledge</b>	<b>Tacit Knowledge</b>
<i>Easy to write down or codify</i>	<i>Difficult to write down or codify</i>
<i>Objective facts or step by step guideline</i>	<i>Subjective to the person who possesses it</i>
<i>Its not personal as it is objective; Impersonal</i>	<i>Personal because its subject to the person's experiences, beliefs etc.</i>
<i>Independent of context place and time</i>	<i>Dependant on Context – here and now</i>
<i>Easy to transfer</i>	<i>Hard to transfer</i>
<i>This is about the "Know what"</i>	<i>This is about the "Know how"</i>
<i>This includes both Data /Information</i>	<i>This includes pure Knowledge acquired by the person</i>

#### Useful View of Knowledge:

1. *A state of mind: a state of knowing and understanding.*
2. *An object: something that can be stored and manipulated.*
3. *A process of simultaneously knowing and acting.*
4. *A condition of having access to information, which is organized for easy retrieval.*
5. *A capacity to use and interpret information to influence future action.*

A person working in a field gains more of an individual trait known as "tacit knowledge" via their experiences both personally and professionally. Through the application of explicit knowledge and the person's use of previously acquired knowledge in the subject, implicit knowledge is created. Within the framework of a project, implicit knowledge can encompass procedures, issues encountered, issues resolved, professional recommendations, expertise, inventions, and firsthand knowledge. Organizational/collective and individual knowledge are two other common categories for knowledge. The majority of Indian customs and culture include the exchange of implicit information. It is more

crucial to document the transfer of information from one culture or generation to the next through explicit knowledge.

**Table 2. The role of KM in Decision-Making**

Using decision support systems	Situation	Using stored explicit knowledge, such as articles, books and reports
Using personal experiences and ideas	<b>Research</b>	Using collaborative tools to contact people with related experiences
	Decision	
Using data mining and analysis tools	Action	Using tacit knowledge saved as explicit, such as know-how and problem solutions
	New knowledge creation and storing	

#### 4. Barriers in Implementation of KM

The primary cause of the restricted use of KM in the construction sector is the inability of specialists to coordinate with one another during a project. In many cases, there is poor communication between on-site and off-site employees, which leads to delays, increased expenses, and subpar work. The effectiveness of using best practices and standards in finishing projects is decreased by infrequent meetings among suppliers, stakeholders, and construction workers (Figure 2).



**Figure 2. Barriers in Implementation of Knowledge Management**

The rise of virtual teams in construction projects also results in fewer in-person encounters between staff members, which is probably lowering the degree of coordination between the many project stakeholders. The decentralization of project responsibilities through outsourcing and subcontracting poses challenges for the several stakeholders in terms of meeting coordination, information sharing, and leveraging individual or collective knowledge.

#### 5. A brief overview of the construction industry in India:

Based on government forecasts, the construction sector in India is projected to grow at an anticipated compound annual growth rate (CAGR) of 6% from USD 701.7 billion in 2022 to USD 1.4 trillion by 2025. Now is the best time to invest in infrastructure in India because the government is giving infrastructure development top priority. An important step in the right direction has been taken with the establishment of the USD 2.5 billion National Bank for Financing Infrastructure and Development (NaBFID), a development finance organization that would facilitate easy access to funding for infrastructure projects in India. Foreign direct investment (FDI) of 100% is permitted in a number of building industries, including urban transportation, water supply, and sewage.

#### 6. Survey and Analysis Study

This study focuses on analyzing the growth, knowledge, and implementation levels of the KM strategy in India. The aim is to examine how this approach is being utilized in the private sectors. In total, 120 survey samples were collected to analyze the current status of the impact of KM system on the operational efficiency of construction companies in India.

A survey was conducted on 40 construction firms from private sectors in India, resulting in 120 samples (samples collected between Oct 2021 to Oct 2023). Qualitative methods was used to categorize data into patterns, with private construction businesses employing project managers, construction managers, and quality engineers. Data was collected through in-person interviews using a specifically designed questionnaire, conducted in a structured, semi-structured, or unstructured

format. Qualitative approaches were employed to evaluate the validity of the hypothesis and determine if the hypothesis needs to be formulated differently. The questionnaire was designed to enquire about interactions among group members to identify key characteristics for understanding and formulating hypotheses. The data obtained was measured using a five-point Likert scale in the suggested questionnaire.

#### Method of collection

- Electronic survey method was used
- Paper based survey where electronic method was not possible

For finding out impact of Knowledge Management System implementation in the operational efficiency of construction organization in India, the following factors were deployed in the structured questionnaire to assess their operational efficiency:

- Knowledge Share success within the organization
- Cost savings in the projects
- Top management support for KM implementation

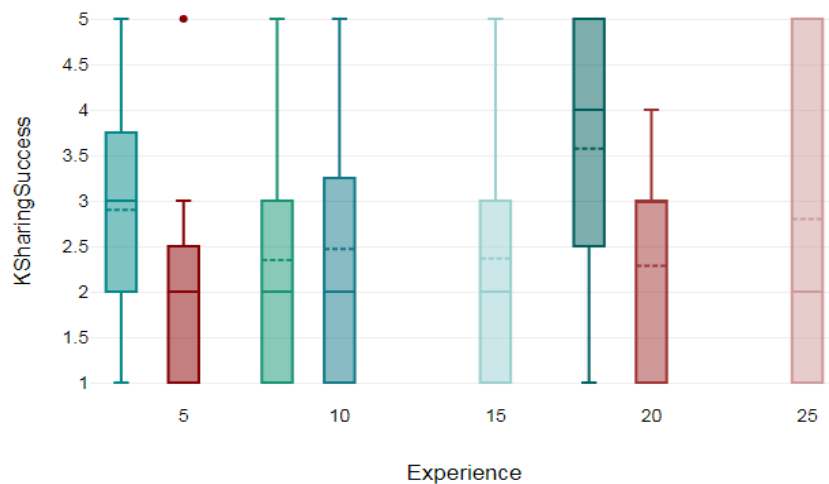
#### 7. Findings

With the right KM system, organisations can reduce headcount through customer self-service and save costs inside their contact centre by reducing agent average handle time, new hire training, and new product training. This is widely acceptable to experienced engineers. But in this sample, most of them strongly disagree (41/120) with accepting this based on their experience. Experienced engineers and managers only accepted the strength of KM in terms of cost savings. 20 years of experience only accepted (table 4 & figure 3) the maximum cost savings of KM in construction industries ( $M = 3$ ).

**Table 3. Descriptive statistics: H (Questionnaire)**

	n	Mean	Std. Deviation
<b>8</b>	26	2.35	1.47
<b>15</b>	22	2.36	1.4
<b>3</b>	10	2.9	1.2
<b>5</b>	11	2	1.26
<b>10</b>	32	2.47	1.52
<b>18</b>	7	3.57	1.62
<b>20</b>	7	2.29	1.25
<b>25</b>	5	2.8	2.05
<b>Total</b>	120	2.48	1.46

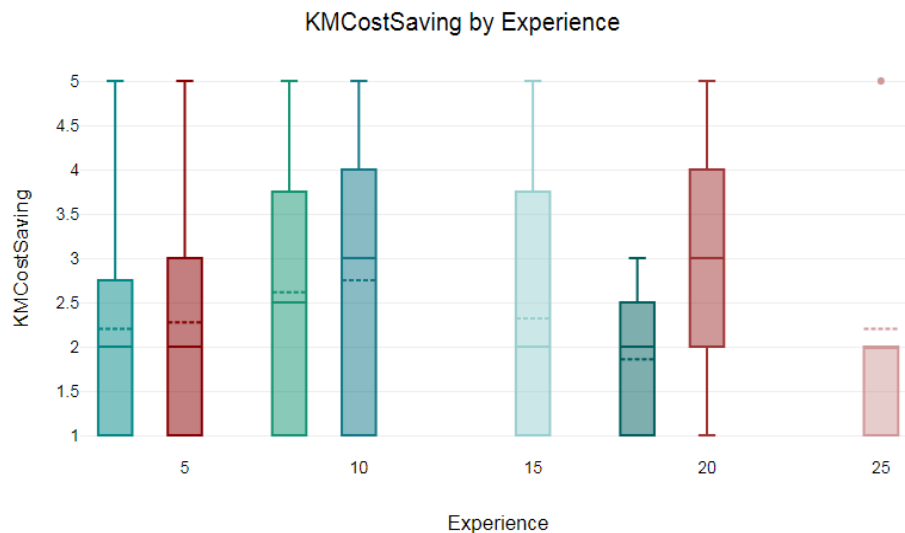
#### KM based analysis for Knowledge reuse in cost saving in the projects KSharingSuccess by Experience



**Figure 3. Box plot of Knowledge Sharing Success rate evaluated by experience based opinion on Knowledge reuse in cost saving in the projects**

**Table 4. Descriptive statistics (Mean & Std. deviation to analyze Questionnaire)**

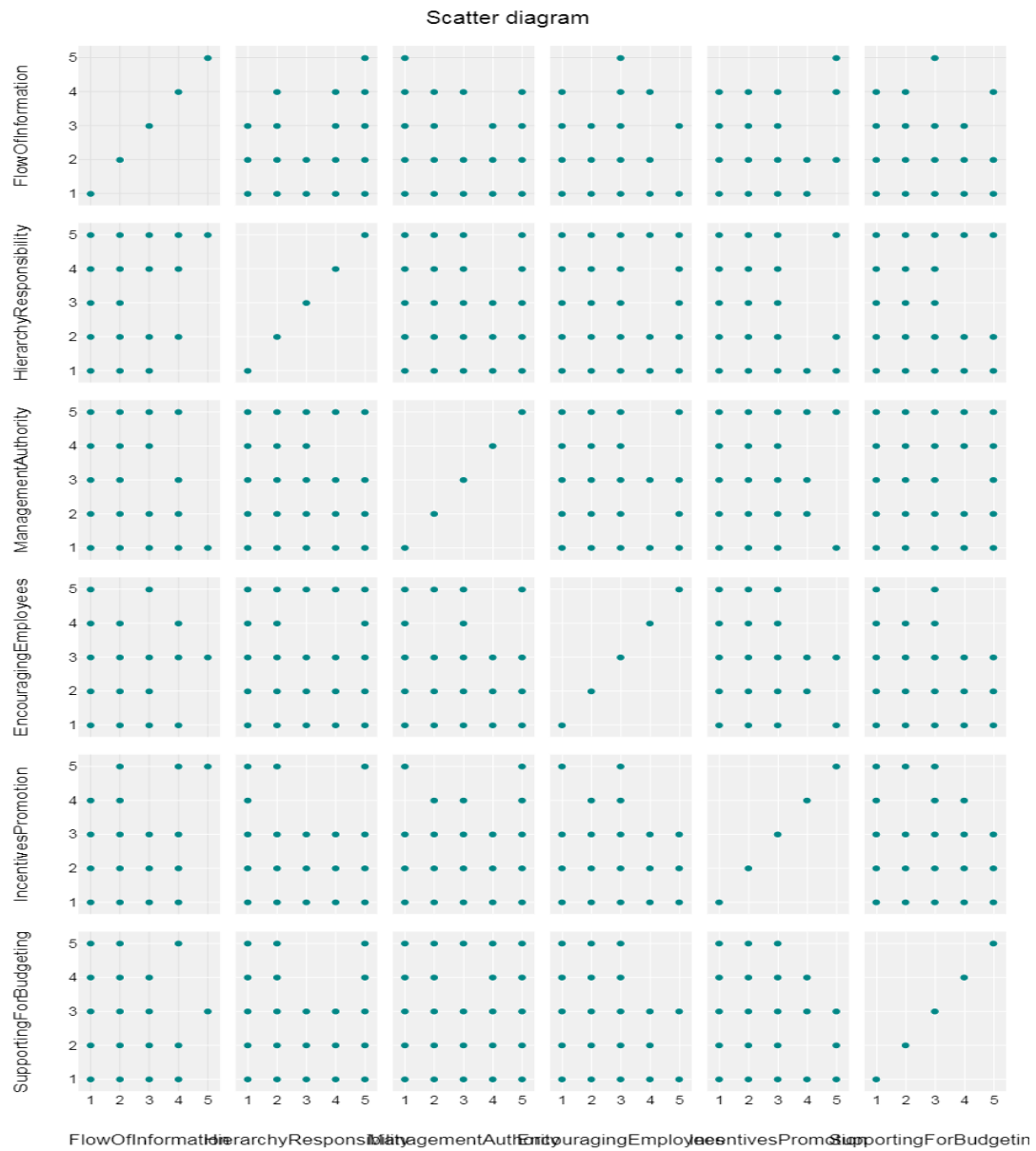
	<b>n</b>	<b>Mean</b>	<b>Std. Deviation</b>
<b>8</b>	26	2.62	1.44
<b>15</b>	22	2.32	1.52
<b>3</b>	10	2.2	1.4
<b>5</b>	11	2.27	1.27
<b>10</b>	32	2.75	1.39
<b>18</b>	7	1.86	0.9
<b>20</b>	7	3	1.41
<b>25</b>	5	2.2	1.64
<b>Total</b>	120	2.49	1.4

**Figure 4. Knowledge reuse helps in cost saving in the projects**

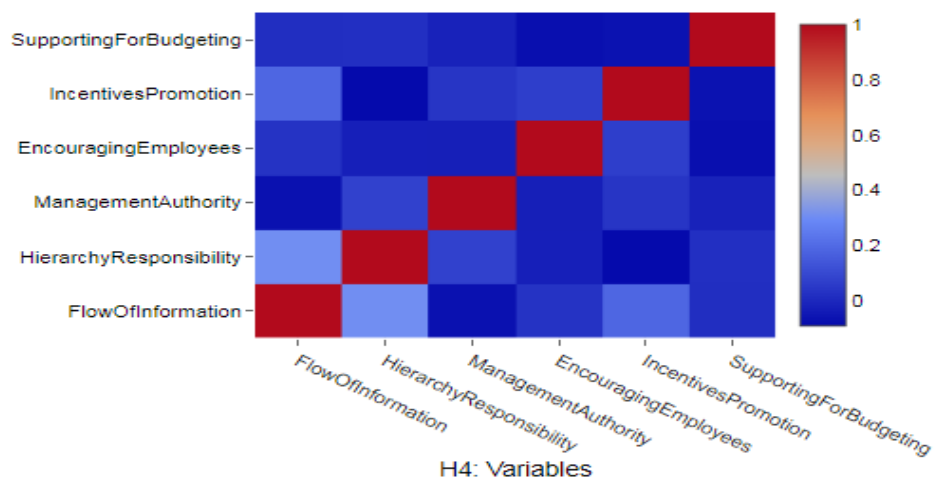
### **KM based analysis on impact of KM between top management support and operational efficiency**

Figure 5 shows a scatter plot that displays the strength, direction, and form of the relationship between two quantitative variables as per Table 5. A correlation coefficient measures the strength of that relationship. Correlation heat maps are a type of plot that visualises the strength of relationships between numerical variables. Correlation plots are used to understand which variables are related to each other and the strength of this relationship. Figure 6 shows the correlation analysis heat map.





**Figure 5. Scatter diagram for all 6 field's opinions of samples**  
Correlation Heatmap



**Figure 6. Correlation Heat map of Top Management Support**

Regarding this matter, we have received favorable feedback from the survey. Engineers are increasingly focused on self-improvement, knowledge sharing, talent selection, and prioritizing customer feedback, as well as utilizing KM support to deliver their work. However, they encounter challenges in accessing the data (0), effectively implementing customer requirements (-0.28) across all channels, and properly receiving seminar presentations (-0.26). Despite these obstacles, they express a strong desire to acquire further knowledge in this area (figure 6& table 5).

**Table5. Covariance (especially for customer's feedback)**

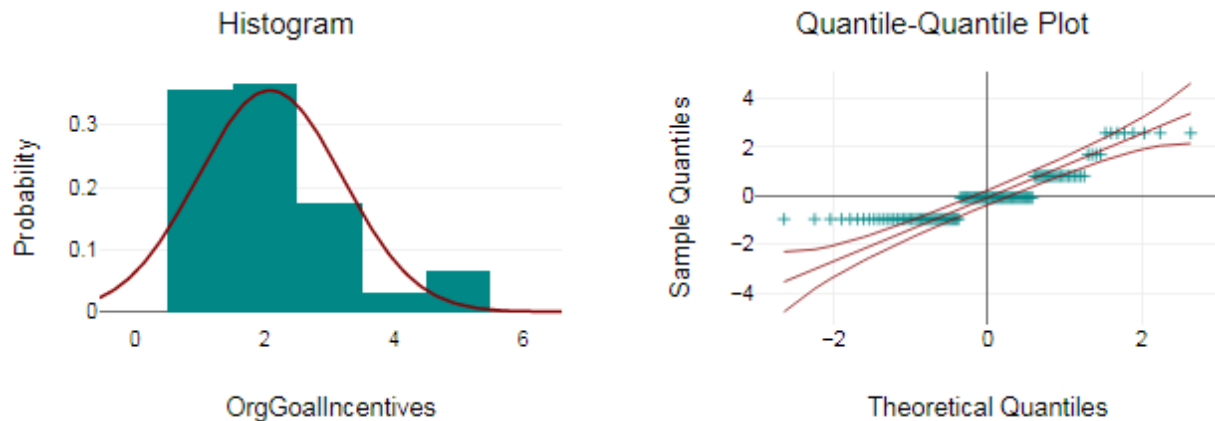
	<b>Data Accessible</b>	<b>Updating</b>	<b>Knowledge Sharing Successful</b>	<b>Seminar Presentation Sharing</b>	<b>Right People Works</b>	<b>Apply Customers Needs</b>	<b>Customers Feedback Provided Information</b>
<b>Data Accessible</b>	1.23	0.16	-0.14	-0.07	0	-0.28	0.13
<b>Updating</b>	0.16	1.41	0.04	-0.13	-0.15	0.09	-0.16
<b>Knowledge Sharing Successful</b>	-0.14	0.04	1.1	-0.01	0.09	0.09	0.07
<b>Seminar Presentation Sharing</b>	-0.07	-0.13	-0.01	1.61	0	-0.26	-0.01
<b>Right People Works</b>	0	-0.15	0.09	0	1.16	-0.11	0.05
<b>Apply Customers Needs</b>	-0.28	0.09	0.09	-0.26	-0.11	1.06	0.13
<b>Customers Feedback Provided Information</b>	0.13	-0.16	0.07	-0.01	0.05	0.13	1.04

**Assumptions:** This table below (Table 6) shows the results of four different statistical tests used to assess whether the data follows a normal distribution. A high p-value (greater than 0.05) suggests that the data does not significantly deviate from normality. Overall, all these tests suggest that the data does significantly deviate from a normal distribution. This means we cannot proceed with statistical methods that assume normality in the data. However, it is always a good idea to take a closer look at the QQ plot.

**Table 6. Tests for normal distribution of Org Goal Incentives**

	<b>Statistics</b>	<b>p</b>
Kolmogorov-Smirnov	0.25	<.001
Kolmogorov-Smirnov (Lilliefors Corr.)	0.25	<.001
Shapiro-Wilk	0.81	<.001
Anderson-Darling	7.75	<.001





**Figure 7. Tests for normal distribution of Org Goal Incentives**

### 8. Analysis and Discussion

The control of KM processes should be centralized under the supervision of designated "knowledge managers" within the company. If the company does not desire to establish a dedicated internal department for this purpose, the quality management unit could take on the responsibility. Therefore, the knowledge manager would conduct final discussions with the project and construction managers after the conclusion of a structural engineering project to identify the key factors that contributed to its success. Furthermore, they would integrate relevant inquiries into the customer interview upon completion of the project. After describing the knowledge clusters, he would proceed to compare them with the knowledge clusters identified in other structural engineering projects, searching for any similarities. Once the knowledge manager has identified the necessary conditions for each knowledge cluster to be considered valid, they will incorporate these new findings into the cluster pool and oversee its management.

At the strategic development level, the knowledge manager would analyze the knowledge required to activate the individual knowledge clusters and identify the relevant areas for potential improvement or development based on that information. Following discussions with the management, the knowledge manager will determine the order of importance for the knowledge clusters and establish appropriate methods for achieving the potential enhancements and advancements. The proposed measures will be submitted to the management as a formal proposal. The knowledge clusters serve as indicators of success factors, allowing for a clear justification of the benefits that the company would gain from implementing the corresponding measures.

After confirming the conditions of validity, they would inform the internal parties involved in the project (such as the calculation team, competitive team, and project manager) about the relevant knowledge clusters at the appropriate times. They would also provide guidance on how to utilize these knowledge clusters and highlight any tools that may have been developed for this purpose. By doing this, one can ensure the activation and consideration of the success factors, which are knowledge clusters. The project management team should have control over the activation of the knowledge clusters during project execution.

The lack of practical tools and the unique nature of each building project are two significant obstacles that hinder the wider acceptance and implementation of KM in construction companies. These obstacles prevent companies from effectively identifying valuable knowledge and understanding the potential benefits of nurturing this knowledge systematically. In order to address these requirements, the Institute for Construction Engineering and Management has devised a systematic and integrated approach to KM that is centered around project and cluster-based processes. This approach aims to seamlessly integrate KM into the day-to-day operations of companies. By doing so, these companies should be positioned to leverage additional opportunities for enhancing their services and, as a result, ultimately enhance their competitive advantage.

An analysis was conducted to identify, describe, and discuss the knowledge clusters involved in the value creation process of a construction project. This analysis allowed for the development of logical conclusions that are applicable to a project-oriented and cluster-oriented KM model for total service contractors in the process of delivering products and services. It focuses on organizing knowledge clusters based on the different phases of the company's product and service delivery process. It is crucial to consider the unique stages and elements of each type of project execution. Subsequently, these discoveries and expertise are applied in the specific pursuit and execution of new construction endeavors.

The respondents encountered challenges when it came to sharing information and engaging in frequent sharing within the hierarchical structure. Only a small number of individuals are reporting negative experiences with the website due to the absence of an effective KMS. It is widely recognized that companies tend to gain more valuable insights from negative experiences than from positive ones. Nevertheless, it is widely recognized that negative experiences are unlikely to be shared beyond the confines of the project team. The knowledge coordinator is expected to possess the necessary authority and approachability to visit the site and engage in discussions with the project team, objectively exploring the lessons that can be derived from the negative experience. Project managers may perceive the task of reviewing the lessons learned file as an additional workload on top of their existing responsibilities. Consequently, there will be some resistance to the new procedures. To address this, it is necessary to have adequate motivation, although the specific nature of this motivation is uncertain. There is an expectation that certain project managers will actively support the management of knowledge, leading to the gradual adoption of this practice by other teams. Furthermore, the requirement to follow specific procedures (**Table 7**) should compel project managers to actively engage in knowledge management.

**Table 7. Significant findings for the Project Managers to follow specific procedures**

<b>Section</b>	<b>Statement</b>
<b>Information and communication tools</b>	<i>We find that the ICT tools (available in the market) for Knowledge Management are not suitable for our organisation</i>
	<i>A lot of knowledge/information stored in the systems (in the organisation) turns out to be useless</i>
	<i>It is difficult to identify the knowledge that is relevant for the organisation</i>
<b>HR</b>	<i>In our organisation, employees lack the ability to exploit the knowledge which is outside the source (lack of absorptive capacity)</i>
	<i>There is a lack of communication within the organisation</i>
	<i>In our organisation, there is ineffective expression of thoughts or new ideas from the employees</i>
	<i>Employees have fear of job security due to inadequacy of knowledge or lack of confidence in their ideas</i>
	<i>Employees are not motivated to use KM</i>
<b>Organization (ORG)</b>	<i>In our organisation, there is a lack of easy communication between knowledge source and recipient, especially if the work space is geographically divided</i>
	<i>Our organisation's leadership style is suitable for KM</i>
	<i>The authority level of the person in charge of KM in the organisation drives the level of implementation of KM</i>
<b>Market and the environment (MRK)</b>	<i>New ideas that could lead to increasing the potential of the organisation get cancelled due to upper management's reluctance towards change</i>
	<i>The delay in achieving success of new ideas that could lead to increasing the potential of the organisation may get cancelled</i>
	<i>Rapid changes in new technologies make innovation obsolete even when the organisation is willing to implement it</i>
	<i>In our organisation, if the knowledge in question is too ambiguous due to its complexity; its adoption in practice is that much scarce</i>

## 9. Conclusions

The success in achieving operational efficiency are positively impacted by KM within the organization. Knowledge-intensive tasks require a lot of funding, Top management support, ICT infrastructure, and training initiatives. The organization's KM resources must be managed successfully and efficiently. Any firm considers knowledge to be a valuable asset. To increase their organizational performance, a

lot of businesses are attempting to implement KM techniques. Numerous research have come to the conclusion that knowledge management, through problem-solving and business expansion, is the primary driver of operational performance. Through group projects and training sessions, there is an urgent need to continually teach and enlighten CEOs and staff members about the value of knowledge management. To maximize the benefits of KM adoption, employees and other stakeholders within the firm must be instilled with a research orientation, a creative culture, and an appreciation of knowledge. An empirical study that begins at the point where this study concludes and considers the additional significant outcomes through successful and effective project completion as well as organizational efficiency and development may be undertaken as a future avenue for this research. The investigations can be reexamined in different segments with comparable characteristics or with minor adjustments. Users' perspectives of the use and use of KM systems in various businesses may also be expanded by the study.

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